

The impact of physical exercise on the overall functioning of children with autism spectrum disorder (ASD) when included with non-autistic children versus segregated

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Mayan Luay Omair

Dedication

I am dedicating this thesis to my everything, my father, Luay Omair: because I owe it all to you.

I will never forget you

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Chapter 1: Introduction

Abstract

This thesis examines the impact of a variety of exercises on the overall functioning of children with autism spectrum disorder (ASD) when included with non-autistic children versus segregated. Of particular interest is the difference between segregated vs. inclusive physical exercise in improving their physical, cognitive, social and emotional and language and communication skills. Fifteen children with ASD and six non-autistic children aged 7-10 years old were examined while engaged in a physical exercise-based program. Thirty-eight parents (fathers and mothers) of the 21 participants were interviewed throughout the program period. Semi-structured interviews, direct observation, and the Movement Assessment Battery for Children 2 (M ABC-2) were employed pre, during and post 10 weeks of physical exercise delivered in an inclusive or segregated manner. Data collected from the observation, M ABC-2 and the interviews revealed that a variety of exercises (swimming, jogging, and mixed games) had a significant positive impact on children with autism in both groups. Exercise enhanced their physical, cognitive, social and emotional, language and communication skills and their psychological health as well as decreased repetitive stereotypical behaviors. In specific to the inclusive group, children with autism had a slightly higher improvement in their social, motor, and language skills. Including children with autism during exercise should be considered when trying to enhance ASD symptoms as inclusive physical exercise appear to facilitate the development of ASD's dysfunction areas.

Introduction

Children without disabilities gain a majority of their physical activity through travel (i.e., walking to school), casual play (i.e., unstructured family and community play), and organized play (i.e., competitive sports in schools and outside schools) (Fox and Riddoch, 2000). In contrast, walking to school, casual, and organized play is rarely part of the everyday schedule for children with ASD (American Psychiatric, 2000; Fox and Riddoch, 2000; Micacchi et al., 2006). Therefore, children with ASD may be at risk for being physically inactive and living a sedentary lifestyle; as a result, they are at high risk of developing diseases such as obesity, diabetes, and heart disease (Guilbert, 2003; Sowa and Meulenbroek, 2012). According to the American Heart Association (AHA), children with ASD are less active compared to children their age, and they do not meet the association's recommendations for physical activity (PA) (Nicholson et al., 2011). In addition, the U.S Department of Health and Human Services recommends for individuals aged 6-17 years 20 min of vigorous exercise at least 3 days a week and 60 minutes or more every day of moderate to vigorous exercise (Obrusnikova and Cavalier, 2011; Pitetti et al., 2007). However, children with autism fail to meet the standards, and their PA levels have lessened compared to previous reports and continue to decline with age (Pan, 2011). In terms of the physical education class, it is recommended that all students, including students with ASD and others with or without disabilities, should be physically active for at least 50% of physical education class time (Pan et al., 2011). Studies have reported that students with and without ASD were not meeting the least percentage, and the ones with ASD were even less active compared to their peers (Pan, 2008; Pan and Frey, 2006; Trost et al., 2002). It was found that children with ASD are less active during their physical education classes and even during recess time when compared to their peers without disabilities (Pan, 2008). Regularly participating in exercise is critical for those without disabilities to improve their health and maintain physical fitness and a healthy lifestyle (Health and Services, 2000). Concerning children with ASD, they have limited choices, and it is even more critical to improve their health and increase their activity level considering their symptoms (Srinivasan et al., 2014). For example, the difficulty in performing some motor skills may lead to preferring simple, sedentary activity such as watching television and playing computer games (Borremans et al., 2010; Potvin et al., 2013). In addition, impairments in social abilities can hinder them from engaging in group sports and interacting with peers (Borremans et al., 2010; Potvin et al., 2013; Reynolds et al., 2011). Sensory problems may affect their performance during exercise and lead to avoiding activities with intense sensory stimulation (Reynolds et al., 2011;

Srinivasan et al., 2014). Therefore, their symptoms should be considered when planning physical exercise-based programs as well as identifying types of exercise to promote their physical activity level (Pan, 2011; Rimmer and Braddock, 2002; Strong et al., 2005).

A healthy lifestyle and exercising are essential for people of all ages (American Psychiatric, 2000; Health and Services, 2000). Exercise improves emotional and cardiovascular health, weight maintenance, joint flexibility, muscle strength, and cognitive performance (Sorensen and Zarrett, 2014). In addition, it decreases the risk of type 2 diabetes, stroke, hypertension, depression, heart diseases, certain cancers, and premature death (Health and Services, 2000; Micacchi et al., 2006; Pan and Frey, 2006; Srinivasan et al., 2014). For people with ASD and severe disabilities exercise is often a neglected area because parents and professionals usually focus on developing the dysfunction areas that are more apparent compared to their overall health using structured sedentary interventions and pay little attention to exercise and a healthy lifestyle (Fox and Riddoch, 2000; Micacchi et al., 2006; Srinivasan et al., 2014). Therefore, obesity is considered a growing health issue in individuals with ASD (Curtin et al., 2010; Curtin et al., 2005; Pan and Frey, 2006). A number of health problems can be caused by being overweight, like bone and joint problems, cardiovascular diseases, diabetes, and depression (Guilbert, 2003). The effects of these conditions, in combination with autism symptoms, can have a negative impact on individuals with autism. Going through physical, social, cognitive and language impairments as an individual with ASD in combination with health problems caused by diabetes might make their symptoms even worse as it would be more difficult for them to engage in their daily activities as going to school and this might lead to worsening their symptoms even more (Bandini et al., 2005; Chen et al., 2010; Rimmer and Braddock, 2002; Srinivasan et al., 2014). Exercise can also be overlooked because having individuals with disabilities in physical education classes can be challenging to the PE teacher due to their characteristics and the difficulties they might have in the movement context (Sugden and Talbot, 1996). The characteristics of the disorder might stand in the way of individuals to participate in any exercise (Guilbert, 2003). Experiencing motor deficiencies, stereotypic behaviors, limited capacity in social and language skills can create limitations to learning and could limit the number of opportunities to participate in exercise. Besides their personal traits, the environment is also an important factor that either enables or disables this population from being physically active (Sugden and Talbot, 1996). The amount of support, opportunities provided, and people's attitude toward this population contributes significantly to engaging

individuals with ASD in physical activity. A better understanding of people with autism and their differing qualities would assist in designing and providing proper physical education programs tailored to their needs and programs that follow structured, engaging procedures that ensure effectiveness and development of their dysfunction areas as well as their overall health (Sugden and Talbot, 1996).

Behavioral intervention programs are the kind of programs mostly used with individuals with ASD (Dawson and Rosanoff, 2009). These programs focus on developing their social, motor, language, and communication and cognitive skills in a well-structured environment that has routine. Some other therapeutic programs like sports (jogging, tennis, swimming, horseback riding, aerobics) have been suggested as been beneficial to their day to day intervention plan (Bass et al., 2009; Huettig and Darden-Melton, 2004; Pan, 2010; Pitetti et al., 2007; Prupas et al., 2006). Since the data on the value of exercise is well established for all people, it is reasonable to assume that exercise can improve the physical and mental health of people with ASD (Bass et al., 2009; Huettig and Darden-Melton, 2004; Pan, 2010; Pitetti et al., 2007; Prupas et al., 2006). Several studies have reported that exercise has a positive impact on the three primary symptoms of ASD as well as on the reduction of stereotypical behaviors and suggested that exercise can enhance standard treatments or contribute to its outcomes (Allison et al., 1991; Anderson-Hanley et al., 2011; Bahrami et al., 2012; Pan, 2011; Pan and Frey, 2006; Reid et al., 1988; Sorensen and Zarrett, 2014). These studies examined the impact of exercise on children with autism examining different variables; all reported positive results in terms of improvement in cognitive performance (Anderson-Hanley et al., 2011), academic engagement and attention (Reid et al., 1988), social and emotional functioning (Pan and Frey, 2006; Pan et al., 2011), self-regulation (Allison et al., 1991) and a decrease in stereotypical behaviors (Bahrami et al., 2012). A study conducted by (Bazzano et al., 2009) provided evidence that lifestyle programs such as exercise for people with developmental disabilities such as autism spectrum disorder (ASD) influences physical activity and weight loss as well as improve overall lifestyle. Therefore, it is recommended that lifestyle active programs (e.g., exercise) should run in conjunction with behavioral clinic/center-based interventions (Bruder, 2001; Rinehart et al., 2018) Consistent with this research is the report by Pellicano that reported that the UK Autism Community research is focusing on plans for learning as well as enhancing lifestyle skills and that exercise programs should sit alongside clinical interventions arguing that both are necessary to provide the most effective learning environment and experience (Bruder, 2001; Pellicano et al., 2014; Rinehart et al., 2018).

Statement

The prevalence of autism is rising, and as a result, the number of children with ASD in schools and special centers and physical education classes is rising. In schools or at home, the focus is usually on controlling their behaviors and improving their social, cognitive, and language skills but rarely on enhancing their physical activity or enhancing their overall functioning through engaging them in exercise/sport (Dawson and Rosanoff, 2009). According to research, this population lives a sedentary lifestyle because of their challenging symptoms and receives sedentary structured interventions that take place in restricted environments (Guilbert, 2003; Sowa and Meulenbroek, 2012). According to the American Heart Association (AHA) and the U.S Department of Health and Human Services, children with ASD are less active compared to children their age and they do not meet the association's recommendations for PA which is being physically active for 50% of the physical education class time and should engage in 20 minutes of vigorous exercise for 3 times a week and 60 minutes of moderate to vigorous exercise daily (Nicholson et al., 2011; Obrusnikova and Cavalier, 2011; Pan et al., 2011). Being physically inactive or at risk might put them at high risk of developing diseases such as diabetes, obesity, and heart diseases in addition to their symptoms (Guilbert, 2003; Sowa and Meulenbroek, 2012). For all people of all ages, exercise is essential as it improves overall health (Pan and Frey, 2006; Sorensen and Zarrett, 2014). Since the importance and the health benefits of exercise is well documented, it is rational to assume that it can extend to the autistic population and positively impact their overall functioning and general health (Health and Services, 2000; Longmuir and Bar-Or, 2000; Micacchi et al., 2006). This population needs therapeutic interventions as exercise programs to be added to their daily schedules or plan of care that work hand in hand with behavioral interventions instead of only depending on sedentary structured interventions (Pan, 2008; Sorensen and Zarrett, 2014). Some sports such as swimming, jogging and walking are suggested by research for children with ASD, and several studies examined its impact and all reported positive effects on the three primary symptoms of ASD (Anderson-Hanley et al., 2011; Bahrami et al., 2012; Pan, 2010, 2011). Several studies examined the impact of exercise on ASD dysfunction areas, and their focus was mainly on examining one variable (e.g., social skills, physical skills, language skills) and used only one type of exercise (Bass et al., 2009; Best and Jones, 1974; Cole and Becker, 2004; Elliott Jr et al., 1994; Pan, 2010, 2011).

Moreover, little if any studies were found that included children with autism with non-autistic children during physical activity. Since children with ASD are usually segregated because of

their challenging symptoms and exercise is overlooked in this population, this study aimed to design an inclusive exercise-based program that includes a variety of activities. This study also focused on a comprehensive design with the emphasis on pedagogy, type of exercise, physical structure, and inclusive exercise and examined its impact on the overall functioning of children with ASD. If this program reveals positive results and impacts the overall functioning of children with ASD, then engaging and including them in exercise programs could have solid evidence and arguments can be made on the importance of offering interventions as exercise programs tailored to their needs in their daily schedules to address their multiple dysfunction areas and that exercise can enhance standard treatments (behavioral intervention programs) or contribute to its outcomes. Also, I can argue that it is beneficial to provide engaging kind of exercise as mixed group games that can influence the autistic children to engage and learn from their peers and encourage natural social integration and interaction that can result in enhancing their social and emotional, language and communication and physical skills and their psychological health.

In light of the issues discussed above, the aim of the research was ultimately to design an exercise-based program (including a variety of activities) for children with ASD and determine how participation (included versus segregated) impacts the overall functioning of children with ASD.

The specific aims of this research therefore are to:

1. Investigate the impact of inclusive exercises (swimming, jogging, and mixed games) versus segregated on the physical, cognitive, social and emotional, language and communication skills and behaviors of children with ASD.
2. Investigate the impact of mixed games sessions compared to individual exercise on the physical, cognitive, social and emotional, language and communication skills and behaviors of children with ASD.
3. Determine the influence of elements applied to the exercise setting such as pedagogy, physical structure and organization of setting on improving participant's performance.

Chapter 2:

Benefits of exercise

This chapter will consider the current definition and classification of autism spectrum disorder (ASD). It will then review the literature on the benefits of exercise for children in general and children with ASD. It will include theories of learning and an overview of the existing research that examines the benefits of exercise for individuals with ASD of all ages and the recommended physical exercise suggestions for this population.

ASD Definition

The term autism spectrum disorder (ASD) refers to a group of related neurodevelopmental disorders that include the diagnoses of Asperger syndrome, autism, and pervasive developmental disorder not otherwise specified (PDD-NOS) (American Psychiatric, 2000). The indicative characteristics of ASD may include delayed or limited development of communication and language skills, difficulty with social interaction, and restrictive patterns of behavior or interests. In addition to these characteristics, delays, or deficits in the development of motor skills can be experienced by individuals with ASD (Sowa and Meulenbroek, 2012). Individuals share common characteristics with ASD. However, the severity and its impact on their daily functioning and the combination of symptoms vary per individual and age group and may change with development, that is why it is considered a spectrum disorder (ASD) (Nicholson et al., 2011). In addition to those core symptoms, cognitive and behavioral impairments are also often reported (Obrusnikova and Cavalier, 2011). Individuals with ASD may have intellectual delays, attention problems, aggression, tantrum, and self-harmful behaviors. Also, they display sensory impairments experiencing difficulties processing auditory, visual, and tactile stimuli as well as hypo-responsiveness or hyper-responsiveness to sensory stimuli (Obrusnikova and Cavalier, 2011). When compared to individuals without disabilities as well as individuals with other disabilities, they perceive their environment differently. Some and different noises distract them; some colors can be overstimulating and the physical structure of the environment surrounding them confuses them if it was insufficient to recognise where to go and what to do (Ben-Sasson et al., 2009; Dawson and Watling, 2000; Srinivasan et al., 2014; Tomchek and Dunn, 2007).

In regard to social interaction, individuals with ASD mainly display a difficulty understanding the behaviors of others because of their inability to adequately process and react to emotional and social signals as communicated throughout facial expressions and eye contact (Sowa and Meulenbroek, 2012). Some of the difficulties individuals with ASD may face in this domain are difficulty remembering/recognising faces, inability to create peer relationships proper to their developmental level, absence of sharing the enjoyment with others, and absence of social\emotional reciprocal relationships. For example, a child with autism may not react when his name is called or follow a facial gesture (Sowa and Meulenbroek, 2012). As adults, individuals with autism will develop to a range of outcomes, from complete reliance to rare cases of successful careers, and they rarely form long-life friendships or partnerships (Barnard et al., 2000; Webster, 2016). Individuals with ASD generally display deficits in non-verbal communication, which is a lack of “theory of mind” (Sowa and Meulenbroek, 2012). This characterises a limited capacity in understanding the feelings, plans, and intentions of others. Usually, they do not understand if someone is mocking them or taking advantage of them (Barnard et al., 2000; Webster, 2016).

When it comes to verbal language, individuals with ASD experience difficulties in developing proper skills and some fail. Therefore, nearly half of all autistic children remain mute, and others experience a language delay with various abnormalities (Sowa and Meulenbroek, 2012). For example, a child at age two may communicate through leading his/her mother to what s/he needs, uses her hand to point or place it on it. With time they may learn to ask about what they need clearly with persistence but continue having difficulties with eye and hand coordination and carrying out conversations. Another difficulty of communication they might experience is the lack of spontaneous make-believe and pretend play (Barnard et al., 2000). They experience difficulty pretending an object is something else, limited capacity of using toys appropriately and giving indications that they want to play with others (Barnard et al., 2000). When the child engages in the process of pretending, it builds developmental areas as social and emotional skills. Pretending helps them experiment the social and emotional roles in life (Barnard et al., 2000). It also allows the child to experiment on how to behave in social situations. Doing so allows the child to practice social skills and later practice it with peers and family (Barnard et al., 2000).

Deficiencies in motor performance is another area that individuals with ASD may find difficult. They display a delay in at least one area of motor development (fine and gross motor functioning, motor coordination, motion planning, balancing) (American Psychiatric, 2000;

Pan, 2008, 2011; Pan et al., 2011). They experience difficulty in object control, ball skills, balance and manual dexterity (Berkeley et al., 2001; Manjiviona and Prior, 1995; Mari et al., 2003). It is frequently reported that individuals with ASD do poorly on standardised tests of motor functioning and they display clumsiness and postural stability (Bauman, 1992; Ghaziuddin and Butler, 1998; Kohen-Raz et al., 1992; Molloy et al., 2003; Rogers et al., 1996).

In regard to stereotypical behaviors, Individuals with ASD may experience one or more of the following: preoccupation with one or more stereotyped patterns or limited interests, devotion to routines and rituals, repetitive motor mannerisms displayed when excited or stressed (i.e. hand flapping, rocking) and unusual interest in parts of objects (Pan et al., 2009). Repetitive motor mannerisms are a defining characteristic of ASD, and sometimes it stands in their way during social interaction and learning as they channel all their attention toward it (Emck et al., 2011; Pan et al., 2009; Vandereycken, 2008). For example, a child may spend an amount of time spinning, spinning objects or watching objects that spin and this behavior can change with development, and it could develop to being fascinated with objects that spin as a teenager.

Benefits of exercise for children:

Studies that have been carried out in the past and have continued to the present reported positive health benefits of exercise across all ages and different health domains especially moderate to vigorous exercise for children (Fletcher et al., 1996; Folkins and Sime, 1981; Janssen, 2007; Janssen and LeBlanc, 2010; Nassis et al., 2005; Sallis et al., 1997; Sorensen and Zarrett, 2014; Sothern et al., 1999; Strong et al., 2005; Tran and Weltman, 1985). It is advised during childhood and adolescence years to engage in regular exercise because it is associated with psychological and physiological variables (Sallis et al., 1997). Exercise improves emotional and cardiovascular health, weight maintenance, joint flexibility, muscle strength and cognitive performance (Sorensen and Zarrett, 2014). In addition, it lowers the risk of type 2 diabetes, stroke, hypertension, depression, heart diseases, certain cancers and premature death (Pan and Frey, 2006). Moreover, engaging in regular exercise promote better health and lifestyle outcomes, including better mood states, physical fitness, functioning, self-esteem and self-confidence and behavior (Fletcher et al., 1996; Folkins and Sime, 1981; Janssen and LeBlanc, 2010). It also builds a stronger immune system by increasing the body ability to fight diseases, so children are less prone to diseases like cancer, allergies and cold (Strong et al., 2005). Intense exercise stimulates cell growth and works as well as growing killer cells that destroy tumour cells, virally infected cells and heal injured tissues (Sothern et al., 1999). Being physically

active increases the body's ability to use oxygen to originate energy for work (Fletcher et al., 1996). When oxygen levels increase in blood, it also increases the amount of blood delivered to the working muscle. As a result, beneficial change occurs in hormonal metabolic, neurological functioning, hemodynamic, respiratory functioning and enhancement in exercise capacity (Fletcher et al., 1996; Janssen and LeBlanc, 2010; Trudeau and Shephard, 2010).

For children, exercise if participated in regularly 40-60 min sessions on 3-5 days a week has been shown to have benefits (Janssen, 2007; Janssen and LeBlanc, 2010; Nassis et al., 2005; Strong et al., 2005). Exercise changes and can maintain body weight; it was reported that children who are active and fit have less fat compared to inactive and unfit children (Fletcher et al., 1996; Janssen and LeBlanc, 2010; Nassis et al., 2005; Tran and Weltman, 1985). It may be a result of exercise controlling and changing lipid and carbohydrate metabolism. Lipoprotein increases when exercise takes place, and it takes away accumulated fat that results in lowering body weight (Fletcher et al., 1996; Janssen and LeBlanc, 2010; Nassis et al., 2005; Tran and Weltman, 1985). Lowering body weight can be beneficial for the heart as it reduces the fat surrounding it and clears arteries and veins from fat (Association, 2007; Diseases, 1991; Health and Services, 2000). There is a well-documented relation between exercise activity and cardiovascular health and preventing heart diseases such as (coronary artery disease) (Association, 2007; Diseases, 1991; Health and Services, 2000). The heart is like every muscle in the body; it improves its performance when regularly exercised as exercise makes the heart stronger and more efficient (Association, 2007; Diseases, 1991; Health and Services, 2000). When it strengthens, diseases can be prevented as exercise clears arteries and veins by decreasing the amount of fat and harmful cholesterol in the blood and it also makes blood vessels walls more flexible, and that lowers blood pressure. As a result, it reduces the risk of heart diseases and strokes (Association, 2007; Diseases, 1991; Health and Services, 2000). Aerobics are suggested for children because it includes continuous muscle movements, increases heart rate, quickens breathing and make them sweat. This is important for developing healthy hearts and lungs (Association, 2007; Diseases, 1991; Health and Services, 2000). According to a systematic review that was published in 2005 sponsored by the U.S. Centers for Disease Control and Prevention (CDC), exercise is beneficial for non-traditional cardiovascular risk factors (heart rate variability, endothelial function, inflammatory markers) (Janssen and LeBlanc, 2010). Regular aerobic exercise improves cardiovascular functional capability and also declines myocardial oxygen demand at any intensity of physical activity (Fletcher et al., 1996). Regular exercise also reduces blood pressure in hypertensive children

(Fletcher et al., 1996). The recommended duration to reduce resting blood pressure specifically in hypertensive children is 40 minutes of moderate to vigorous exercise.

Regular exercise builds up stronger muscles, improves power, strength, muscular endurance, motor performance, bone density and fitness level (Fletcher et al., 1996; Sothorn et al., 1999). Building stronger muscles allow children to do their daily life skills without stressing their muscles or joints (Association, 2007; Diseases, 1991; Health and Services, 2000). This promotes good posture and enhances healthy growth and development. Two studies that were included in a systematic review of the health benefits of exercise on school-aged children revealed that after 2 years of being physically active for 3 days a week, children improved their fitness levels being able to run for longer time and do more activities compared to the beginning of the program with better motor performance (Janssen and LeBlanc, 2010). Just as exercise makes muscles grow stronger, bones also react by getting stronger (Association, 2007; Diseases, 1991; Health and Services, 2000). This result in increased bone density that prevents bones from weakening and becoming fragile (osteoporosis condition). Exercise encourages children to stretch and bend, and that encourages flexibility (Association, 2007; Diseases, 1991; Health and Services, 2000). Being flexible allows them to be more active in practising daily skills without muscle and joints restrictions. Also, studies have revealed that exercise reduces type 2 diabetes. It was suggested that intense training has greater benefits in controlling glucose metabolism (reduce blood sugar by preventing it from accumulating in the blood and stimulating muscle glucose intake from the bloodstream and use it for energy) and also increasing insulin sensitivity (Association, 2007; Diseases, 1991; Health and Services, 2000). As a result, children who exercise can prevent the risk of developing diabetes (Warburton et al., 2006).

Exercise enhances brain functioning by stimulating the brain, and that stimulation increases the reserve of the number of neurons as well as the extent of their interconnection (Trudeau and Shephard, 2010). This stimulation leads to better brain development and functioning. Studies revealed that active children have improved memory and concentration levels and that improved their academic and classroom performance (Fletcher et al., 1996). Another study revealed that teachers favored engaging children in exercise as it increased their student's learning of academic skills (Shephard, 1997). A systematic review of studies that examined the association between exercise and academic performance revealed that there was a total of 251 associations between academic performance and exercise, where children displayed progress in academic achievement, cognitive skills, academic behavior and attitudes and concluded that

exercise is positively correlated to better academic performance (Rasberry et al., 2011). Improving psychological health by exercising is well established. A decrease in psychological stress such as anxiety, tension and depression levels and anger are promoted by exercise (Sothorn et al., 1999). Specifically, 30 minutes and more intense exercise has a positive impact on psychological health. Studies reported that active children have less depression and anxiety levels as well as better mood/outlook and sleep quality (Fletcher et al., 1996; Janssen, 2007; Janssen and LeBlanc, 2010; Sothorn et al., 1999). It was also reported that when stress levels are reduced, the levels of blood pressure and the risk of heart diseases decline (Association, 2007; Diseases, 1991; Health and Services, 2000). Emotional wellbeing can be improved as well by exercising. It was reported that most children feel calm and happy after exercising (Association, 2007; Diseases, 1991; Health and Services, 2000; Strong et al., 2005). According to a theory, exercise releases a natural substance called endorphin. Increased endorphin in the nervous system has great power in enhancing the sense of well-being (Association, 2007; Diseases, 1991; Health and Services, 2000; Strong et al., 2005). Another theory points out that exercise releases serotonin in the central nervous system (Association, 2007; Diseases, 1991; Health and Services, 2000).

High levels of serotonin are associated with mental health, feelings of wellbeing and increasing the appetite. It was reported that exercise reinforces positive social skills, develops social skills and builds children's self-esteem and confidence (Strong et al., 2005). Exercise is all about communicating and interacting with peers and the trainer. It also focuses on group and teamwork. Being in such environment allows the children to learn and acquire valuable new social skills and other skills such as problem-solving, cooperation, creativity, social interaction, fitness and cognitive (Strong et al., 2005). It starts with simple skills as remembering names and greeting others that give confidence during exercising to develop more positive skills such as accept losing, sharing and cheering for others. These skills will be implemented in the exercise setting and can also be transferred to other settings, and that helps them become better learners and individuals (Strong et al., 2005).

Research revealed substantial health benefits of exercise for typically developing children, especially moderate to vigorous exercise. A number of studies suggest that moderate to vigorous exercise may be as beneficial for children with ASD including psychological, physiological, cognitive and behavioural functioning (Allison et al., 1991; Anderson-Hanley et al., 2011; Bahrami et al., 2012; Lang et al., 2010; Pan, 2011; Pan and Frey, 2006; Reid et al., 1988; Sorensen and Zarrett, 2014; Sowa and Meulenbroek, 2012). The section below will

present a review of the literature on the benefits of exercise for children with ASD including theories of learning, an overview of the existing research that examines the benefits of exercise for individuals with ASD of all ages and the recommended physical exercise suggestions for this population.

Benefits of exercise for individuals with autism spectrum disorder (ASD)

There is growing evidence regarding the effects of exercise on individuals with ASD and a growing interest in exercise for this population. The following section will discuss the rationale behind the positive impact of exercise on individuals with ASD, the recommended sports for this population as well as an overview of the existing research that examines the benefits of exercise for individuals with ASD of all ages.

Theoretical perspectives

Participating in exercise has been highlighted by previous researchers as therapeutic intervention to help children with ASD live a healthy lifestyle and develop their dysfunction areas (Anderson-Hanley et al., 2011; Bahrami et al., 2012; Bass et al., 2009; Cannella-Malone et al., 2011; Fragala-Pinkham et al., 2008; García-Villamisar and Dattilo, 2010; Movahedi et al., 2013; Nicholson et al., 2011; Pan, 2010; Pan et al., 2011; Todd and Reid, 2006). The study of (Anderson-Hanley et al., 2011) examined the impact of cyber cycling on a group of children with autism and reported a decrease in the occurrence of stereotypical behaviors and an increase in executive functioning. Similarly, a study conducted by (Bahrami et al., 2012) implemented a KATA program on children with autism and also reported a decrease in stereotypical behaviors and the decrease was maintained at 30 days follow up. The study of (García-Villamisar and Dattilo, 2010) tested the impact of a leisure program on individuals with autism and revealed that it had an impact on their stress levels. Exercise decreased their stress levels and enhanced their quality of life. Another study examined the impact of horseback riding on a group of children with autism and reported an improvement in pre to post-test scores in sensory, social and motor skills (Bass et al., 2009). The study of (Cannella-Malone et al., 2011) implemented an aerobic intervention on a group of children with autism and reported positive results where children's aggression levels decreased. Two studies examined the impact of aquatic exercise programs on children with autism (Fragala-Pinkham et al., 2008; Pan, 2010). Both studies reported an improvement in aquatic and motor functioning skills. In addition, the study of Pan reported a decrease in children's anti-social

behaviors. Pan conducted another study examining the impact of general physical education on children with autism (Pan et al., 2011). The study revealed positive results where children showed improvement in their fitness and motor skills and gained higher scores when compared to the control group. The effects of jogging on children with autism were also examined by (Nicholson et al., 2011; Todd and Reid, 2006). Todd and Reid reported an improvement in motor functioning where Nicholson reported an increased level of academic engagement time during and after the treatment as well as an increase in their engagement time during the exercise.

Regular and repetitive exercise can help individuals with ASD improve in several areas due to feedback to the vestibular system and its impact on their brain processing (Morin, 2009). According to the **Ecological theory of motor control and learning**, when an individual tries to perform a motor action biological and physical conditions changes; subsequently established neural patterns and signals change to complete the action (Turvey et al., 1982). Exercise activates the cortex, and changes in neuronal metabolic activity take place especially in the basal ganglia and motor cortex that controls motor movement in the brain, especially voluntary ones (Morin, 2009). In other words, when practising certain skills or experience a certain task, the complex process occurs in the brain in response to that. As a result, change in the central nervous system happen and allows motor skills production (Lennon and Stokes, 2008; Umphred and Lazaro, 2012). This process involves multiple body systems to collaborate input, output and central processing in the nervous system. An interaction between the individual, the chore and the environment occurs while performing a motor action and that influences motor behavior and learning. Perceptual information that is used to control movement is influenced when the person interacts with any given environment. This motivates the person to achieve a desired movement and consequently facilitates learning. When learning takes place, an increase in the coordination between motor perception and action through task and environmental constraints. There are three specific stages of motor learning: cognitive, associative and autonomous. In the first stage, movements are slow, inefficient and inconsistent and requires a substantial brain activity. The person needs to understand what to move and control body parts consciously. The environment and the tasks have to focus on performance incorporating a clear image (technical and visual) as well as less variable. In the second stage, movements are smoother, more consistent and efficient and require less brain activity. During this stage, the person controls movements consciously were some are automatically. During practice sessions, the performance and the results are linked, and the

performance should be more accurate. Moving to stage three, the movements are accurate, consistent and efficient requiring little or no brain activity. The person during this stage controls the movements automatically and start focusing on tactical choices. During practice sessions, positive results can be seen, and the person can move on to a greater range of movement, speed and use these skills in a novel situation.

Exercise also influences cognitive development by expanding cerebral blood flow, altering excitement and related neuro-hormonal equalisation, changing dietary status, or advancing the development of inter-neuronal associations (Shephard, 1996). As a result, better brain development, coordination and functioning take place (Nicholson et al., 2011). Further research has highlighted that deep breathing, learning a new motor task and performing specific body movements during exercise stimulates the right and the left hemispheres of the brain to work as an integrated whole (Dennison and Dennison, 1985; Nicholson et al., 2011). This process generates and strengthens neural connections and improves overall brain functioning and coordination. Researchers are suggesting that these findings extend to children with ASD and such training can positively impact their overall functioning in all developmental areas especially when engaged in adapted integrated exercise that involve a range of movements which are considered the most effective interventions for individuals with ASD (Auxter et al., 1997; Dennison and Dennison, 1985; Morin, 2009; Nicholson et al., 2011; Shephard, 1996; Turvey et al., 1982).

Autism and exercise / Recommended exercise

Aerobic activities have been found to improve muscular strength, functional ability, fitness level and reduces stereotypical behaviors while not decreasing other positive behaviors in children with ASD (Elliott Jr et al., 1994; Powers et al., 1992; Yilmaz et al., 2004). Developing muscular strength, flexibility and a high fitness level can have further benefits on physical/motor functioning in individuals with ASD (Janssen, 2007; Janssen and LeBlanc, 2010; Nassis et al., 2005; Strong et al., 2005). Furthermore, children who participated in aerobics displayed improvements in social interaction (Pan, 2010), communication skills (Sowa and Meulenbroek, 2012), academic engagement (Nicholson et al., 2011), and sensory skills (Bass et al., 2009).

Lang et al., 2010 states that:

“Stereotypic behaviors (e.g., body rocking, and spinning in circles) are often hypothesized to occur because the behavior itself produces pleasant internal consequences for the individual (automatic reinforcement). These behaviors

interrupt previously learned behaviors & learning and distract a child from response cues from the environment. Physical stimulation obtained via exercise/aerobics may be similar to that obtained via stereotypy for some children.” “Because exercise may involve similar body mechanics to that of stereotypy and therefore may produce similar internal states, it is possible that the participant’s need for this automatic reinforcement is obtained sufficiently during exercise sessions” p 574.

Therefore, aerobic exercise discourages and reduces the appearance of stereotypic behaviors (Nicholson et al., 2011). The study of (Elliott Jr et al., 1994) examined the effects of aerobic exercise on maladaptive behaviors and stereotypical behaviors in children with ASD and mental retardation. The study reported that a significant reduction in maladaptive and stereotypical behaviors was observed due to exercise. It was suggested that the intensity of the exercise (vigorous) that was critical in reducing these behaviors when it was compared to general motor training that did not have any effect. Another study was conducted and examined the impact of aerobic exercise intensity on reducing stereotypical behaviors in individuals with autism (Celiberti et al., 1997). The participants participated in two different intensity programs. The mild program consisted of walking, and the vigorous program consisted of jogging (which is classified under aerobic). The study measured the frequency of the stereotypical behaviors before, during and after exercise and revealed that stereotypical behaviors were reduced with the vigorous jogging program only.

Similarly, (Kern et al., 1984) investigated the impact of mild versus vigorous exercise on children with autism. The results revealed that (ball playing) mild exercise had no effect on children’s stereotypical behaviors where (jogging) vigorous exercise was constantly followed by a reduction in the occurrence of stereotypical behaviors. The pilot study of (Celiberti et al., 1997) reported a sharp reduction of stereotypical behaviors immediately after jogging, and a gradual increase took place but never returned to baseline levels over 40 minutes period. The study of (Cannella-Malone et al., 2011) engaged three participants with autism in eight daily aerobic sessions during the school day and reported that challenging behaviors decreased for two boys to zero and near-zero for the third boy. Another study investigated the impact of aerobic on stereotypical behaviors and academic performance (Rosenthal-Malek and Mitchell, 1997). The study revealed a decrease in stereotypical behaviors following the aerobic exercise and an increase in the number of correct responses as well as the number of tasks completed. The study also mentioned that the level of exercise and the duration of sessions are important variables for improvement. Similarly, (Nicholson et al., 2011) also examined the impact of jogging on academic performance and revealed an increase in the percentage of academic

engagement for the participants in the experiment group and added that participants who were consistently running/jogging displayed the greater results. lastly, a study designed an aerobic program for children with ASD and indicated that the program improved participants fitness level and abdominal strength as well as positive behaviors toward exercise (Magnusson et al., 2012). It was concluded that the right kind of sport/activity could positively change and develop this population.

The studies mentioned above theorized that the development noticed is due to the type of exercise and the intensity that contributed to integrated neurological functioning. It results of improving the communication between different areas of the brain that was obvious in reducing the stereotypical behaviors and increasing academic performance and engagement as well as improving motor functioning and fitness levels (Nicholson et al., 2011). Research has indicated that intense exercise stimulates the brain to function in a better way that in turn, may positively impact performance and learning (Dennison and Dennison, 1985). This indication can apply to aerobic exercise. Another possible consideration behind the development after being engaged in aerobic exercise is the monoamine hypothesis. Exercise increases the transmission of monoamine in the brain (Ransford, 1982). Subsequently, monoamine named (dopamine, serotonin, norepinephrine) impact attention and arousal that results in better functioning and development of various developmental areas.

Aquatic activity is beneficial for all typically developing children and children with ASD in specific because the entire body is exercised without placing excessive stress or tension on specific body parts opposed to land settings (Cole and Becker, 2004). The warm water environment, splashing and kicking improve normal muscle tone, permitting more efficient movement compared to rigid land settings (Cole and Becker, 2004). It is also considered an appropriate environment for early learning intervention because children feel more free in the water and less stressful compared to any other environment (Bachrach et al., 1978; Best and Jones, 1974; Hamilton et al., 1972). It is a result of the Buoyancy allowing the initiation of independent possibilities of movement which are difficult to achieve on land due to gravitational restrictions (Hutzler et al., 1998; Prupas et al., 2006). The properties of hydrostatic pressure and buoyancy may facilitate the improvement of sensory and social skills (i.e. paying attention, maintain eye contact) and motor abilities in children with ASD by providing them with postural support and sensory input (Fragala-Pinkham et al., 2008; Prupas et al., 2006). In general, children with autism display poor motor abilities (Levinson and Reid, 1992; Morin and Reid, 1985; Yilmaz et al., 2004). As a consequence, they need intervention programs that

emphasize on motor skills and patterns and physical games that increase physical proficiency (Yilmaz et al., 2004). Swimming and aquatic activities have been found successful in this regard. It is also believed that it facilitates language and motor development (balance, muscle tone and eye-hand-leg coordination), self-concept and social skills (Bachrach et al., 1978; Best and Jones, 1974; Cole and Becker, 2004; Hamilton et al., 1972; Hutzler et al., 1998; Pan, 2010, 2011; Prupas et al., 2006).

For the reasons mentioned above, therapeutic use of aquatic activities for children with ASD is highly recommended, and findings of previous research studies are compatible with these suggestions when examined the effects of aquatic activity on children with ASD as they reported an improvement in social skills, aquatic skills, physical fitness, motor abilities and a reduction in stereotypical behaviors (Huettig and Darden-Melton, 2004; Pan, 2010; Yilmaz et al., 2004). The study of (Yilmaz et al., 2004) examined the effects of a 10-week swimming program on fitness and motor performance of children with autism and observed the behaviors of participants while becoming familiar with the pool. After being engaged in the program, participants showed an increase in motor performance scores and developed muscular strength, fitness, balance and flexibility. It also decreased stereotypical behaviors. It was also reported that participants showed an unusual interest in the water as it was enjoyable and educational. The study of Best and Jones implemented a swimming intervention on three children with autism. It was an individualised program that focused on imitation, following commands and self-motivation. It was reported that over and after 15 weeks, participants improved body awareness, the ability to follow commands and confidence (Best and Jones, 1974). Another study examined the impact of swimming on water orientation skills in children with autism (Killian et al., 1984). The study reported an improvement in water orientation skills and that the training offered a learning opportunity for autistic subjects.

Similarly, the study of Pan examined the effects of a 10-week water exercise training on the social and aquatic skills in children with autism. Study results indicated an improvement in aquatic and social skills in all 16 boys (Pan, 2010). The effects on social skills was a decrease in anti-social skills but not an increase in social competence. Pan suggested that the aquatic environment following the intervention process facilitated the development of physical skills and if continued, it is possible to enhance more behavioral and social skills. Another study investigated the impact of water activity on the acquisition of aquatic skills by four children with autism (Huettig and Darden-Melton, 2004). Ongoing assessment of aquatic skills was

conducted during the study, and the results revealed that all participants significantly improved their swimming and stroke skills. All the research studies mentioned above agreed on the benefits of aquatic workout for children with autism and suggested that it is an educational environment that teaches skills beyond motor skills. Therefore, it was highly recommended by a number of research studies to offer behavioral, social and language skills in such environment for children with autism to acquire and develop such skills through interacting with trainers and peers while swimming (Pan, 2010, 2011; Yilmaz et al., 2004).

Many previous investigations, as well as current ones, were conducted to measure the impact of exercise on individuals with ASD on different domains such as physical, cognitive, social and emotional, language and communication and all reported a positive impact of exercise on all domains examined (Anderson-Hanley et al., 2011; Elliott Jr et al., 1994; Huettig and Darden-Melton, 2004; Kern et al., 1984; Killian et al., 1984; Pan, 2010, 2011; Rosenthal-Malek and Mitchell, 1997; Sorensen and Zarrett, 2014; Srinivasan et al., 2014; Tomporowski et al., 2011; Yilmaz et al., 2004). A meta-analysis that included 16 studies reported that therapeutic interventions such as exercise prompted a 37% change in general symptomatology of autism (Sorensen and Zarrett, 2014). Different studies targeted different outcomes; a number of studies focused on examining the effects of exercise on decreasing self-harmful behaviors (e.g., aggression, self-injury) and also reducing stereotypical behaviors (Bahrami et al., 2012; Kern et al., 1984; Kern et al., 1982; Levinson and Reid, 1992; Movahedi et al., 2013; Pan et al., 2009; Pan et al., 2011). All studies reported a decrease in these behaviors during and following the exercise interventions. One of these studies examined long term effects of exercise on the reduction of stereotypical behaviors after the intervention was over by doing a one month follow up (Bahrami et al., 2012). The study reported sustained benefits as participants were still showing a significant reduction in the occurrence of stereotypical behaviors after 30 days of no practice compared to pre-intervention time. In the study of Levinson and Reid, it reported a decrease in repetitive behaviors during and after exercise, but after 90 min, it returns to baseline (Levinson and Reid, 1992). Five studies examined the effects of mild versus vigorous exercise on reducing stereotypical behaviors. The difference between the two exercise intensities was examined and all studies reported that vigorous exercise was critical in reducing the stereotypical behaviors when compared to mild exercise such as walking that did not have any effect (Kern et al., 1984; Kern et al., 1982; Levinson and Reid, 1992; Pan et al., 2009; Pan et al., 2011). As mentioned earlier in the section above (pg. 22) that the reason behind the development as theorised that intense exercise offers a greater stimulation for the brain that

results in greater development. Another study was conducted by Pan examining the self-determined motivation of adolescents with ASD and the impact of mild versus vigorous exercise on self-regulation and social engagement (Pan et al., 2011). The study reported the beneficial effects of vigorous exercise only on self-regulation and social engagement.

Studies provided evidence on the positive effects of exercise on cognitive functioning and academic performance among typically developing children and children with ASD (Anderson-Hanley et al., 2011; Kern et al., 1982; Nicholson et al., 2011; Reid et al., 1988; Rosenthal-Malek and Mitchell, 1997; Tomporowski, 2003; Tomporowski et al., 2011). The study of Anderson et al. examined the impact of increased physical activity on cognitive outcomes and reported positive results (Anderson-Hanley et al., 2011). It reported an increase in the executive functioning abilities specifically the memory span where participants were able to remember a long list of items and repeat it in the correct order; DSF digit span forward and DSB digit span backwards. Other studies examined increasing physical activity by exercising and its effect on attention, academic performance and compliance (Kern et al., 1982; Reid et al., 1988; Rosenthal-Malek and Mitchell, 1997). The study of Kern et al. investigated the increase in exercise (jogging) on increasing subsequent responding to questions and instructions. Increased jogging sessions produced an increase in inappropriate play and academic responding in all 7 participants (Kern et al., 1982). The positive change was observed in three different settings a clinic, play area and a quiet room where no activities were taking place. The study of Reid et al. conducted a physical exercise program to examine its impact on decreasing off-task behaviour and increasing on-task behaviors and other appropriate behaviors in adolescents with autism. Three boys participated in the program and showed a decrease in off-task behaviors and an increase in on-task behaviors (Reid et al., 1988). Another study suggested that exercise increases academic engagement and staying on task if it took place before classroom lessons (Srinivasan et al., 2014). The study reported that physical exercise preceding classroom sessions led to a decrease in the occurrence of stereotypical behaviors (disruptive behaviors) that usually stood in the way of learning for children with ASD and the decrease in the occurrence of disruptive behaviors correlates positively with academic engagement. A systematic review and a meta-analysis were performed on studies that investigated the impact of classroom-based physical exercise on academic and physical abilities of children with ASD (Watson et al., 2017). Most of the studies included featured aerobic movements (e.g. sit-ups, jumping jacks) inside and outside the classroom. Results revealed that classroom-based physical exercise had a positive effect on related academic

outcomes such as (increasing on-task behavior and reducing off-task behavior, improving selective attention, improvement in academic achievement) both after participation and after longer follow up periods. Most of the studies included also reported that classroom based physical exercise also had a positive effect on overall physical activity levels.

Studies that examined the effects of exercise on the physical abilities in children with ASD, all reported beneficial effects and improvements in motor skills (Pan et al., 2011; Pitetti et al., 2007), endurance (Pan et al., 2011; Todd and Reid, 2006; Todd et al., 2010), strength (Lochbaum and Crews, 2003; Pan et al., 2011), flexibility (Pan, 2011), cardiovascular (Pan, 2011) and aerobic fitness (Lochbaum and Crews, 2003). Some studies reported positive results examining the relationship between body composition and exercise (Pan, 2011; Pitetti et al., 2007). Pitetti et al. conducted a study examining the efficacy of a 9-month treadmill walking on Body Mass Index (BMI) and exercise capacity for children and adolescents with severe autism. The authors noticed a monthly increase in walking frequency, speed, calories expended and BMI reduction. Pan examined the efficacy of a 14-week aquatic exercise program on physical fitness and aquatic skills in 15 children with autism and their siblings. Improvement was noticed in aquatic skills and fitness levels but not in body composition subtest. A study of (Fragala-Pinkham et al., 2008) examined the impact of a 14-week aquatic exercise intervention on 6 children with autism who were included with other children with disabilities. The study indicated an improvement in motor functioning (cardiorespiratory endurance) while motor skills and muscle strength showed no significant results. It was also reported that the exercise intensity was low for some participants, and that may have contributed to the lack of significant results on muscle strength and fitness outcomes. Similarly, the study of (Lochbaum and Crews, 2003) indicated an increase in aerobic fitness 33%, 50% and 33% for the three participants who participated in an aerobic and muscular strength training program and reported that all participants improved their upper, core and lowered muscular strength.

Social engagement and its relationship to physical activity was also one of the domains examined by research. Only a few studies have examined if the social engagement can be related to the physical activity of children with ASD (Movahedi et al., 2013; Pan, 2009; Pan et al., 2011). The study of (Pan, 2009) examined the relationship between social engagement and physical activity in 25 children with ASD. Their physical activity and the level of social engagement was assessed and observed daily. It was found that participants who had frequent social engagement with adults had high physical activity levels during physical education (PE)

sessions. It was also reported that the older the age of the participant, the more peer interaction that took place during PE and an increase in social engagement rate was evident as children become older. Lastly, (Movahedi et al., 2013) implemented a 14 week KATA program that consisted of 65 minutes sessions on 26 children with autism. Social interaction was evaluated before and after conducting the program and at one month follow up. The results revealed that the exercise group showed a significant improvement in social interaction and this improvement remained unchanged at one month follow up. The study also reported that the control group showed no change in their social deficiency during the experimental period. The, study concluded that martial arts are beneficial for children with ASD especially for improving their social skills.

In summary, overall, there is significant confirmation from several studies that exercise is effective in enhancing the overall functioning of children and adults with ASD. The literature highlights the importance and benefits of exercise for children with ASD. The following tables represent recent studies that examined the effects of exercise on individuals with ASD.

Table 2.1 Characteristics of some of the key studies reviewed.

| Study | Sample size | Age in Y (range) | Functioning | Setting | Type of intervention & content | Type of intervention |
|--------------------------------|-------------|------------------|---------------|-----------------|--|----------------------|
| (Anderson-Hanley et al., 2011) | N=22 | (8–21) | Not specified | School | Cyber cycling: 20 min | Group |
| (Andy, 2020) | N=27 | (8–12) | ASD | Not specified | Jogging: 12 weeks | Group |
| (Bahrami et al., 2012) | N=30 | (5–16) | ASD | Sports facility | Kata: warm-up (15 min), lesson 65 min*4 per week, cooldown (10 min) | Individual |
| (Bass et al., 2009) | N=19 | (5-10) | ASD | Not reported | Therapeutic horseback riding 1- h, 12 weeks | Individual |
| (Cannella-Malone et al., 2011) | N=3 | (8–11) | Low | School | Aerobic, resistance, stretch, scooter board, calisthenics: 20 min *2 per week extends to 1h* | Group |

| | | | | | | |
|---|-------|---------|----------------------------------|---|--|---|
| | | | | | 5per week | |
| (Fragala-Pinkham et al., 2008) | N=6 | (8-10) | Autism PDD | Center | aquatic exercising: 30–50 min, 14 weeks | Group with children with other disabilities |
| (Ferreira et al., 2018) | N= 51 | (4-12) | Not specified | Not specified | Physical education: 35 min, 40 weeks,80 exercise sessions | Group |
| (García-Villamizar and Dattilo, 2010) | N=37 | (17-39) | Autism &Asperger | Learning center& local community institutions | Leisure activity: 1 year | Group |
| (Guest et al., 2017) | N=13 | (8-12) | ASD | Local school gymnasium | Multi-sport, outdoor and indoor activities: 5days | group |
| (Hameury et al. 2010) | N=6 | (5-7) | Not specified | Not reported | Equine-assisted therapy: 1 h* per week | Individual |
| (Hillier et al., 2011) | N=18 | (13–27) | Not specified | University | Low-intensity PA: 75 min 1*week; 5–10 min/activity extends to 10 min continuous mild physical activity | Group |
| (Hinckson et al., 2013) | N=17 | (7-21) | Autism & intellectual disability | School | Aerobics (aerobics sessions &pool sessions): 60 min*2 per week, 10 weeks | Individual\group |
| (Lochbaum and Crews, 2003) | N=5 | (16–21) | low | Not specified | Stationary bike: 20 min, 3*week resistance: 1 h, 2–3*week | Individual |
| (Magnusson et al., 2012) | N=6 | (9-15) | Not specified | Not reported | Aerobics: 60 min 2*week, 12 weeks | Individual\Group |
| (Morrison et al., 2011; Morrison, 2007) | N=4 | (10–21) | Not specified | Not specified | Therapy ball, scooter boards, stationary bike, moon shoes: 10-min | Individual\group |
| (Movahedi et al., 2013) | N=26 | (5–16) | Not specified | Sports facility | Kata: warm-up (15 min), Lesson (65 min), cool down (10 min) | Group |

| | | | | | | |
|-------------------------------|-----------------|---------|-----------------------------|-----------------------------------|---|------------------------------------|
| (Nakutin and Gutierrez, 2019) | N=3 | (6-7) | ASD | School | Jogging:12 min | Group |
| (Nicholson et al., 2011) | N=4 | 9 | High functioning & Asperger | School | Jogging: 12-min 3*week, 2 week | Group with healthy same-aged peers |
| (Pan, 2010) | N=16 | (6-9) | High functioning & Asperger | School | water exercise-swimming program: 90 min *1 week, 10-weeks | Group |
| (Pan, 2011) | N=15 | (7-12) | Not specified | School | Aquatic exercise: 60 min 2* week, 28 sessions, 14 weeks | Group with non ASD |
| (Pan et al., 2011) | N=100 ASD=25 | (13-15) | Not specified | School | Regular physical education: 45 min 2*week | Group with non ASD |
| (Pitetti et al., 2007) | N=10 | (14-19) | Severe | Residential school | Tx: 8-20 min/session Treadmill: 30 min * 3 per week progressed to 5 per week | All at the same time |
| (Rogers et al., 2010) | N=3 | (4-5) | Autism & PDD | Recreation center in a university | Swimming: 45-60 min | Individual |
| (Schmitz et al., 2017) | N=7 | (12-14) | ASD | Not specified | Aerobic exercise: 10-20 min, 5 days | Individual |
| (Todd and Reid, 2006) | N=3 | (15-20) | Low | Local park | Jogging, snowshoeing: 30 min per * 2 weeks | Group |
| (Todd et al., 2010) | N=3 | (15-17) | Low | School | Cycling: 30 min*3 weeks | Group |
| (Toscano et al., 2017) | N=16 | (5-11) | ASD | Not specified | Circuit training: 30 min *2 16 sessions | Group |
| (Tse et al., 2018) | N=30 | (9-12) | ASD | Not specified | Ball tapping exercise: 20 min *2, 24 sessions | Group |

| | | | | | | |
|-----------------------|------|---------|---------------|---------------|---|------------|
| (Wilson, 2019) | N=6 | (4-13) | ASD | Sort facility | Swimming: 30 min*2 | Group |
| (Ye et al., 2019) | N=24 | (11-14) | ASD | Not specified | Walking: 8 weeks, 60 min*3 Jogging: 12 min *3 Paper plane: 30 min*2 | Group |
| (Yilmaz et al., 2004) | N=1 | 9 | Not specified | Not specified | Swimming: 60 min* 3 weeks, 10 weeks | Individual |

The following table includes the domain assessed by each study included in table 1 and states the improvement in percentages and the key findings.

Table 2.2 Results of some of the key studies reviewed.

RSB Repetitive stereotypical behaviours, EF executive function, DSF digit span forward, DSB digit span backwards, AGG aggression, STR stress, CORT cortisol, ANX anxiety, FIT fitness, SIB self-injurious behaviour, SOE social engagement, MOT motor skills, SR self-regulation, AQUA aquatic skills, SOB social behaviours, SOF social functioning, COM communication, AET academic engagement time, SR social responsiveness, SS sensory skills.

| Study | Domain | Findings |
|---|---|---|
| Anderson-Hanley et al. (2011) | RSB | RSB significantly decreased & EF increased (DSB &DSF). |
| (Andy, 2020) | Emotion regulation & behavior functioning | Significant improvement in emotion regulation and reduction in behavioral problems (ps<.05) |
| Bahrami et al. (2012) | RSB | RSB decreased for Kata group (42.54 %). Gains maintained at 30-day follow-up. |
| Bass et al. (2009) | SOR, SS | The experimental group showed significantly increased pre-to-post-test scores with significant interaction effects for four of the five subscales: sensory seeking, attention and distractibility, sensory sensitivity, and sedentary. Sensory seeking: 6.16 Inattention/distractibility: 28.57 Sensory sensitivity: 9.55 Sedentary: 18.52 Fine motor/perception: 5.62 Social response scale: 14.32 Social cognition: 22.6 Social awareness: 18.18 Social motivation: 27.75 |
| Cannella-Malone et al. (2011) | AGG | AGG: decrease (87–99 %). |
| Fragala-Pinkham, Haley, and O'Neil (2008) | MOT | MOT functioning improved (Cardiorespiratory endurance) 2.5%. (motor skills & muscle strength showed no significant results. |
| (Ferreira et al., 2018) | Asd | A significant change in the symptomatic profile and the level of |

| | symptomology | physical activity |
|--|---|---|
| García-Villamisar and Dattilo (2010) | STR and quality of life | Stress had significantly decreased following the leisure program by 9.51%. Quality of Life had improved by 27.47%, and post-test total scores were significant. |
| (Guest et al., 2017) | MOT, SOF, SOB, physical self-perception | An improvement in MOT ($p < 0.0001$), SOB ($p = 0.005$), physical self-perception ($p = 0.044$) was reported. |
| Hameury et al. (2010) | MOT, SO, COM | Children showed 80% improvement in MOT, 79.67% SOF, 64.5% COM. |
| Hillier et al. (2011) | STR, ANX | STR, ANX: decreased CORT ($\eta^2 = 0.482$) after PA, but not across weeks. |
| Hinckson, Dickinson, Water, Sands, & Penman (2013) | FIT, WT | Participants showed improvement in FIT skills and parents reported decreased consumption of confectionary post-intervention. |
| Lochbaum and Crews (2003) | FIT | FIT (aerobic): all improved 33–50 %; (strength): only participant 1 (19–47 %) and 2 (12–28 %). |
| Magnusson et al. (2012) | FIT | Participants showed significant improvements in FIT skills. |
| Morrison et al. (2011) | RSB, SIB | RSB, SIB: decreased in Time Sampling phase for all; (males): pre- to post-decrease for exercise only; (Females): No pre-post decreases. |
| Movahedi et al. (2013) | SOE | SOE decreased for Tx ($\eta^2 = .38$). |
| (Nakutin and Gutierrez, 2019) | AET & EF | Large effect sizes for academic engagement. No significant effects were found on EF. |
| Nicholson et al. (2011) | AET | Children's AET increased during the physical exercise with an average of 37%, and all showed a significant increase in total engagement time in the treatment and follow-up with an average of 11%. |
| Pan (2010) | AQUA, SOB | ASDs showed improvement in scores on water orientation, breathing, floating, stroke, and entry & exit skills. The study decreased antisocial behavior problems but did not increase social competence behaviors. |
| Pan (2011) | FIT, MOT | Findings indicated that children with ASD in group A (experimental group) had significantly higher scores than those of children with ASD in group B (control group). Children with ASD in group A (experimental group) also had significantly higher scores than those of children without ASD in group B (control group) on 30 s curl-ups and aquatic skills at stages II, V. |
| Pan et al. (2011) | SOE, SR | Introjected SOC associated with MVPA ($r = .50$) and moderate PA ($r = .58$). |
| Pitetti et al. (2007) | FIT: WT, BMI, PA CAP, CAL: | The participants showed a significant reduction in BMI after the program; the relative percentage in BMI reduced from the baseline |

| | | |
|-------------------------------------|----------------------------|--|
| | kcal/min | with a minimum of 2.8–17.2%. Weight reduction showed no significant. |
| Rogers, Hemmeter, and Wolery (2010) | MOT, AQUA | Overall skills were mastered at an average rate of 92.59. |
| (Schmitz et al., 2017) | RSB | Significant reduction in stereo typical behaviors. |
| Todd and Reid (2006) | MOT | Overall MOT functioning improved at an average of 150.8. |
| Todd et al. (2010) | SR, cycling distance | Participants increased the distance cycled throughout the program except one. |
| (Toscano et al., 2017) | RSB, SOB | A decrease in stereo typical behaviors and non-social skills. |
| (Tse et al., 2018) | RSB | Significant reduction in stereo typical behaviors. |
| (Wilson, 2019) | Amount & quality of sleep | Improved sleep on nights of aquatic exercise. |
| (Ye et al., 2019) | Physical health & behavior | Significant reduction is fat mass and remarkable improvement in their behavior. |
| Yilmaz et al. (2004) | FIT, RSB | 1-h observations showed a reduction in “swinging” from 7 to 5 min, “spinning” from 2 to 0 min, and echolalia from 4 to 2 min. FIT improved at an average of 83.475. RSB were reduced: Swinging: 28.57% Spinning: 100 % Echolalia: 50%. |

Studies in the tables above have examined the impact of exercise on individuals with ASD employing different kinds of sport such as (swimming, cycling, jogging, aerobic games and KATA) with varying intensities (mild, mild to moderate, moderate to vigorous and vigorous). The interventions employed included children and adolescents with ASD either in individual or group exercise conducting different activities such as swimming, aerobics, weight training, jogging, cycling, horseback riding and other activities. Individual interventions included only one individual with ASD interacting with one therapist/teacher or more; group interventions involved more than two participants. It should be noted that in most of the studies, communication between participants was not required but they were aware that they were engaged in a group exercise. The three core symptoms of ASD (social, language and communication and motor skills) were the focus of many studies. However, some also examined the effects on attention, academic engagement, stress and anxiety and repetitive stereotypical behaviors. All studies reported a clear overall improvement and mentioned that exercise did have a positive behavioural change on children and adolescents with ASD (Anderson-Hanley et al., 2011; Bahrami et al., 2012; Bass et al., 2009; Cannella-Malone et al., 2011; Fragala-Pinkham et al., 2008; García-Villamizar and Dattilo, 2010; Hameury et al.,

2010; Hillier et al., 2011; Hinckson et al., 2013; Lochbaum and Crews, 2003; Magnusson et al., 2012; Morrison et al., 2011; Movahedi et al., 2013; Nicholson et al., 2011; Pan, 2010, 2011; Pan et al., 2011; Pitetti et al., 2007; Rogers et al., 2010; Todd and Reid, 2006; Todd et al., 2010; Yilmaz et al., 2004). Some of the Studies in the tables above were included in a meta-analysis conducted by (Sowa and Meulenbroek, 2012) that evaluated a number of studies that examined the impact of exercise on individuals with ASD. It was reported in the analysis that the type of intervention (individual/group) was a significant factor. Participants engaged in individual interventions profited more compared to those in group interventions. Individual interventions reported larger positive effects on motor skills and the same but to a lesser degree for social skills as in individual interventions the focus is on one child only and not more and that gives the child more practice attempts and more focus from the trainer (Sowa and Meulenbroek, 2012). Thus, group interventions may be more effective for improving social skill as the trainer will be communicating with more than one child, and it might influence participants to communicate with each other (Sowa and Meulenbroek, 2012). The types of physical exercise most commonly investigated were swimming and jogging. A number of studies focused on the impact on motor functioning and social skills and all reported promising effects on these two core symptoms (Bass et al., 2009; Fragala-Pinkham et al., 2008; Movahedi et al., 2013; Pan, 2010, 2011; Pan et al., 2011; Rogers et al., 2010; Todd and Reid, 2006). In summary, research shows beneficial positive effects of exercise on individuals with ASD despite the heterogeneity and the age of the participants. Research provides strong evidence regarding the benefits of exercise as well as pointing out effective strategies, interventions and also stressing on the importance of promoting a healthy lifestyle for this population (Anderson-Hanley et al., 2011; Bahrami et al., 2012; Bass et al., 2009; Cannella-Malone et al., 2011; Fragala-Pinkham et al., 2008; García-Villamizar and Dattilo, 2010; Hameury et al., 2010; Hillier et al., 2011; Hinckson et al., 2013; Lochbaum and Crews, 2003; Magnusson et al., 2012; Morrison et al., 2011; Movahedi et al., 2013; Nicholson et al., 2011; Pan, 2010, 2011; Pan et al., 2011; Pitetti et al., 2007; Rogers et al., 2010; Todd and Reid, 2006; Todd et al., 2010; Yilmaz et al., 2004).

Chapter 3:

Inclusive education

This chapter examines the benefits of inclusive education for children with and without special needs with a particular focus on children with ASD. It will include a review of the benefits of inclusive education for individuals with ASD and in specific during exercise. This chapter will also include a review of the recommended elements and teaching procedures that should be

applied to exercise settings to successfully include and engage children with ASD in exercise/sport.

Benefits of inclusive education

The education of individuals with special needs has been supported by federal mandates and acts (IDEA, 2004 as well as the previous versions of this act and No Child Left Behind, 2001) (Downing and Peckham-Hardin, 2007). As a result, inclusion and inclusive education became a priority and an ultimate objective for many parents of children with special needs and professionals (Barnard et al., 2000; Downing and Peckham-Hardin, 2007; Eldar et al., 2010; Ferraioli and Harris, 2011). Inclusion is including all children with special needs in the regular education classroom with other students without disabilities regardless of their variability (Downing and Peckham-Hardin, 2007; Idol, 2006; Ward and Lee, 2005). For inclusion to be effective, inclusive education/practice must be implemented. Inclusive education requires a set of components to provide the student with an opportunity to learn, be challenged, be supported and develop regardless of variability (Downing and Peckham-Hardin, 2007; Idol, 2006; Ward and Lee, 2005). It requires collaboration between professionals, effective leadership, professional support, implementing effective educational strategies and types of support to provide a high-quality education for all students to learn (Downing and Peckham-Hardin, 2007; Idol, 2006; Ward and Lee, 2005).

Gal et al. (2010) describe inclusion as

“restructuring educational provision to promote belonging, all pupils in a school see themselves as belonging to a community, including those with significant disabilities. As such, inclusion embraces the concept of diversity as a natural state of being human or in educational terms, of being a learner. Inclusion presupposes a significant restructuring of mainstream schooling so that every school can accommodate every child irrespective of disability accommodation rather than assimilation” p.89.

Avramidis et al. (2000) describe inclusion/inclusive education as

“Educational strategies and collaboration among educators yield specially designed instruction and supplementary aids and services for all diverse students as needed for effective learning” p.278.

Idol (2006) describes inclusion as

“In the inclusive school, all students are educated in general education programs. Inclusion is when a student with special learning and/or behavioral needs is educated full time in the general education program. Essentially, inclusion means that the student with special

education needs is attending the general school program, enrolled in age-appropriate classes 100% of the school day” p. 4.

All three definitions agree on the philosophy of inclusion, and all propose the fundamental concept that all students with disabilities should be educated with their typically developing peers in the general education class with all the required services brought to them (full inclusion). Nevertheless, many research studies discussed that each definition outlines different components of inclusion to focus on since every child is unique and requires unique learning needs (Knight, 1999; Mesibov and Shea, 1996). The definition of Gal (2010) focused on creating and seeking a community of learners by educating students with and without disabilities in the general education classes by restructuring mainstream schooling to inclusive schooling to meet the needs of every child. Previous research supported this component and mentioned that creating inclusive schools can establish a community of diverse learners respecting each other and learning from each other (Fennick and Royle, 2003; Salend and Duhaney, 1999). The definition of Avramidis et al. (2000) is specific and clearly states the components that best serve to develop and maintain inclusive education for students with and without disabilities, such as collaborative teaming among educators and professionals, design educational strategies, and instructions and design special aids and services. In addition, applying these components can ensure effective learning and belonging (Avramidis et al., 2000a, 2000b; Avramidis and Norwich, 2002; Fennick and Royle, 2003; Salend and Duhaney, 1999). The definition of inclusion by Idol (2006) emphasised the importance of the degree of inclusion, which is educating the students with special needs in the general education classes as full time in inclusive schools and receive the entire academic curriculum in the general education classes. This definition was after differentiating between inclusion and mainstreaming, which is when students with special needs are taught in special education classes for a portion of the day and in the general education classes for the rest of their school day (Idol, 2006). Both mainstream and inclusion are ways of teaching students with special needs in schools. Another intent of this definition was to determine if schools are following the mandate in the Education for All Handicapped Children Act of 1975 and the Individuals with Disabilities Education Act (IDEA) 1990 and providing students with disabilities with the least restrictive environment (LRE) (Idol, 2006).

Inclusion and inclusive education have been and still is a debated topic among professionals, educators, and parents. Inclusion can be social, fully inclusive or partially inclusive. Inclusion can primarily be for social reasons (Carter et al., 2005; Copeland et al., 2004; Downing and

Peckham-Hardin, 2007). It is defined as just being placed with other students without disabilities in the general education classroom or other settings. The rationale for social inclusion and being with classmates without disabilities included receiving natural support, having role models, partners to speak to, and having peers as motivators (Downing and Peckham-Hardin, 2007). The studies of (Carter et al., 2005; Copeland et al., 2004) mentioned that being placed for social reasons is insufficient. They argue that since children gained access, the goal should be academic as well as social where the educational team can identify the curriculum content that the children need, and the types of support needed. Inclusion can be partial were children with special needs are placed in the general education classroom for most of the school day but pulled out to special resource rooms for a session or two during the day to receive special instructions mainly academic and some for speech and language therapy (Ferraioli and Harris, 2011; Idol, 2006; Salend and Garrick Duhaney, 1999). Moreover, Inclusion can be fully included and educated (full time) in general education classrooms for children with mild, moderate and severe disabilities receiving all their services in the general education classroom and also attending and being part of the school's programs 100% of the school day (Downing and Peckham-Hardin, 2007; Harrower and Dunlap, 2001a; Idol, 2006; McLeskey and Henry, 1999; Turnbull et al., 2004; Westwood and Graham, 2003).

For many, inclusive education is considered a challenge because of the transformation done to the environment surrounding it including setting, staff, educational strategies and pupils (Adamowycz, 2008; Downing and Peckham-Hardin, 2007; Eldar et al., 2010; Knight, 1999; Westwood and Graham, 2003). Restructuring the physical environment could be a challenge for some schools but necessary when including children with special needs and especially the ones with a physical disability (Adamowycz, 2008; Avramidis et al., 2000a, 2000b; Avramidis and Norwich, 2002). For example, some schools would have to build ramps, straighten sidewalks, keep classrooms and all activities on a ground floor for successful inclusion of children with special needs. It is a challenge that worries teachers because of the demand on their teaching methods (curriculum adaptations and accommodations) as well as the behavioural challenges they face and the difficulty they face in assessing students (Adamowycz, 2008; Downing and Peckham-Hardin, 2007; Eldar et al., 2010; Knight, 1999; Westwood and Graham, 2003). Curriculum adaptations and accommodations are a challenge for regular education teachers who teach children with special needs. In the study of (Westwood and Graham, 2003), teachers were asked about the challenges/problems faced when teaching children with special needs in regular classrooms, and they reported difficulty

in planning a lesson effectively for all individuals in the class. Teachers mentioned that planning lessons and teaching strategies for children with special needs require extra planning, organisation, management and teaching skills and that all need extra time to be able to meet the needs of every child. In the study of (Knight, 1999) teachers shared the same concern and mentioned that they are expected to deal with a variety of disabilities, large class size, and other children from different cultures and backgrounds. They added to this list the demand to cope with student's high support needs that require them to be more organised, have expert skills, have routines, and be open and flexible to change anything whenever needed. In regard to behavioural challenges, some teachers in the Downing study reported that children are engaged in disruptive, aggressive behaviors such as hitting, biting and spitting (Downing and Peckham-Hardin, 2007). It was reported that some students decrease the rate of these behaviors after being included and for some, it remains the same and remains a challenge for teachers and staff. Teachers in the study expressed their frustration as they wanted the best for these children and to meet their needs, but it needed energy and time, which was taken from the education class time, and that was limiting the children from being involved and engaged in the curriculum.

Assessing students with special needs and especially assessing what students are learning is another concern for teachers (Adamowycz, 2008; Downing and Peckham-Hardin, 2007; Eldar et al., 2010). This concern among teachers was primarily found with students who are with severe disabilities and/or nonverbal. It was reported that some teachers found it hard to assess these students as they were not certain whether the student is just trying and guessing right sometimes, or s/he actually learned because usually right answers are inconsistent and that what makes it hard (Adamowycz, 2008; Downing and Peckham-Hardin, 2007; Eldar et al., 2010). Teachers stated that some students would answer or respond to everything one day, and the next day s/he would not answer/respond to any question. Parents also raised concerns and not only teachers when asked about inclusion (Adamowycz, 2008; Eldar et al., 2010). Some parents worry about the effectiveness of the inclusive program and whether teachers are capable of handling the challenge. Some parents of autistic children mentioned that their children need one to one instruction for part of the day, some would find it difficult to work cooperatively with others at sometimes and these require extra directions and input from the teacher to make progress that the teacher might not be able to provide because she is in charge of other students too (Adamowycz, 2008; Eldar et al., 2010). Therefore, much concern among parents that inclusion and inclusive education might not be as effective, and it might have

negative effects on their children and others.

A range of research has examined all aspects of including children with disabilities. Studies have examined the benefits of inclusive education to children with and without special needs and the benefits to children with ASD (Barnard et al., 2000; Cambra and Silvestre, 2003; Cuckle and Wilson, 2002; Downing and Peckham-Hardin, 2007; Ferraioli and Harris, 2011; Idol, 2006; Lindsay, 2007; Markussen*, 2004; McLoughlin et al., 2017; Rea et al., 2002; Sansosti and Sansosti, 2012; Starr et al., 2001; Yang et al., 2003). As the range of research reporting positive impacts of inclusive education for children with and without special needs the numbers of families and professionals requesting such placement for the children is increasing (Barnard et al., 2000; Downing and Peckham-Hardin, 2007; Eldar et al., 2010; Ferraioli and Harris, 2011).

Several studies have examined the benefits of inclusive education on children with and without special needs reporting positive results in terms of academic achievement, social/psychological aspects, and pedagogical development.

Academic benefits

Research has indicated that included children make a range of academic gains including academic engagement, academic performance, improved scores on academic assessment measures, mastering academic goals in their individualised education plans, more completed assignments by students with special needs and are more motivated to learn and go to school (Downing and Peckham-Hardin, 2007; Lindsay, 2007; Salend and Duhaney, 1999). Research indicated that children with and without special needs benefited academically from being placed in inclusive classroom due to high considerations in pedagogical methods applied by teachers and school staff such extra teacher support, given educational strategies, teacher collaboration in planning and teaching, assistive technology and curriculum modifications (Downing and Peckham-Hardin, 2007; Lindsay, 2007; Rea et al., 2002). The study of (Downing and Peckham-Hardin, 2007) examined the impact of an inclusive placement on children with moderate to severe disabilities in preschool, elementary and middle school. It was reported by parents that their children showed exceptional progress academically as they started reading and counting. Teachers and paraeducators of students in the preschool and the elementary level reported that inclusive placement specifically improved students' academic performance in basic math (i.e., counting, identifying numbers), reading (i.e., identifying letters, the sound of the letter, sight words) and writing skills (i.e., writing full sentences). This

progress was noticed and measured through observations, following the individualised educational plan (IEP) goals and informal assessment. All teachers mentioned curriculum support when asked about the reason behind the improvement. All teachers across age levels mentioned providing individualised modifications to the curriculum and assistive technology. The teachers gave examples such as simplify content, rephrase questions, alternative ways to write in class and the use of pictures to communicate and explain. They also provided examples of assistive technology including adapted chairs, slant boards, computers with adapted hardware and voice output communication devices. Teachers discussed that the modifications allowed the students to access, learn and benefit from the general education curriculum.

The study of (Rea et al., 2002) compared 8th grade students with learning disabilities in two middle schools in the U.S, one is full inclusion, and the other school applies pullout\partial inclusion at parts of the day. The study found that the inclusive group scored higher on a range of academic measures and had better attendance records. Teachers mentioned that the feature behind the success was the teacher's teamwork. Teachers used to plan and teach all the sessions together cooperatively. Another study compared 777 students with special needs, where 285 were placed in special classes, and 492 attended in general education classes (Markussen*, 2004). The study reported that students attending special classes had lower levels of academic achievement compared to those in general education classes. The study did not report any contributing factors to these results. Similarly, the study of Waldron and Mcleskey (1998) compared 71 elementary students with learning disabilities in an inclusive program to 73 with learning disabilities who received resource room service. The study reported that students in the inclusive program showed higher gains in reading and math than their peers in the resource rooms (Waldron and McLeskey, 1998). Also, a number of students with learning disabilities showed significant progress in reading to a parallel rate to their grade level peers without special needs. Relatedly, (Banerji and Dailey, 1995) examined the impact of an inclusive program on the academic skills of 13 elementary students with learning disabilities and 17 of their peers without learning disabilities. The study results revealed after collecting academic performance measures that students with learning disabilities progress in math and reading were similar to their peers without disabilities.

Social and psychological benefits

Another positive finding of inclusive education is social and emotional gains including (social acceptance, social engagement, helping others, raising self-esteem and being happier) (Cambra

and Silvestre, 2003; Capper and Pickett, 1994; Cawley et al., 2002; Cuckle and Wilson, 2002; Downing and Peckham-Hardin, 2007; Fryxell and Kennedy, 1995; Hall and McGregor, 2000; Salisbury et al., 1995). Research suggests that including children with typically developing peers may lead to positive social experience and self-concept and children will be more likely selected than rejected by their peers and less isolated (Cambra and Silvestre, 2003; Fryxell and Kennedy, 1995; Salisbury et al., 1995; Wiener and Tardif, 2004). Inclusion is beneficial for students with and without special needs because they may learn positive behaviors from each other and experience rewarding positive feelings for supporting one another (Biklen et al., 1989; Capper and Pickett, 1994; Hendrickson et al., 1996; Salend and Garrick Duhaney, 1999; Staub et al., 1994). Studies have revealed that children with and without special needs showed more positive interaction with each other when included in an inclusive setting (Downing and Peckham-Hardin, 2007; Salend and Duhaney, 1999). A study examined the impact of inclusive education on preschool, elementary, and middle school students and interviewed parents and teachers regarding the impact it had on the children's social and psychological health. Parents reported that their children became more independent, happier and motivated to go to school (Downing and Peckham-Hardin, 2007). The majority of teachers reported that learning in inclusive classrooms also benefited students without disabilities. The benefits they mentioned were greater awareness and accepting differences, having compassion for others and empathy, and learning while helping others. A Canadian study of 117 children in grades 4-8 with learning disabilities that were educated in one of four different service settings: inclusive classrooms, resource room support, self-contained special classrooms, in-class services. The comparison between the four groups addressing social factors such as (friendship, loneliness, self-perception, and learning social skills) favored inclusive classrooms (Wiener and Tardif, 2004). The study of Cawley 2004 conducted a study where they included students with learning disabilities and severe emotional disturbances into science lessons that were co-taught by regular education teacher and a science teacher. Teachers reported no behavioral problems and positive social interaction between students with and without special needs (Cawley et al., 2002). Three children with disabilities were in an inclusive setting during their kindergarten and grade 1 school years (Hall and McGregor, 2000). It was reported that all three were involved in peer relationships as sharing toys and activities and playing with peers in the playground through the years. It was also reported that the level of involvement reduced when these students moved to upper elementary grades. Hall and McGregor speculate that by the end of elementary years, the boys were in an inclusive setting but not perceived as part of the classroom. Another study interviewed 14 young people with Down syndrome aged 12-18 years

attending a mainstream school (Cuckle and Wilson, 2002). The results of the interviews revealed that children had positive attitudes toward friendships though it was limited to school. It also revealed that students with special needs considered their peers as role models and had reciprocal friendships with peers with special needs. Cuckle and Wilson suggest that students have common interests and match of emotional maturity and communication level. A study observed eight students with severe disabilities in an inclusive elementary school. Collected data through class observations revealed that students without disabilities initiated the social interactions, including playing, talking, physical affection and assistance (Salisbury et al., 1995). It was also reported that the interactions were all-natural and some children with disabilities were more popular among their peers than others because these children may be judged differently compared to their peers without disabilities. Another study conducted by (Fryxell and Kennedy, 1995) on 9 students with severe disabilities educated in general education classrooms observed the impact of the inclusive setting on their social skills. Observations revealed that children with special needs had social contact with peers without disabilities and rich friendships. They also received more social support when compared to their peers who were in self-contained classrooms. Fryxell used a similar research project and compared the effect of inclusive placement on social relationships of intermediate school students with severe disabilities. The findings of this study revealed that students in general education classrooms had a great number of interactions and social contact with students without disabilities and had large friend network and lasting relationships with students without disabilities (Kennedy et al., 1997). Growing up with a disability may limit individuals from participating in everyday activities. When included, they will have access to a wide range of experiences which is highly important as it promotes healthy living and the development of foundation skills (Sugden et al., 1998; Utley, 1994). Being exposed to school programs, facilities, community and family events will ensure students with special needs are part of a diverse continuum and fulfil their needs.

Some studies examined the impact of inclusive programs on the social skills and relations of students without disabilities and reported that children without special needs experience positive outcomes as a result of inclusive education (Biklen et al., 1989; Capper and Pickett, 1994; Hendrickson et al., 1996; Staub et al., 1994). Inclusion and being placed in inclusive settings facilitates tolerating differences, showing greater awareness about their peer's needs (personal growth), becoming more companionate and empathised with others (attitudinal growth), and enhancing their ability to learn while helping others (Downing and Peckham-

Hardin, 2007). Students without disabilities, when educated in an inclusive class, are exposed to differences and interacting with people with differences. This experience teaches them patience and understanding of others that would not exist in a regular classroom (Downing and Peckham-Hardin, 2007). The study of Biklen interviewed students without disabilities aged 9-11 years regarding their experience in inclusive settings. Their answers included that the program helped them understand others, understand differences in behaviors and appearance, understand their connection with students with disabilities and their feelings, and the value of their peers (Biklen et al., 1989). Staub used interviews, observations and video recordings to study the relationship between elementary students with and without disabilities. Students without disabilities reported that they felt important in class after offering assistance to their peers, finding different companionship and that made them feel comfortable and secure (Staub et al., 1994). The study of Capper examined two groups of students, one attended a traditionally structured school, and the other group attended an inclusive school and compared the effect on their social relations and psychological health. The group who attended the inclusive school reported an increase in their acceptance and understanding of others, tolerance of individual differences compared to the other group who were engaged in stereotyping thoughts and negative perceptions of students with disabilities (Capper and Pickett, 1994). The study of Hendrickson surveyed middle and high school students concerning their friendships with students with disabilities. The results revealed that they were happy being friends with students with special needs and that the setting facilitated the development of their friendships. They also had several strategies to build friendships with students with special needs as cooperative grouping arrangements, sharing information about disabilities and introducing social activities to promote student interaction. Studies acknowledged that social benefits occurred when extra teacher support is available in the classroom (Salend and Duhaney, 1999; Westwood and Graham, 2003). Additional support gives teachers the chance to teach all children with and without disabilities efficiently and creates a positive classroom environment for students to learn and interact. Also, the positive characteristics of some children with special needs (friendly, happy, hardworking, resilient) can affect the class as a whole in a positive manner (Westwood and Graham, 2003).

Pedagogical development

Another benefit of inclusive education is pedagogical development. Studies also have examined the impact of inclusive education on pedagogical development (curriculum and teaching strategies) (Minke et al., 1996; Phillips et al., 1995; Salend and Garrick Duhaney,

1999; Walther-Thomas, 1997). A study surveyed 318 teachers of students with mild disabilities (185 general education teachers, 64 special education teachers in inclusive settings, 69 general education teachers in inclusive settings). The results revealed that general and special education teachers who collaborated and worked with collaborative teaching in inclusive classrooms had higher rates of satisfaction and curriculum efficacy in teaching students with special needs than the teachers who taught in general education classrooms (Minke et al., 1996). The study of Philips 1995 interviewed general and special education teachers regarding teaching students with mild and severe disabilities. All teachers reported that involving collaborative teaming by engaging in shared planning and teaching, solving problems together, and learning from each other made them enjoy teaching and develop the curriculum to fit student's needs and individual interests (Phillips et al., 1995). However, two teachers were not successful at inclusive teaching because of their inability to communicate and resolve personal differences that negatively impacted their teaching and curriculum development. Teachers who were successful indicated that collaborative teaching allowed them to teach a wide range of disabilities and observed a positive change in students with and without disabilities. The study of Walther 1997 used interviews, classroom observations, and relevant school documents to study the experience of 18 elementary and 7 middle school co-teaching teams in developing the curriculum and their teaching strategies when teaching in an inclusive setting. General and special education teachers in all teams reported academic and social benefits for students with and without special needs because teachers shared their expertise, helped each other to expand their capabilities in teaching and planning, and built a suitable curriculum basis (Walther-Thomas, 1997). Another study that was conducted in Norway examined teacher's practice in an inclusive classroom who was working with 23 7th grade students, 3 of whom with special needs (Flem* et al., 2004). The teacher reported that having students with special needs gave her the chance to use teaching strategies that she never used before (e.g., scaffolding, modeling, time management, giving feedback, collaborating with teachers). Using such strategies were very beneficial for students with special needs socially and academically.

Another study investigated the impact of pedagogical development on students with special needs and found that the development of curriculum was useful and effective as a change in students behavior was observed (Hunt et al., 2003). Teachers reported that developing individualised educational plans (IEP) and teaming with teachers have increased the level of engagement interaction with teachers and students and improved student's performance. One of the pedagogical strategies that were emphasised on by research and developed by teachers

as a result of inclusive education is guided internality (Knight, 1993; Knight, 1999). This strategy was developed by teachers who taught students with special needs and defined as working with the student within his/her level and developmental ability, setting realistic goals with the students, encourage student's active role in making decisions, sufficient practice trials and choosing teaching strategies. Teachers reported that developing such a strategy promoted realistic instructional planning that encouraged students to become active learners and responsible for their learning. It also guided them as teachers to guide their students to manage their learning by learning appropriate strategies for dependent learning and teachers phased out the guiding cues but still intervening when needed. Teachers concluded that receiving curriculum support (modification) is an advantage for students with special needs as they will have access to the general education curriculum and learn the same concepts as their peers but presented in a differentiated manner (Knight, 1993; Knight, 1999).

In summary, inclusive education placements are believed to provide many benefits for students with and without special needs. In specific to students with autism spectrum disorder (ASD), inclusive placements are offered as part of their continuum of services and believed to offer substantial benefits on many domains (academic, social and emotional, psychological, language and communication). The benefits of inclusive education for children with ASD is discussed in the section below.

Benefits of inclusive education for children with autism spectrum disorder (ASD)

The literature available divides outcomes into social, behavioral, cognitive and academic domains. Some existing research reported mixed findings, but the majority suggest positive outcomes for including children with ASD. The next section will discuss the social, cognitive, language and behavioural benefits of inclusive education for children with ASD.

Social benefits

It has been noted that full inclusion is a very effective teaching strategy for children with ASD (Barnard et al., 2000; Downing and Peckham-Hardin, 2007; Eldar et al., 2010; Ferraioli and Harris, 2011; Harrower and Dunlap, 2001a; Mesibov and Shea, 1996; Phillips et al., 1995; Sansosti and Sansosti, 2012; Sorensen and Zarrett, 2014). Inclusion is beneficial for children with ASD as it positively impacts their development supporting the progression of appropriate social and emotional, behavioural and language and communication skills (Barnard et al., 2000; Downing and Peckham-Hardin, 2007; Eldar et al., 2010; Ferraioli and Harris, 2011;

Harrower and Dunlap, 2001a; Mesibov and Shea, 1996; Phillips et al., 1995; Sansosti and Sansosti, 2012; Sorensen and Zarrett, 2014). Inclusive settings usually provide children with ASD with a balanced educational program including communication and social skills in addition to academics (Downing and Peckham-Hardin, 2007). Inclusion provides children with ASD with a chance to learn how to initiate social interaction, express and understand emotions and play with others. Many families and professionals viewed inclusion for children with high functioning autism as an effective treatment as it provides opportunities for acquiring new social and language skills (Council, 2001; Starr et al., 2001). Research by (Eldar et al., 2010; Harrower and Dunlap, 2001a) compared students with ASD in an included setting to their peers with ASD in a segregated setting reporting that students who were fully included developed, improved and mastered advanced social interaction and engagement skills. It was concluded that being supported by social groups and friends was beneficial compared to the segregated group. In addition, studies revealed that children with ASD who are fully included display high levels of social interaction and engagement, receive and give social support, have a wide social network and have an opportunity to become members of the community as children and later on as adults (Farlow, 1996; Fryxell and Kennedy, 1995; Harrower and Dunlap, 2001b; Hauck et al., 1995; Lord and Hopkins, 1986; Zanolli et al., 1996). The efficacy of group-based physical activity on children with ASD was examined by (Howells et al., 2019) by conducting a meta-analysis. It has been defined as two or more people playing an organized physical activity (OPA) (Dunton et al., 2012; Edwardson and Gorely, 2010; Okely, 1999). Results of the meta-analysis indicated that group-based organised physical activity increases social skills development compared to individual-based exercise. Most of the studies that were analysed reported significant improvement in social functioning and communication skills after participation in group-based organised physical activity. It was discussed that the reason behind the improvement is playing with a group that provides increased opportunity to interact and communicate with peers. It was also mentioned that movement could promote and develop social understanding and social skills as moving with a group positively influence social interaction (Howells et al., 2019).

The studies of (Chamberlain et al., 2007; Sansosti and Sansosti, 2012) suggested that the included students with ASD not only improved their social skills but also had a good number of friends, had more social contact, were chosen by their classmates to participate in different activities as students without disabilities and were provided with social support than their peers who were in self-contained classrooms. It was noted that the pedagogies adopted including

peer training, social support and teaching procedures like pivotal response training and modeling were the factors behind this improvement (Chamberlain et al., 2007; Sansosti and Sansosti, 2012). Another study examined the social interactions of preschoolers with ASD when their typical peers were either present or absent (Myles et al., 1993). Class observations indicated that students with ASD interacted less with their teachers when their classmates were present. Teachers gave less praise, fewer instructions and comments and reported that children with ASD displayed positive social behaviors when around typically developing children more than the ones with autism. The studies of (Hoyson et al., 1984; Strain, 1984; Strain, 1983; Strain et al., 1985) focused on preschoolers and elementary students with ASD and the impact of inclusion on their social behaviors. It was reported that the groups in the inclusive setting had their social behaviors stimulated and learned social interaction skills (e.g. sharing toys, talking) by interacting with typical peers. Some studies focused on including children with ASD and implementing interventions to teach social and emotional curricula (Gena, 2006; Kamps et al., 1992; Pierce and Schreibman, 1995; Yang et al., 2003). These studies reported an increase in the frequency of social interaction and responses, social engagement, verbal and non-verbal sharing and enhanced skills in emotional acquisition and expression. In a study about elementary school students with ASD (Kamps et al., 2002), it was reported that students with ASD spent more time with trained peers than untrained peers who were familiar with ASD than the ones who were unfamiliar with this population. Research suggest that training typical peers on modeling social and language behaviours when included with students with ASD can be very effective for their peers with ASD (Garfinkle and Schwartz, 2002; Goldstein et al., 1992; Odom et al., 1985; Odom and Strain, 1986; Pierce and Schreibman, 1997). Another study supported minimal training to positively impact the development of social skills in children with ASD (Pierce and Schreibman, 1995). The study reported that children with ASD demonstrated an increase in social interaction length, play and initiating conversations, language development and joint attention.

Cognitive, language and behavioral benefits

Studies also revealed that included children with ASD improved their cognitive and language skills, academic performance as well as their behaviors. The study of (Harris et al., 1991) observed preschool-aged children with autism and examined the positive outcomes of inclusive education. The study concluded that children with ASD benefited academically and cognitively when included in an inclusive setting as they gained language skills and increased their IQ after one year of inclusion. Other studies reported that children with ASD improved their social and

communication skills and had a significant increase in their IQ as they had higher educational goals when taught in an inclusive manner (Fisher and Meyer, 2002; Stahmer and Ingersoll, 2004a). Another study that was conducted at children's toddler school, an inclusive preschool for children with autism reported an increase in children's IQ, communication and social skills as well as play skills (Stahmer and Ingersoll, 2004b). It was also reported that the children showed a significant decrease in autism symptoms. In another study, parents and teachers of children in an inclusive setting mentioned that the included children with ASD and severe disabilities showed significant improvement academically and socially when included in inclusive classrooms (Downing and Peckham-Hardin, 2007). It was reported by parents that their children showed exceptional progress academically as they started reading and counting. Teachers and paraeducators of students in the preschool and the elementary level reported that inclusive placement specifically improved students' academic performance in basic math (i.e. counting, identifying numbers), reading (i.e. identifying letters, the sound of the letter, sight words), and writing skills (i.e. writing full sentences). This progress was noticed and measured through observations, following the individualized educational plan (IEP) goals and informal assessment. Teachers and parents also noted that a few weeks later, the children seemed happy, loving their friends, the school and were more independent. It was also reported by parents that their children took their peers as role models, learned from them more than learning from their parents and were looking up to them. Teachers of elementary students reported a behavioral change in addition to the academic gains (i.e. independence, self-help, dealing appropriately with change and moving from one activity to another). The study of (Harris et al., 1991) compared between included and segregated groups of children with ASD and the effect of the setting on their language development. Students with ASD and the typically developed in the inclusive group showed a significant increase in their language development level and rate by the end of the inclusive program. A research study suggested that natural environment training in general education classrooms and procedures as pivotal response training can lead to an increase in language skills in children with autism (Smith and Camarata, 1999). The study of (Eldar et al., 2010) interviewed 37 inclusive education coordinators who spent a year including children with autism in general education classrooms in schools. The coordinators reported positive behavioral change including increased ability to self-help, independence, coping with new routines and change and a decrease in stereotypical behaviors. It was also reported that children with autism showed improvement in their cognitive abilities. Children improved their learning and academic skills in all subjects, and some cases were able to reach the class average. These cases showed higher concentration levels and were like their typical peers in

class participation and in meeting academic requirements.

Society/community benefits

Being included in schools and being accepted and valued could extend to being accepted in a larger setting as the community (Downing and Peckham-Hardin, 2007; Eldar et al., 2010). Inclusive education gives children with ASD an opportunity to improve their skills and become members of their community in their childhood and later as adults (Downing and Peckham-Hardin, 2007; Eldar et al., 2010). Parents of children with ASD that were fully included reported that including their children provided them with an opportunity to participate in all aspects of everyday life and being exposed to different emotional, social, physical and academic experiences (Downing and Peckham-Hardin, 2007). Parents also reported that being included was the basic foundation for creating positive environments even outside the school and feeling accepted on a wider level as their children learned and will continue learning the skills needed to deal with the outside world starting with the school (Downing and Peckham-Hardin, 2007). The parents of children with autism and severe disabilities noted that after including their children in school, they included them in family events, after-school programs and community and recreational events. These parents compared the inclusive experience to the segregated one and described it as “superior”. Their children were more disabled, not being challenged to learn, lacked role models and had limited experiences in their previous segregated environment.

Similarly, some of the studies included in the meta-analysis mentioned above (Howells et al., 2019) also suggested that group-based organised physical activity programs improve social skills and that may push for more community-based programs to benefit children with ASD and their families that can positively lead to adult community engagement later in life (Pellicano et al., 2014; Rinehart et al., 2018). It was noted that this is considered an advancement in this field since the demand for more active lifestyle-enhancing treatments is increasing (Pellicano et al., 2014; Rinehart et al., 2018). Along with educating children with autism in inclusive settings was the concept of acceptance where teachers viewed students with autism as capable learners who belonged at the school and as a result were accepted by their peers (Downing and Peckham-Hardin, 2007). In summary, inclusive education has a positive impact on children with ASD and research shows that being fully included in general education classrooms develops children’s social, cognitive, language and communication, academic and behavioral skills that can, as a result, provide an opportunity for these children to become

effective members of their society as children and later on as adults.

Benefits of inclusive physical education for children with autism spectrum disorder (ASD)

Inclusive physical education is defined as all children with disabilities, including those with ASD are placed, accepted and educated in a supportive sport environment (Kelly, 1994). It was also defined as every child with a disability is engaged in a physical exercise designed to meet his/her individual needs (Block, 2007). Also, (Sherrill, 1998) defined it as a modified physical education curriculum to fully include children with disabilities in physical education sessions. Studies focusing on including children with disabilities in physical exercise are arising and some studies focusing on including children with ASD in exercise have indicated the benefits of inclusive education (Porretta and Sherrill, 2005; Schleien et al., 1987; Schleien et al., 1988; Ward and Lee, 2005; Webster, 2016). This section will discuss the social, motor and psychological benefits of inclusive education in exercise on children with ASD.

Social and motor gains

Including children with ASD in sport and exercise helps them build social skills, make friends, get along with teammates, learn group playing skills and improve in terms of psychological skills (Webster, 2016). A study conducted a 3 weeks summer sports program, including swimming, gymnastics and free games for children with autism and a group of non-autistic children (Schleien et al., 1987). Observations revealed that children with ASD displayed appropriate play behaviors and orientation to objects and peers (e.g. attending to another participant, engaging in activities involving objects) and it increased with time in all sport settings. The study also reported a decrease in inappropriate play behaviors (e.g. aggressive behaviour, engaging in non-goal directed activity). The study concluded that the positive change in children's behaviour is due to the cooperative group structure, the use of effective teaching strategies such as training peers to deal with special friends and to be included in physical exercise which is a face to face learning experience that facilitates cooperative learning and social integration. Another study conducted by Schleien, Heyne, and Berken (1988) supported previous findings by reporting that included children with ASD in sports sessions decreased inappropriate play behaviors and developed their motor proficiency in catching and striking skills (Schleien et al., 1988). Similarly, a study included children with autism aged 4-10 years in a summer camp with typically developed peers (Brookman et al., 2003). Children were involved in all the sports events and activities in the camp and were

supported by trained staff. The study concluded that all children had a successful experience because of the staffing, resources and strategies used were they improved their interpersonal and relationship skills. The study concluded that the camp provided the children with a sense of normalcy and they participated in sports in a fun way. One study supported including children with ASD in physical education and included them in different levels of play activities for 30 minutes of school sessions. Children with ASD developed appropriate play behaviors during higher-level physical activities (Schleien et al., 1990). Likewise, in the study of (Moon, 1994) a child with autism participated in a football league for elementary school children. A practice group was formed to assist in improving his skills and met weekly for additional practice sessions. Appropriate play behaviors of the child significantly improved during the duration of the practice and the league.

Additionally, a study examined the impact of additional inclusive recreational physical activities for children with autism. It served disabilities with special help (one on one instructions with trained coaches) (Fennick and Royle, 2003). The program included swimming and gymnastics classes. It was reported that all children enjoyed the sessions, participated in an appropriate level, improved their overall functioning and displayed positive interactions with the coaches and other children. The study of (Ward and Lee, 2005) examined the effects of peer tutoring during including children with autism in physical education. Peer tutoring was defined as involving the whole class in reciprocal roles of tutor and tutee. The study reported that including children with autism in exercise with non-autistic children was beneficial, especially when using peer tutoring as an inclusive strategy. Children with autism and the typically developed peers developed their throwing and catching skills. The study concluded that peer tutoring is an effective teaching strategy in inclusive physical education settings where it can facilitate the development of motor functioning and increase the social interaction in children with autism (Ward and Lee, 2005). Other studies investigated the impact of peer tutoring in physical education with typically developed children and reported an improvement in children's motor skills performance and a significant increase in scores of motor skills tests (Ernst and Byra, 1998; Goldberger and Gerney, 1986). It has been also proven to be effective with children with special needs as it helped to increase the moderate to vigorous exercise of students who are deaf (Lieberman et al., 2000), to increase correct performance of motor skills in developmentally disabled students (Houston-Wilson et al., 1997), and to increase the subject learning time of students with moderate to severe developmental disabilities (DePaepe, 1985; Webster, 1987).

Psychological gains

Including children with ASD in sport and exercise builds up their confidence and gives them a purpose to look forward to (Webster, 2016). A group of children and teenagers with ASD participated in sports and were included with typically developed children and teenagers of the same age. Participants were interviewed and asked about the impact of inclusion on their overall functioning (Webster, 2016). All participants reported that participating in sport and exercise and being included with typically developed individuals benefited them positively. A teenager with autism who participated in sport shared his experience by saying that playing rugby -a team game- gave him confidence and has changed his life. Another teenager noted that being active with a team made him feel part of a small community and it taught him that he could be successful. Other children reported that exercise made it easier to deal with sensory overload, to keep trying and to never give up and handle tantrums and meltdowns. In addition, it helped release their stress by being part of a group and the skills they learned during exercise extended to other situations (Webster, 2016). Some children reported that it taught them how to be successful, it improved their coordination, and they learned to keep trying until they succeed. Research suggests that including children with autism in physical education classes may develop better personalities when paired with non-autistic children as it allows direct interaction where the child with autism may begin to copy and learn pleasant behaviors and skills from the other student (Crollick et al., 2006). Despite these positive findings, inclusion is still a debatable topic in the literature and especially in adapted physical activities for autism. The debate should not be about inclusion versus segregation, but rather about providing the most effective support and pedagogy for this population in an inclusive setting. However, individuals with ASD need a wide range of effective support, strategies and inclusive programs that fits their wide range of developmental behaviors since effective supports is not “a one size fit all” response.

Engaging individuals with ASD in exercise

Engaging individuals with ASD in exercise is challenging, considering their symptoms. Therefore, it is highly important to follow a planned structure of the setting as well as use effective and engaging teaching procedures to have engaging, beneficial and successful exercise-based programs. The following section will discuss a range of elements and practical teaching strategies specific to children with ASD that can be applied to physical exercise /sports sessions to make it accessible, beneficial and successful.

Elements applied to exercise settings and recommended teaching procedures

The following are specific recommended elements for exercise sessions involving children with autism spectrum disorders (ASD) such as the structure of the environment/physical setting and structured teaching procedures. Also, some exercise considerations are discussed such as managing challenging behaviours, following a routine and selecting age-appropriate sports/tasks.

Structure

The Treatment and Education of Autistic and Related Communications-Handicapped Children (TEACCH) recreational structure program is a well-known international program that focuses on modifying the structure of the environment to accommodate the symptoms of children with autism (Schopler et al., 1995; Schultheis et al., 2000). The program emphasises the need for structure when planning educational programs for children with ASD to facilitate their understanding and reduce behavioral problems. The program recommends a structured environment consisting of structured teaching procedures, structured physical setting and structured materials (Schopler et al., 1995; Schultheis et al., 2000). Research suggests that following a structure and a framework (e.g. time tables, picture symbols, clear boundaries outlining activity areas) facilitates children's participation, enables them to understand the environment and predict the events to come (Webster, 2016; Zhang and Griffin, 2007).

Physical structure

TEACCH emphasises the use of physical boundaries (i.e. room dividers/partitions, coloured tapes, flags). Visual clear boundaries that mark the space available for specific activities increase the independence of students with autism; with time they will know where to start, where to finish and how to move from one activity to another without directions but by them utilising the visual boundaries provided (Schopler et al., 1995; Schultheis et al., 2000; Webster, 2016; Zhang and Griffin, 2007). In the studies of (Schopler et al., 1995; Schultheis et al., 2000) who engaged children with autism in exercise and used physical boundaries as recommended by TEACCH noted that students with autism were able to identify tasks, continued exercising in the designated space for each activity/exercise and finished assigned tasks with fewer instructions when physical boundaries were used. They also noted that their students became familiar with the environment and the exercise routine as well as remembered the activities associated with the clear boundaries and that made them successfully follow their assigned schedules with fewer teacher instructions. Moreover, it was noted that physical boundaries

foster emotional security (Schopler et al., 1995; Schultheis et al., 2000). Some students with autism may feel overwhelmed when putting in new situations/environment especially if large and unstructured (Schopler et al., 1995; Schultheis et al., 2000). It was reported in the study of (Schultheis et al., 2000) that physical boundaries made students feel less overwhelmed, more comfortable as well as reduced off-task behaviours as it kept them focused. It was also suggested that physical boundaries decrease external distractions since they clearly designate work areas (Schultheis et al., 2000). The study reported that room dividers blocked students' view from external distractions; as a result, students gave their maximum time, attention and effort to finish the tasks. Another study suggested that the environment should be consistent from session to session as well as the equipment used (Prupas et al., 2006). The research reported that organising the environment and having the same setting and materials every session reduces potential anxiety in children with autism (Houston-Wilson and Lieberman, 2003; O Connor et al., 2000; Prupas et al., 2006; Reid and Collier, 2002). In regard to equipment, it is suggested that using equipment in a structured manner is an effective way to increase student's participation in exercise (Prupas et al., 2006). Since children with autism have sensory interests; some might be interested in balls or wheels and some might like objects that feel soft or rough. The physical education teacher should choose equipment based on their sensory preference (Prupas et al., 2006). For example, if a child likes balls, the teacher should provide activities using different kinds of balls. Adapting to the student's preference and need will help develop the student's skills and build interest in playing other activities and sports (Prupas et al., 2006).

Teaching procedures

Using appropriate systematically planned teaching instructions when teaching children with mild, moderate and severe autism physical exercise skills is highly recommended (Coucovanis, 1997; Schopler et al., 1995; Schultheis et al., 2000; Sherrill, 1998; Wolery et al., 1992; Zhang, 2006; Zhang and Griffin, 2007). Several teaching strategies were successfully used by physical education professionals who included students with ASD in their physical education classes and proven to be effective such as (direct instructions, reinforcement, planning a routine, prompting, modelling, using visual materials) (Blubaugh and Kohlmann, 2006; Coucovanis, 1997; Houston-Wilson et al., 1997; Morrison et al., 2002; Prupas et al., 2006; Rao and Gagie, 2006; Reid and Collier, 2002; Schopler et al., 1995; Schultheis et al., 2000; Simpson and Myles, 1990; Zhang, 2006; Zhang and Griffin, 2007). The main goal behind these strategies is to ensure student's engagement and success in learning various social, motor,

language and cognitive skills (Wolery et al., 1992; Zhang, 2006; Zhang and Griffin, 2007).

- Using visual schedules

Schedules are a kind of visual supports that are commonly used with children with ASD as it provides each student with a predictable set of events in a specific order and clear expectations of the activity session (Fittipaldi-Wert and Mowling, 2009; Morrison et al., 2002; Simpson and Myles, 1990). Using schedules is one of the elements recommended and developed by TEACCH to be applied to the exercise setting to accommodate the symptoms of individuals with ASD during class periods (Schopler et al., 1995; Schultheis et al., 2000). Using pictures, drawings, written information/steps on activity board schedules are all examples of useful visual schedules for children with ASD (Blubaugh and Kohlmann, 2006; Rao and Gagie, 2006). It can be created by using a board of any color or be posted on boards or posters with pictures, drawings, short words and activity cards in a sequential order that depict class activities with the student's name and or photo on top (Fittipaldi-Wert and Mowling, 2009; Houston-Wilson et al., 1997). Developing schedules is effective for several reasons. Schedules create order, organisation, consistency and predictability which what individuals with autism need and want (Simpson and Myles, 1990). Schedules targets students who have a difficulty understanding the idea of "what", "when" and "where" (Coucouvanis, 1997; Sherrill, 1998). The studies of (Coucouvanis, 1997; Sherrill, 1998) used schedules with students with autism during exercise and reported that it stimulated student's cognition thinking "what", "where", "when" to do it and found that it reduced disruptive behaviours and increased on-task time which contributed to the success of their programs. The study of (Fittipaldi-Wert and Mowling, 2009) examined the use of visual support during exercise and reported that it allows the students with autism to know and picture the activity before performing it. The study also concluded that sticking a star or drawing a check next to each activity after finishing gives the student a sense of accomplishment. The study of (Schultheis et al., 2000) that examined the impact of using schedules and other elements when teaching children with autism physical exercise indicated that using schedules during physical education programs with visual cues (i.e. colors, activity cards, symbols, pictures) and students names and photos were very successful and beneficial. The studies of (Schopler et al., 1995; Schultheis et al., 2000) used exercise charts which is a strategy used during exercising to keep a record of the activities required during a period of time. The studies reported that this strategy helped participants understand what they are expected to do, recorded their participation, kept track of their progress throughout the session, kept them organised and self-motivated and reinforced

independence. It is also an accommodation for individuals with receptive and expressive language problems (Schultheis et al., 2000). Children with autism can be verbal but may have a limited vocabulary or be nonverbal. However, schedules can compensate for language problems as schedules increase independence and self-motivation (Schultheis et al., 2000).

- Reinforcement

Reinforcement is adding a reinforcer following behavior to increase the likelihood of the behavior to occur again in the future (Firman, Beare, and Loyd, 2002; Hughes et al., 2002). The usage of external reinforcement is one of the most important teaching procedures when teaching children with disabilities and children with ASD in specific as it motivates them to complete a task and increases the occurrence of pleasant behaviours (Firman et al., 2002; Hughes et al., 2002; Srinivasan et al., 2014; Utley and Astill, 2001). Different types of positive reinforcement can be given during exercise to engage children with ASD during their participation and motivate them to finish the exercise. Reinforcements such as verbal cueing, tangible, edible reinforcement, verbal and gestural reinforcement and reinforcement boards are often used with individuals with ASD. For example, the trainer/physical education teacher can shout out “good job”, “super-performance” after the child finishes a jogging lap. Another example could be the child receiving a sticker for shooting hoop and scoring a point. Gestural reinforcement can also be used as clapping, tap on the shoulder and high fives after mastering or finishing a task. Different forms of reinforcement were used with children with autism and proven to be successful (Firman, Beare, and Loyd, 2002; Hughes et al., 2002; Srinivasan, Pescatello, and Bhat, 2014). A study conducted by (LeBlanc et al., 2003) examined the impact of reinforcement and video modelling as teaching strategies on 3 children with autism. The study revealed that both strategies were effective as 2 out 3 children were able to master the tasks required after the intervention. The study concluded that video modelling is best paired with reinforcement as both together gave significant results. Another study examined the impact of different teaching strategies as reinforcement, video modelling and prompting on modifying behaviors of three preschool children with autism (Gena, 2006). Reinforcement as tokens and verbal praise was provided upon effective responding. The results revealed that children began affective responding after reinforcement and prompting procedures were implemented.

- Direct instructions

Social and language communication should be as clear as possible when dealing with

individuals with ASD (Webster, 2016). As known, some individuals with autism find it difficult to understand facial expressions, tone of voice and keep eye contact. Therefore, coaches and trainers need to use clear, direct instructions. Using language that is clear, direct, precise and concrete is highly recommended for the children to be able to process the information and follow the instructions combined with modeling and physical guidance (Lang et al., 2010, p. 574; Srinivasan et al., 2014; Utley and Astill, 2001). It is suggested to rely more on direct explanations and avoid body language, and facial expressions as some individuals may not be able to interpret them (Bickers, 1993; Cannella-Malone et al., 2011; Todd and Reid, 2006; Webster, 2016). The literature suggests using verbal directives, verbal cueing and verbal encouragements as forms of direct verbal instructions when instructing individuals with ASD (Bickers, 1993; Cannella-Malone et al., 2011; Todd and Reid, 2006; Webster, 2016). Verbal directives are clear, direct verbal statements that direct individuals to do an activity or a skill (Cannella-Malone et al., 2011). Verbal cueing is a form of external reinforcement by directing and encouraging verbally (Todd and Reid, 2006). Verbal cueing/encouragements as statements are usually utilised during different assessment procedures or during exercise sessions to support patients to reach their maximum potential and keep them attentive (Bickers, 1993). Phrases such as “good job”, “keep going”, “you are a champion”, “super” can be used during the activities, if participants stopped moving or were slowing down as well as to congratulate them for completing the session. These forms of verbal instructions can be provided by physical activity teachers, trainers and coaches who accompany the students during the exercise sessions (Bickers, 1993; Cannella-Malone et al., 2011; Todd and Reid, 2006; Webster, 2016). Offering regular, positive verbal instructions and encouragement promotes engagement, boosts student’s performance and encourages pleasant behaviors that can result in developing their overall functioning (Lang et al., 2010, p. 574; Srinivasan et al., 2014; Utley and Astill, 2001).

- Modelling and physical guidance

Modelling is a form of observational learning which is defined as observing the behaviour of a model (Bandura, 1969). Observational learning through modelling is one of the oldest methods of changing behavior, reducing the occurrence of unwanted behaviors and facilitating learning everyday behaviors (Bandura, 1969; Brody et al., 1978). The research of Albert Bandura suggests that a behavior can be strengthened, weakened or maintained by the modelling of behaviour by others. Research also suggests that it is an effective teaching strategy used with children with autism since they learn more by observation when compared

to typically developed age-matched children (Shipley-Benamou et al., 2002). Modelling facilitates natural behavior acquisition and acquiring new skills (Bandura, 1969; Brody et al., 1978). Modelling can take place by demonstrating each activity/skill first by the trainer or the physical education teacher and then ask participants to perform the same skill. In addition, modelling activities should be ongoing and repeated when needed, and it should not be a ‘one-off’ incident (Allison et al., 1991; Bandura, 1969; Celiberti et al., 1997; Shipley-Benamou et al., 2002). Moreover, modelling can be paired with verbal, tangible and gestural reinforcement to increase the likelihood of the behavior to be repeated (Shipley-Benamou et al., 2002). In regard to physical guidance, it is a teaching strategy commonly used with modeling which is defined as guiding the movement of the learner to support him or her while practising the skill to perform independently eventually (Allison et al., 1991; Celiberti et al., 1997). It is considered an effective teaching strategy as it keeps participants with ASD exercising at a target pace for the planned amount of time and it is gradually faded (Allison et al., 1991; Celiberti et al., 1997). The trainer or the physical education teacher can use their physical touch (e.g. hand over hand, lifting hand up to the desired level while jogging) to guide the participant through the desired movement until the participant learn to do it without guidance (Allison et al., 1991; Celiberti et al., 1997).

- Individualise instructions

To teach children with autism in a physical exercise environment or any other environment, it is important to individualise instruction to meet each student’s need as physical education is very diverse in terms of abilities, movements and skills (Zhang, 2006; Zhang and Griffin, 2007). As shown by research, children with ASD may be delayed in their motor development and coordination and display motor clumsiness and weak muscles (Reid and Collier, 2002; Zhang and Griffin, 2007). For this reason, offering individualised instructions for these children can facilitate their participation, increase their engagement and develop their motor abilities (Schwartz et al., 1998). Planning individualised instructions can start by choosing physical exercise skills based on student’s abilities (Schwartz et al., 1998). For example, the physical education teacher can set several mixed games like shooting, hopping, kicking, racing and allow the student to perform the activities at his/her level (Schwartz et al., 1998). The child may not be able to hop on two legs at first, so the teacher can let him/her hop using one leg and with practice and time s/he will be able to hop using two legs. It can also include offering different equipment as objects of different sizes, weights and textures. The more varieties and individualised instruction the teacher can offer, the more engaged the student is likely to be,

and the more successful his/her participation in physical education can be (Reid and Collier, 2002; Schwartz et al., 1998; Zhang and Griffin, 2007).

- Task modification

Some children with ASD have a limited range of interests and may lack the motivation to participate in activities that are not within their interest range paired with task constraints (e.g. kind of activity) and or individual constraints (e.g. physical ability) (Pope et al., 2012). Therefore, modifying the activities and the environment to suit the child's needs is important as it may motivate the child to participate and engage more (Pope et al., 2012; Todd and Reid, 2006). For example, a child with autism may feel discouraged to run or jog several laps around the track during the physical education session and may display aggressive behaviors when confronted with the task (Pope et al., 2012). The trainer can modify the presentation of the task by instructing the child to run like a train and whistle really loud when completing a lap. When the child observes his speed and performance and engages all his senses, that would change his perception and may start to like jogging around the track (Pope et al., 2012). The physical education teacher can modify the activities and relate them to the student's interest when experiencing low motivational levels (Pope et al., 2012). For example, the child can be instructed to run around plastic cones being told "these are aliens and you are the superhero who will save the city" if the child is interested in superheroes. Another example of task modification can be if the child is experiencing difficulty learning basketball skills as dribbling. The physical education teacher can modify the task constraint by practicing with a small ball that will allow the child's body to be more relaxed (relaxed grip and knees) and handle the ball better while dribbling, then move on by using the basketball whenever the child is physically ready.

Some children with ASD may experience individual constraints as low muscle tone, overweight, sensory sensitivity and low motivation (Pope et al., 2012; Srinivasan et al., 2014; Webster, 2016; Zhang and Griffin, 2007). The physical education teacher can apply some modifications to engage these children and improve their performance (Pope et al., 2012; Srinivasan et al., 2014; Webster, 2016; Zhang and Griffin, 2007). For instance, if the child has low muscle tone and reduced muscle strength and the tasks include weight lifting, then it can be modified by using lighter weights (e.g. dumbbells, foam balls) and then systematically increase the weight as the child increases strength (Akshoomoff et al., 2007; Barrow et al., 2011; Calhoun et al., 2011). Some children may be overweight and find it difficult to participate

in a high-intensity workout (Pope et al., 2012). It is advised to modify the workout to low impact activities as marching in place instead of jumping jacks or sprinting and with time-intensity can be increased (Akshoomoff et al., 2007; Barrow et al., 2011; Calhoun et al., 2011). Some children with autism may experience light and sound sensitivity (Hughes, 1996; Jansiewicz et al., 2006; Ming et al., 2007; Pope et al., 2012; Stephenson and Carter, 2009). The physical education teacher can allow the child to wear a cap, sunglasses, ear muffers to decrease light and auditory sensitivity. After all, by modifying the exercise tasks and the equipment used, it is possible to fulfil the child's needs and be successful at exercise/sport (Hughes, 1996; Jansiewicz et al., 2006; Ming et al., 2007; Pope et al., 2012; Stephenson and Carter, 2009).

Managing challenging behaviors

Children with autism display challenging behaviors such as spinning, flapping, acting as if deaf, attached to certain materials inappropriately and engage in odd play and these behaviors often interfere with their learning (Auxter et al., 1997; Reid and Collier, 2002; Schwartz et al., 1998; Zhang, 2006; Zhang and Griffin, 2007). These behaviors are exhibited by children with ASD as a way of communicating what they are unable to say (Zhang and Griffin, 2007). Some techniques have proven to be effective in eliminating these behaviors in children with ASD, such as positive reinforcement and behavior management (Collier and Reid, 2003). Another approach to reducing these behaviors especially during exercise is by connecting the child's interest/challenging behavior to the tasks to gain similar physical stimulation via the exercise movement to that obtained via the stereotypic behaviors (Lang et al., 2010; Zhang and Griffin, 2007). For example, if the child likes spinning, then the activity can transfer into jogging/running around a certain area for a period of time to produce a similar pleasant internal state to that produced of stereotypy. Students who like jumping can be provided with an activity that matches their behaviour like jumping rope, hopping and jumping jacks. Also, engaging them in vigorous exercise is another way to manage their behaviors and channel their energy into other activities (Celiberti et al., 1997; Elliott Jr et al., 1994; Nicholson et al., 2011; O Connor et al., 2000; Powers et al., 1992; Yilmaz et al., 2004). Engaging them in sports as jogging, swimming and aerobics activities can make it difficult for them to exhibit challenging behaviors and can decrease it as they would be busy performing the exercise movements (Celiberti et al., 1997; Elliott Jr et al., 1994; Nicholson et al., 2011; O Connor et al., 2000; Powers et al., 1992; Yilmaz et al., 2004).

Following a routine

Individuals with autism experience difficulty to cope with change, and some may experience levels of anxiety and stress around sudden change (Webster, 2016). It can be due to environmental change such as new activity space, new partner/teacher/trainer and new rules/instructions (Webster, 2016). Therefore, having a routine and a structure is important for individuals with autism to be able to prepare and cope with change (Prupas et al., 2006; Reid and Collier, 2002; Webster, 2016). It is known that individuals with autism have a strong preference to routine and it could be a strength because it was suggested that this population once settled, they can be very committed to the routine and display honesty and punctuality (Webster, 2016). Having sequenced and consistent activities and program components (e.g. environment, materials, professionals) help the children get comfortable during the sessions and remember the sequence of the events from session to session and from week to week (Lang et al., 2010; Prupas et al., 2006). The organisation and instructional routine ensure consistency for the students, reduce potential anxiety and ensure a smooth transition (Houston-Wilson and Lieberman, 2003; Reid and Collier, 2002). Additionally, studies also suggest that following a routine allows the children to associate specific equipment with specific activities (Lang et al., 2010; Prupas et al., 2006).

Targeting age-appropriate sports/skills

Research suggests that participating in age-appropriate exercise can make children's engagement more successful and more motivated to learn (Lang et al., 2010; Zhang and Griffin, 2007). The physical educator must determine the physical abilities/motor skills that the child with autism is capable of to be able to choose an age-appropriate sport (Block, 2007; Lang et al., 2010; Zhang and Griffin, 2007). For example, if the child can kick and run and kick a ball, then the child can participate in football. The literature suggests that participating in age-appropriate activities that teaches age-appropriate motor skills is an effective method to engage children with ASD in exercise (Davis and Burton, 1991). Learning age-appropriate skills can develop their motor skills and facilitate their inclusion in physical education classes with peers without disabilities (Block, 2007). A study conducted by (Zhang, 2006) examined the impact of teaching age-appropriate motor skills on a child with Asperger syndrome. The child participated in 2 60 minutes sessions for a semester that focused on age-appropriate skills as catching, throwing and striking. The results revealed that the child significantly improved his motor skills and most importantly, was included in the physical education class with his peers

in age-appropriate sports.

Self-determination

For exercise to be effective, motivation during exercise has to take place. The self-determination theory (SDT) suggests that to get motivated in a physical activity setting, there is a sequential psychological process. This process starts with competence (feeling of efficacious to the activity, autonomy (e.g. having a choice/independence) and relatedness (e.g. socially attached or related)). Consequently, this process of motivation leads to positive consequences. In exercise, motivation and self-determination contributes to better behaviours and maximises performance and adherence (Hagger and Chatzisarantis, 2007). External motivators such as the kind of sport, teaching strategies are key elements to motivate children with autism to participate in exercise, maximise their sports performance and maintain training. Research also suggests that external regulation is important in facilitating exercise participation in an adolescent with ASD and to stay motivated and determined to succeed (Pan et al., 2011). Another study suggests that considering the unique characteristics of individuals with ASD can influence their motivation to engage in exercise (Hamm and Yun, 2018). The findings of this study suggest that considering the psychological needs of children with ASD when engaged in a physical exercise setting can enhance their motivational skills. Children and young adults need to feel independent, able to exercise and being related or connected. The results added that professionals have to understand the motivation process of physical exercise in children and young adults with ASD (Hamm and Yun, 2018). For example, if children with ASD were provided with a well-designed exercise program considering the elements mentioned above as well as an activity of their choice with a group of children under the supervision of professionals that can foster social interaction and engagement, with time and practice they can engage with the group members, feel related and have a sense of community (Hamm and Yun, 2018). This sequential motivation process can make them determined to succeed, put greater effort, enjoy exercise and benefit in many developmental areas.

After all, it is about meeting the individual needs and developing better wellbeing for individuals with ASD. Following some or all of the elements/procedures mentioned above can vary depending on the child's level and his/her place at the learning process. These elements and teaching procedures will facilitate the learning and the teaching process. They will enable the child to reach his/her full potential as well as has access and inclusion with integrity (Utley and Astill, 2001). Moreover, if learning and progress took place when applying these elements

and teaching procedures, exercise might become a habit. It may result in long-term positive effects on the overall functioning of children with ASD.

Chapter 4: Research methods

This chapter describes the research method used in this study as well as the research design and rationale. This chapter will also include the data collection tools and explains their appropriateness to the explorations of the research aims outlined in the section below. Thereafter, the specifics of the research design dealing with the subjects in the study, procedures taken (data collection procedures), trustworthiness and ethical considerations are discussed. Lastly, the chapter will conclude by providing a summary of the data collection methods and the research study plan.

Research aims:

The aims of this research were ultimate to design an exercise-based program (including a variety of activities) for children with autism spectrum disorder (ASD) and determine how participation (included versus segregated) impacts the overall functioning of children with ASD.

The specific aims of this research therefore are to:

1. Investigate the impact of inclusive exercises (swimming, jogging and mixed games) versus segregated on the physical, cognitive, social and emotional, language and communication skills and behaviors of children with ASD.
2. Investigate the impact of mixed games sessions compared to individual exercise (jogging and swimming) on the physical, cognitive, social and emotional, language and communication skills and behaviors of children with ASD
3. Determine the influence of elements applied to the exercise setting as structured teaching procedures, physical structure and organisation of setting on improving participant's performance.

Research Approach/Method

The main research approach adopted for the present study is a mixed-methods approach. In the following paragraph, an overview of the definitions of mixed methods is given as well as the rationale behind choosing this method. In the subsequent sections, the data collection tools are discussed covering the definition of each, reasons behind choosing each method and strengths and weaknesses, research procedure (recruitment of participants and how each method was conducted) as well as issues of trustworthiness.

Mixed methods: definition

(Johnson et al., 2007) defined mixed methods as:

“mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purpose of breadth and depth of understanding and corroboration” p.118.

The main element of this definition is that mixed methods combine both qualitative and quantitative approaches on one or more of the research phases epistemology, methodology and methods. This rests on the rationale that there is a strong link between methods and methodologies. This definition bases the assumption that collecting multiple and varied kinds of data best delivers a comprehensive understanding of a research problem.

(Stange et al., 2006) formed this definition by synthesising the perspectives of 31 leaders in the field and defined mixed methods as:

“it Involves integrating quantitative and qualitative approaches to generating new knowledge and can involve either concurrent or sequential use of these two classes of methods to follow a line of inquiry.” p.292.

Similarly, this central definition element is collecting, analysing and integrating quantitative and qualitative data in the same study to provide a broad analysis of the research problem. Stange et al. described this method as a bridge between quantitative and qualitative paradigms and discussed that the combination of methods complements and strengthen each other, and it also allows the researcher answer emerging questions rather than being limited. They also elaborated by noting that using multi-methods can bring together numbers, descriptions, narratives and understanding of context to provide a greater image of the phenomenon under study. Stange et al. used Green’s justification of why we should have mixed methods (Greene, 2008). Green noted that it is better to conduct multiple tools and methods of hearing and to see when dealing with social inquiry to make sense of the complex world and better understand the multi-faceted characters of any social phenomenon (Greene, 2008). Using mixed methods originated when (Campbell and Fiske, 1959) used multiple methods to examine the validity of psychological traits. Then other researchers were encouraged to conduct their multiple method approach in collecting data in their studies (Greene et al., 1989; Jick, 1979; Mertens, 2003; Sieber, 1973; Tashakkori et al., 1998; Teddlie and Tashakkori, 2003). These studies concluded that combining one method to another can develop and inform the other method and multiple methods can support one another and provide understanding into various dimensions or units of investigation.

The type of mixed methods research design that was adopted in the present study is concurrent/triangulation design that is associated with a mixed-methods approach was adopted in this study. It is a procedure that involves converging quantitative and qualitative to provide a comprehensive analysis of the research problem (Creswell, 2013). In the present study, the primary investigator collected both forms of data qualitative and quantitative at the same time

(simultaneously) during the course of the study giving equal priority to both forms to provide a better understanding of the research problem and fulfill the research aims. The research topic was studied and examined from more than one standpoint (Creswell, 2013). Subsequently, all gathered data at the different phases was integrated in the interpretation of the overall results in the discussion chapter (Bulsara, 2015). One of the steps in following a triangulated/concurrent model is to report results in separate sections (Bulsara, 2015). In the present study, the results of the quantitative and the qualitative tools as well as the analysis was reported in separate sections but the discussion brought points together providing greater depth of perspective not only about the impact of exercise and inclusion on children with autism but also about the impact of mixed games sessions compared to individual exercise as well as the influence of elements applied to the exercise setting as on improving participant's performance. The quantitative data (The Movement Assessment Battery for Children-2 Movement ABC-2 (M ABC-2)) was nested within the qualitative data. As by the semi structured interviews and the observations the researcher was able to collect larger data about the impact of exercise on the physical skills of children with ASD as well as on their social and emotional, language and communication, behaviors, cognitive and psychological health.

Research design and rational

Although individuals with ASD share common characteristics, each individual is unique. The severity and the combination of symptoms vary from one individual to another, and its impact on their daily functioning may change as they develop (Nicholson et al., 2011). The literature recognises that the impact of exercise and how individuals experience it differs from one person to another across all ages (Faulkner and Sparkes, 1999). Furthermore, Faulkner and Sparkes (1999) also argue that involving individuals with special needs in research studies is quite complex due to their heterogeneity, even when having the same disability. This is often the case in individuals with ASD. A mixed-methods approach, therefore, was chosen specifically to thoroughly examine such unique and complicated population that display a combination of wide-ranging symptoms. It was noted that researchers have to be logical when attempting to examine a given phenomenon (Greene et al., 1989). Examining the impact of a variety of exercise on children with ASD when included with non-autistic children is uncommon, and this current study examined different variables using a variety of data collection tools and involved multiple phase project (multiple stages of data collection), it was only logical to use mixed methods to explore, further understand and develop a detailed view of the impact of integrated exercise versus segregated on children's social and emotional, language and

communication, physical and cognitive skills and psychological health as well as generalise the findings to the ASD population if possible. Research suggests that gathering data from more than one source (multiple sources) can result in achieving completeness or comprehensive responses to the research aims and questions (Drisko, 1997). Using mixed methods in the present study including various data collection tools can help the researcher achieve a full picture of the research aims as it offers multiple findings combining the depth and the natural insights of qualitative research and the efficiency but less rich power of quantitative research that ensures that there are no gaps to the data collected as one methodology may not provide all the information required (Bulsara, 2015; Teddlie and Tashakkori, 2003). It was concluded by (Webb et al., 1999; Webb, 1966) that mixed methods increase the research validity as various findings either affirm or confound each other; thus reduces the inappropriate generalisations. Therefore, using mixed methods in the current study can lead to greater research validity unlike the use of one method that can limit the results.

Quantitative and qualitative are indeed different in form but using the different elements from both in the same study gives richness to the information. It delivers the complexity of the situation from more than one standpoint (Drisko, 1997). Two studies used mixed methods approach and reported meeting the mixed method criteria (combining methods and integrating results), and both revealed its effectiveness in addressing different elements of the research problems (Blatchford et al., 2007; Sammons et al., 2007). The study of (Blatchford et al., 2007) investigated the relationship between teaching assistants (TA) and class size, student's behavior and student's achievement. The study used a survey, systematic observations, interviews and academic tests to examine the link between the presence of TAs and student's behavior in class and academic achievement. The study conclusions were based on numerical and qualitative data and reported detailed results that would not exist using only one method. The study of (Sammons et al., 2007) examined variations in teacher's work by surveying and interviewing 300 teachers in 100 schools assessing their teaching styles and their impact on pupil's tests results. Both quantitative and qualitative measures were analysed and concluded that mixed methods are an effective approach in analyzing qualitative and quantitative data to support the research study arguments.

In the present thesis, quantitative data (Movement Assessment Battery for Children) (M ABC-2) provides statistics (facts and figures) about participant's motor functioning before and after being engaged in the program where on the other hand, qualitative data (observations and interviews) provides depth to the numeric data and reveals more information (e.g., behaviors,

opinions, development) which is very important when studying children. In the current study, the combination of both approaches complemented each other. It provided the researcher with a better understanding and clarity of the impact of the whole program procedure including the surroundings (the trainers, environment, elements applied to exercise setting, type of exercise) on the children with ASD. This way, findings can be generalised to the population, and a focused view of the phenomenon is available. Moreover, the researcher may be able to base her assumptions on well-grounded information that will lead it to be recognised and supported by audiences (e.g., faculty members and professionals) (Creswell, 2013). This research study is one of very few that was done in my country (Saudi Arabia). Therefore, establishing well-grounded literature and a solid framework (data collection and analysis procedure) is highly important for it to be recognised and supported.

As mentioned above the research approach adopted for the present study is a mixed-methods approach. In the following paragraph, the data collection tools (qualitative and quantitative) are discussed.

Data collection tools

Interviews

Semi-structured interviews were conducted with the parents prior, during and post the intervention. Semi-structured interviews are a set of closed and open-ended questions that are more flexible and less rigid compared to structured interviews. Semi-structured interviews allow the interviewer to bring up new ideas during the interviews as a result of what the interviewee says allowing for a discussion instead of following a list of question and answer format (Quinn, 2002). A series of interviews, including closed and open-ended questions following a semi-structural guide were mostly chosen to provide more details to the researcher and to explore detailed responses in depth (Quinn, 2002). Interview questions were generated by the principal investigator “researcher” and were approved by the study supervisor to facilitate the interviews (see appendix 1). Closed and open-ended questions were mostly chosen to provide more details to the researcher, following a semi-structural guide to explore detailed responses in-depth without being restricted with standardised interview questions (Quinn, 2002). After the interview guide was developed, it was pilot tested with the first parent couple. All questions went smooth posing no issues. Therefore, no modifications, deletions neither additions were made, and data were added to the analysis (Holloway, 1997). The

principal investigator conducted all interviews. Interviews were not audio recorded as parents did not consent to an audio recording. The investigator typed their answers during the interviews, and two research assistants were present in the same room to type every word said by the interviewees for the interview flow to keep ongoing. Answers copied by the investigator and the research assistants were compared, and no corrections were made. (see procedure section for details).

Semi-structured interviews were chosen and conducted to explore participant's (the parents) live experience when engaged in exercise and to understand parent's views and opinions of the PA program as well as their experiences when their child is engaged in exercise and explore their opinions in greater depth with less rigid structure (Rubin and Rubin, 2011). Moreover, semi-structured interviews were chosen to ensure gathering authentic perspectives of parents in regard to the impact of the exercise program on the overall functioning of their children and how it influenced their children's quality of life and represent it accurately in the findings. Another reason for choosing semi-structured interview as one of the data collection tools is that it has been used by several research studies studying children with special needs and children with autism spectrum disorder as well and proven to be reliable and valid over the years in fulfilling research aims and answering research questions (Aggerholm and Moltke Martiny, 2017; Bahrami et al., 2012; Buchanan et al., 2017; Burke et al., 2017; Downing and Peckham-Hardin, 2007; Eldar et al., 2010; Idol, 2006; Lindsay, 2007; Magnusson et al., 2012; McLoughlin et al., 2017; Movahedi et al., 2013; Obrusnikova and Cavalier, 2011; Pan, 2009; Pan et al., 2009; Salend and Duhaney, 1999; Sansosti and Sansosti, 2012; Ward and Lee, 2005).

One of the benefits of interviews is enabling the researcher to understand the participant's views and experiences and the meanings attached to their daily lives (Rubin and Rubin, 2011). It is useful as one to one, face to face questions can obtain participant feelings, opinions and perception (Rubin and Rubin, 2011). In addition, interviews allow the researcher to ask questions relevant to the purpose of the study to elicit a further depth of information depending on the responses of the interviewee as ambiguous answers can be clarified and incomplete answers to be followed up (Rubin and Rubin, 2011; Wolcott, 2005). Interviews can have some drawbacks. It was noted that a researcher cannot rely on the respondent's ability to accurately recall details about previous and current experiences that they are asked about (Esterberg, 2002). Therefore, research suggests observing people instead of interviewing them to know what they do instead of what they say or interviews can be followed by observations to supplement the data collected by interviews (Esterberg, 2002; Newcomer et al., 2015). Another

weakness to interviews is that it needs considerable time and effort (Esterberg, 2002; Newcomer et al., 2015). It is time-consuming and expensive, starting with creating an interview guide, identifying a sample, conducting it and then coding and analysing the results (Esterberg, 2002). The process preparing for the interview, preparing the setup, conducting the interviews and then analyse the data collected is not an easy neither a quick process. Analysing the interview notes and transcript can take hours and days (Newcomer et al., 2015).

Observation

The researcher adopted the role of participant-observer (Gold, 1958; Robson and McCartan, 2016), whereby children were engaged in exercise sessions and the researcher engaged in the activities, while simultaneously observing using observation sheets and collecting field notes (see procedure section for details). The researcher documented field notes after each session, including detailed events, incidents happening on the site relevant to the research study to ensure recording fresh events that facilitate rich and detailed observations of the settings. The researcher did not find an existing observation sheet to record notes that meets the researcher's needs. Therefore, an observation sheet was developed complicated enough to observe the selected areas (see appendix 2). The observation sheet was developed based on Social Skills Checklist 2007. It is a checklist that rates the child's skill level in social and emotional and language and communication development. For the purpose of the present research study, the behavior checklist and the notes section were adapted to be within the scope of the research aim and represent the research hypothesis (Richard et al., 2014). Two modifications were executed. (1) The scale was extended to include physical skills development including skills such as fine and gross motor functioning, motor coordination, motion planning and balancing, postural stability and fitness. These skills are appropriate to the physical abilities of the current participants to include them in our comparison when examining the change and progress of their physical abilities before, during and after the program. (2) The rating scale was excluded because the purpose behind the observations was recording participant's behaviors and its development throughout the program and not rating the child's skill level to be followed with instruction as it is in the social skills checklist. Appendix 2 presents a description of the observation categories and skills.

Collecting data through participant observation was chosen and conducted for the researcher to see and hear and then systematically record participant's behaviors while being engaged in exercise. It allowed the researcher to observe the participants and attend to details while being a member in the setting to help her understand what is going on and transfer it to others as it

permits a lack of artificiality unlike other methods (Bryman, 2003; Silverman, 2015). This method was used to objectively provide information about the change, progress and the series of development in participant's social, language and communication and physical skills; most importantly examining and noting whether the exercise based-program and inclusion had a positive or a negative impact on children's targeted behaviors and skills. In addition, observations were conducted to examine the difference between the two groups (included vs segregated) and within individuals with mild and moderate autism (Gray et al., 2008). Participant observation was used to usefully support data obtained by other methods (semi-structured interviews and M ABC-2) (Robson and McCartan, 2016). For example, it can provide an opportunity to gain information that parents may forget to mention or unwilling to discuss during the interviews. In addition, observations were chosen to be conducted as it is one of the methods that are commonly used when studying the behaviors of children with special needs and children with ASD in specific as well as in analysing exercise and sport instruction for children with autism (Baron et al., 2006; Bauminger, 2002; Bauminger et al., 2003; Celiberti et al., 1997; Elliott Jr et al., 1994; Fragala-Pinkham et al., 2008; Heyman et al., 2014; Kern et al., 1984; Lindsay, 2007; Movahedi et al., 2013; Myles et al., 1993; Nicholson et al., 2011; Pan, 2008, 2011; Salend and Garrick Duhaney, 1999; Sansosti and Sansosti, 2012; Schultheis et al., 2000; Shephard, 1996; Staples and Reid, 2010; Yilmaz et al., 2004; Zask et al., 2001).

Observations have been used as a practical research method over the past 50 years, especially among professionals interested in human development and individual and group relatedness (Margolin et al., 1998). One of the benefits of observations is enabling the researcher to record individual and/or group behaviors in a particular context with detailed objective information (Margolin et al., 1998). In addition, it is one of the methods that can clarify relations between and among human behaviors (Margolin et al., 1998). Moreover, observations are considered a practical method that is useful in answering research questions from different aspects as providing individual outcomes, group outcomes and interaction process of a phenomenon (Margolin et al., 1998). Though observation is a practical research method, it has its downsides. Research suggests that even if it is well planned using observation sheets, coding systems, training team observers, observation itself can be time-consuming and expensive (Heyman et al., 2014). Another research argues that collecting data then interpreting it, then managing and analysing it could be quite costly (Margolin et al., 1998).

Motor functioning assessment

The Movement Assessment Battery for Children-2 Movement ABC-2 (M ABC-2): (Henderson et al., 2007) was used to compare the test results of motor functioning in a group of boys and girls with mild and moderate autism and age-matched typically developing boys and girls (participants in the study) pre and post the intervention to examine the exercise based program's impact on their motor abilities/competence. The M ABC-2 was developed by (Henderson et al., 2007) and has been standardised on 1172 children aged between 3 and 16 years in the UK. The battery measures performance of both gross and fine motor skills for children in three age bands (3–6 years, 7–10 years, and 11–16 years). The battery assesses three domains of motor competence: manual dexterity, aiming and catching and balance (see table 4.3). Each domain consists of eight tasks for every age band. The test, which is the first component in the battery requires the children to perform multiple motor tasks in a specified way using different materials. Each item/task raw score can be converted to a standard score and then to a percentile. A total test score and its equivalent percentile can be found in the norm tables published in the (M ABC-2) manual by adding the eight tasks standard scores. Calculating the total test score and its equivalent percentile can determine a child's motor impairment/delay. In the present study, only the test which is the first component in the battery that requires the children to perform multiple motor tasks in a specified way using different materials was conducted in line with previous research (Utley et al., 2010)

The M ABC-2 is a test commonly used with children with autism spectrum disorder and children to determine the extent of motor impairment in their fine and gross motor skills (Green et al., 2009; Leemrijse et al., 1999; Liu and Breslin, 2013; Miyahara et al., 1997; Siaperas et al., 2012; Utley et al., 2010). Research suggest that the MABC-2 is a clinically useful assessment tool, easy to implement and uses simple testing materials (Brown and Lalor, 2009; Green et al., 2009; Leemrijse et al., 1999; Liu and Breslin, 2013; Miyahara et al., 1997; Siaperas et al., 2012; Utley et al., 2010). One primary weakness that was noted by (Brown and Lalor, 2009) is that though it is a comprehensive battery and variable studies reported its reliability and validity. However, more studies are required for further reliability and validity. The battery was used to identify participant's motor difficulties before being engaged in the exercise program and after being engaged to compare the scores and measure the effectiveness of the exercise program and its impact on the children's physical abilities (motor competence) (Henderson et al., 2007). In addition, it was used because it is an already well-established research tool and commonly used in studies of children with motor difficulties and as a measure

of the change in studies offering interventions as the present study (Henderson et al., 2007). The battery was also used as it is one of the commonly used motor assessment tools with children with ASD and with typically developing children (Green et al., 2009; Leemrijse et al., 1999; Liu and Breslin, 2013; Miyahara et al., 1997; Siaperas et al., 2012; Utley et al., 2010). Another reason for using this tool was that individuals with ASD experience deficiencies in motor performance. They show some degree of delay in at least one area of motor development (fine and gross motor functioning, motor coordination, motion planning, balancing) (American Psychiatric, 2000; Pan, 2008, 2011; Pan et al., 2011). They experience difficulty in object control, ball skills, balance and manual dexterity (Berkeley et al., 2001; Manjiviona and Prior, 1995; Mari et al., 2003). Therefore, it was relevant to use the battery as it assesses some of the domains of motor competence (manual dexterity, aiming and catching and balance) which children with ASD find difficult.

In regard to test reliability, studies have employed the M ABC-2 and reported that the scores remained consistent despite who administered it and on what occasion when performed interrater reliability and test-retest reliability (Barnett and Henderson, 1998; Chow and Henderson, 2003; Croce et al., 2001; Geuze et al., 2001; Van Waelvelde et al., 2007). Over the years, occupational therapists, physiologists, paediatricians and psychiatrists have reported that the M ABC-2 can be used reliable (Visser and Jongmans, 2004). To increase the reliability of the motor test in the present study, interrater reliability was conducted. The researcher measured the extent to which testers (researcher and research assistants) agree on the scores of each participant. The researcher and the research assistant both evaluated the children's performance and reached a 95% agreement with the scores (Breslin and Rudisill, 2011; Liu and Breslin, 2013). The test scores of the researcher and the research assistant were compared by performing an inter-rater reliability test. The percentage of the inter-rater agreement between the scores was high (99%). In regard to the validity of the MABC-2, it was found in studies that correlated the test scores with other measures that test similar domains (i.e., Bruininks-Oseretsky Test of Motor Proficiency (BOT 1978), McCarron Assessment of Neuromuscular Development (MAND 1982), Peabody Developmental Motor Scales (PDMS-2)) (Croce et al., 2001; Folio and Fewell, 2000; Smits-Engelsman et al., 1998; Tan et al., 2001). Also, test validity was achieved through comparing the performance of two different groups of children who are expected to have difficulties and differ on the construct measured by a test (Henderson et al., 2007). Measuring the difference in motor competence between children with ASD and typically developed children have been reported on a number of studies (see (Smith,

2004). The study of (Green et al., 2002) focused on children with Asperger and measuring the severity of their motor impairment. 11 children with Asperger Syndrome were tested on M ABC. Results reported that all children were poorly coordinated, and their scores on the test were below the 15th percentile with some even below the 5th percentile. A similar study using M ABC-2 conducted by (Siaperas et al., 2012) reported the same results. These results are compatible with the results reported on the classic paper of Asperger 1944 that presented several cases with autism spectrum disorder (Frith, 2003).

The paragraphs below outline information about the participants, inclusion criteria, recruitment of participants, and data collection procedures.

Participants

A total of twenty-one 7-10 years old (autistic n=15, 14 males, 1 female and non-autistic children n=6, 2 males, 4 females) took part in this study (see table 4.1). Autistic children were recruited from a special centre for children with disabilities, and an internet posting approached the non-autistic children. The children were randomly assigned to one of two groups (experimental group 1/experimental group 2) to ensure that each group was mixed abilities (see table 4.2). Seven participants who took part in the study were diagnosed with moderate autism. Three of these participants were assigned to experimental group 1 (segregated group), the rest (four participants) were assigned to experimental group 2 (inclusive group). Eight participants who took part in the study were diagnosed with mild autism. Five of these participants were assigned to experimental group 1 (segregated group), three were assigned to experimental group 2 (inclusive group). Six participants who are typically developed took part in this study and were assigned to experimental group 2 (inclusive group). The mean age of group 1 was 8.13 years old, and the standard deviation SD was 1.03. The mean age of group 2 was 7.45 years old and the standard deviation SD was 0.40. Eight children with mild and moderate autism (segregated group) were compared to an (inclusive group) of mild and moderate autism and typically developing children.

The following description of inclusion in the current program and the set of components applied was developed by the principal investigator to describe inclusion/inclusive education during the exercise program in the present study clearly. This description was developed in reference to the definitions provided in (CH 3 pg.35-36) that focused on the concept of inclusion and the different components applied to create an inclusive educational setting. The current description proposes the same fundamental concept stated in the definitions which is

including children with disabilities (ASD) with typically developing children with all services brought to them with only one difference which is adapting the setting to an exercise-based program instead of the general education class to be within the scope of the research aim and represent the research hypothesis. The current description outlines different components to ensure the implementation and the effectiveness of an inclusive practice which are specially designed effective teaching strategies and instructions, professional collaboration and teaming and special effective supports. Also, the description focused on creating a community of learners that best serve and meet the needs of every child.

Inclusion described as:

“Including children with mild/moderate autism spectrum disorder with non-autistic children who are typically developed during exercise sessions in a specially designed program with specially designed instructions/procedures applied by experienced professional in a structured outdoor environment for high quality, effective and successful learning/practice; promoting exercise, belonging and positive social experiences (interaction and integration) and embracing diversity as a natural state of being a child and a learner as well.”

A number of previous studies were conducted to measure the impact of exercise on children with ASD when included with typically developing children, siblings and family members (Fennick and Royle, 2003; Pan et al., 2011; Prupas et al., 2006; Qi and Ha, 2012; Schenkelberg et al., 2017; Zhang and Griffin, 2007). These studies have targeted different outcomes, but all had similar context to the present study which is inclusion and inclusive practice. All the studies focused on the concept of including children with ASD in exercise setting and highly considered the different components to create an inclusive educational setting. A combination of components was applied by the previous studies such as specially designed effective teaching strategies and instructions, professional collaboration and teaming and special effective supports.

Inclusion criteria for children with ASD

- All children (males and females) should meet the criteria for the autistic disorder of the DSM-IV and assessed by clinical psychologist and professional doctors.
- Children are identified with mild/moderate/high functioning autism spectrum disorder or Asperger's.
- Children should be free from diseases and medical conditions that can stand in their way of being engaged in exercise (chronic illnesses, motor deficiencies, epilepsy).

Children will be judged healthy in reference to their reports (personal profiles) available at the centre that includes their medical history as well as their parent’s statements.

- Children should be physically able to participate in exercise and follow instructions.
- Children should age 7-10 years old.

Inclusion criteria for typically developed children

- All children, males, and females should be typically developed and free from diseases and medical conditions that can stand in their way of being engaged in exercise (chronic illnesses, motor deficiencies, epilepsy). Children will be judged healthy in reference to their recent visit to the GP and their parent’s statements
- Children should be physically able to participate in exercise.
- Children should age 7-10 years old.

Table 4.1 Participant information (ASD and typically developed)

| Participant | Age | Diagnosis | Education | Related disabilities | Repetitive stereo typical behaviors |
|--------------------|------------|-------------------------------|-------------------|-----------------------------|--|
| AS | 7.11 | Autism Moderate range | Special school | None | None |
| AB | 8 | Autism Mild range | Special school | None | None |
| AH | 7 | Autism Mild-moderate range | Special school | None | None |
| AS 2 | 9.4 | Autism Mild-moderate range | Special school | Partial hearing impairment | Finger flapping Inappropriate laughter |
| EZ | 7.6 | Autism Mild range | Mainstream school | None | None |
| JA | 7.5 | Autism Moderate range | Special school | None | Hitting self |
| RB | 9.5 | Autism Mild-moderate range | Special school | None | None |
| SL | 7.2 | Autism Very mild range | Mainstream school | None | None |

| | | | | | |
|-------------|------|---------------------------|-------------------|------|------------------|
| YH | 7.7 | Autism Very mild range | Mainstream school | None | Hand flapping |
| MG | 7.11 | Autism Very mild range | Mainstream school | None | None |
| MK | 9.10 | Autism Moderate range | Special school | None | Hitting objects |
| YH 2 | 7.6 | Autism Moderate range | Special school | None | None |
| NB | 7.6 | Autism Moderate range | Special school | None | Rotation of eyes |
| AM | 7 | Autism Very mild range | Mainstream school | None | None |
| MA | 8 | Autism Moderate range | Special school | None | Biting self |
| MB | 7.2 | Typically developed | Elementary school | None | ----- |
| NB 2 | 7.2 | Typically developed | Elementary school | None | ----- |
| AB 2 | 7.2 | Typically developed | Elementary school | None | ----- |
| TS | 8.3 | Typically developed | Elementary school | None | ----- |
| SS | 7.3 | Typically developed | Elementary school | None | ----- |
| SM | 7.3 | Typically developed | Elementary school | None | ----- |

Table 4.2 Participant groupings

| | | |
|------------|-------------|---|
| Ex-group 1 | 8 children | Only autistic/segregated group |
| Ex-group 2 | 13 children | Inclusion group (autistic & non-autistic) |

Recruitment of participants

After gaining the ethical approval from the University of Leeds Ethics department, Jeddah Institute for Speech and Hearing (JISH) and the leisure centre were approached via emails from the lead researcher (Mayan Omair). They received an initial email with an information sheet attached, including written details of the study. When the head of the centre and the manager of the leisure centre demonstrated interest, they were given 1 week to read the sheets and consult other professionals. After showing initial agreement, a meeting took place with the head of the centre and the manager of the leisure centre to ask the researcher all the questions/concerns they are not sure over. Once they were happy and fully understood the requirements of their participation, they were given an informed consent sheet to sign. Sheet includes them agreeing taking part in the study and that they can withdraw at any point. After gaining their approval, participant recruitment took place, followed by the data collection tools procedures mentioned below.

The Staff of JISH (Jeddah Institute for Speech and Hearing) assisted in the process of participant recruitment by identifying potential participants according to the inclusion criteria mentioned above. After that, they outreached the parents to inquire on their interest in taking part in this research. JISH offers intervention program/sessions for individuals with ASD along with their services for the population with hearing and speech impairment. Parents who demonstrated interest were provided with an information sheet, including written details of the study (see appendix 3). They were given enough time to read and consult with their children and/or healthcare professionals and given a chance to ask the researcher any questions. Once the families were happy and fully understood the requirements of their participation, they were invited to the institute to sign an informed consent sheet to consent on behalf of their children (see appendix 4 & 5).

Furthermore, parents agreed to the institute providing information about their children's current diagnosis/symptoms and interventions received. A profile for each participant with ASD was developed that included (background information, medical history, characteristics and skills) combined with participant's recent evaluation reports and current interventions. Professional evaluation and opinion is an important resource of the participant's abilities and functioning skills as it states the child's cognitive, physical, language and social and emotional development level for the principal investigator and the PA trainers know how to interact with the participants and meet their needs. Also, it assisted in choosing and designing the right procedures to implement the exercise program, keeping in mind individual traits. In regard to

non-autistic participants, their parents were approached by an internet posting that included a brief about the study and the inclusion criteria. Prospective participants/parents of participants who responded to it were contacted by the study researcher. The same procedure was taken as the one with the parents of the autistic children. It was important to ensure that enough participants were recruited to be able to fulfil the aims of the research. The number of participants was based on the number of children currently attending therapeutic sessions at the Jeddah Institute for speech and hearing (JISH). The number recruited n=21 n=15 of autistic children and n=6 non-autistic children is considered realistic. There are many studies on special populations where this number is considered appropriate, and the work has been published (Bass et al. 2009; Pan 2010; Pan, 2011).

Interview procedure

All parents (fathers and mothers) of the 21 participants were interviewed 3 times over a 10 weeks period. Thirty-eight parents-15 parent couples of children with ASD and 5 parent couples of typically developing children were interviewed. A couple had a child with autism, and a typically developing sibling participated, and another couple had two typically developing children participated in the study. Parents were chosen to speak on behalf of their children with ASD because of the social and language difficulties experienced by individuals with ASD (Temple et al., 2006). Parents were asked to provide and share their own perspectives/opinions during being engaged in the interviews, rather than answering in ways they thought their child would answer “proxies” (Sheldrick et al., 2012). Interview sessions were conducted in an office at the leisure centre where the program took place, at a convenient time for the parents. Interviews lasted on an average of 30 minutes. The time frame was flexible and accommodated to the needs of the parents. Parents were informed that if they felt tired or don't wish to continue at any point, interviews can be held or resumed at a convenient time for them. The first interview focused on parent's views and previous experience of their children in exercise programs. Sample questions included “Did your child enjoy being engaged in exercise programs, tell me why?” “Were you satisfied with the program, tell me why?” “Can you tell me about the influence it had on your child's quality of life, did it enhance certain skills?”. The second interview focused on getting to know parent's views and opinions of the exercise program and its impact on their child. Sample questions included “What do you like most and least about the jogging sessions?” and “What progress have you seen on your child since the beginning of the program?”. The third interview focused on the overall impact of the activities on the child's skills and parent's recommendations. It included questions such as

“What was the program’s overall impact on your child’s skills/abilities?” and “What are your recommendations to help us improve the quality of the program?”. During all three interviews, the researcher used probes to encourage parents to provide more details about their child’s experience including challenges, barriers and positive and negative impact (see appendix 1 for interview questions). In addition, interviewees were encouraged to focus on the answers and were supported to translate their child’s experiences into words (Petitmengin, 2006).

Observation procedure

Observations took place at the beginning (week 1), toward the middle (week 3&5) and the end (week 7&10) of the program. Observations were conducted on three different days of each week at different activity sessions (jogging, mixed games and aquatic). Each observation was different in length depending on the length of each activity session; jogging was 25 minutes, mixed games were 50 minutes, and swimming was 60 minutes long. Children with mild and moderate autism and the typically developed were observed as a group keeping in mind the severity of autism (mild, mild to moderate and moderate) and sometimes a single child’s behaviour was recorded if displaying different behaviors compared to the other participants in the group. The researcher and the trainers would start the sessions as planned following the procedure of the session (see chapter 5 for a detailed description of sessions procedures) under the supervision of the researcher directing trainers and participants to follow the session’s schedule. The researcher was always involved and engaged in the activities (i.e. giving directions, reinforcing, keeping watch of time, modelling) while simultaneously observing participant’s behaviors and skills as a participant-observer noting down what was happening developing a set of quick notes specific to the areas and categories selected (physical, language and social) focusing on the clearly described behaviors and the list of example on the observation sheet (see appendix 2). After each observation session, the researcher emerged the notes by writing field notes including detailed events, incidents happening on the site relevant to the participant’s social, language and physical skills to ensure recording fresh, rich and detailed events. The researcher had the training and prior experience in observing children especially as a participant-observer during her professional years as a teacher. Therefore, the researcher was able to observe and be involved at the same time without negatively influencing the setting neither the data collected.

Motor testing procedure

The primary investigator “researcher” and the research assistants administered the motor functioning test at a testing room at the leisure centre. Participants undertook a motor functioning assessment test using the Movement Assessment Battery for Children-2 (Movement ABC-2). Research assistants were trained to administer and evaluate children’s performance on each task. Research assistants were also blind to the purpose of the test. The test was administered twice. First, before the start of the exercise program and the second time was on week 11 after completing the 10 weeks’ program. Assessment sessions were conducted in a testing room at the leisure centre at a convenient time for the participants. Administering the test took from 20-30 minutes, and it depended mostly on the child’s ability to complete the tasks. The timeframe was flexible and accommodated to the needs of the individuals. If the participant felt tired and were not able to perform well or even distracted after performing a number of items, the rest would have been given or resumed at another day at a convenient time for the participant. A one to one test set was provided to minimise distractions and achieve maximum performance. The parents were in an adjacent room if the child was calm and did not need them and also if their presence affects the performance of the child. They were nearby if needed.

The testing room was 6m* 6m and had blank walls and was cleared from any extra materials and unnecessary furnishing for safety purposes. Part of the floor surface was hard, and part was smoothly covered with non-slip rubber mats for the hopping and jumping items. Materials were arranged and prepared before the arrival of the participants where they were easily accessible but out of the child’s range. The room contained a table and two chairs with a suitable height and size to children. Another table was provided for equipment and scoring materials. The room had good lighting and free from noise. Each participant was tested in a single session. The testing administration procedure was followed in accordance with the test manual where each domain was explained; manual dexterity, aiming and catching and balance, and each domain consists of eight tasks (see table 4.3). Each participant had several practice trials before performing formal trials. Each task was demonstrated first emphasising the correct performance, followed by the practice phase that consists of 1 practice attempt that was followed by 2-5 formal trials depending on the task. If any child made a mistake or did not seem to understand the task, the child was provided with additional verbal instructions and demonstrations.

Table 4.3 Items of the Movement ABC (performance tests); second age-band

| Domain | Tasks |
|------------------------------|-----------------------------------|
| Manual dexterity | |
| Item 1 | Placing pegs |
| Item 2 | Threading lace |
| Item 3 | Drawing |
| Aiming & Catching | |
| Item 4 | Throwing & catching a tennis ball |
| Item 5 | Throwing bean bag on the mat |
| Balance | |
| Item 6 | Hopping |
| Item 7 | Heel to toe walking |
| Item 8 | Balance |

Establishing trustworthiness of the data

To judge the quality of the data collection tools, the following criteria were followed to achieve trustworthiness (credibility, transferability, auditability, confirmability) (Lincoln and Guba, 1985, 1986). These issues of trustworthiness were considered during the data collection process to increase the trustworthiness of the research study. In the following section, the concepts above are defined, and different strategies that were used to achieve each concept such as thick description, audit trail, research reactivity and member check are discussed.

Credibility

Credibility refers to the extent to which the findings and the results of a study characterise the meanings of the research subjects (Lincoln and Guba, 1985). The description of the findings and results must be accurate and authentic representing the primary participants (Drisko, 1997). The following strategies were considered and implemented to achieve credibility during the interviews and the observations; research reactivity, bias and thick description. For example, to make sure that neither the researcher nor the research procedures had an impact on the participants and thereby change the findings, an audio recording was not taken as parents did not consent it. Research suggests that audio recording and videotaping might affect the way

participants interact and answer questions (Lietz and Zayas, 2010; Padgett, 2016). As a result, whatever is on the tapes can be not a true representation of how participants truly would have answered or behaved. Instead, everything related to the interview questions and the observation categories was documented (written) as said and seen. Moreover, the researcher was always aware of her own biases (Lietz et al., 2006). For example, the researcher developed and included interview questions that ask about the negatives and the positives of the program sessions not only the positives as well as asked parents about their recommendations to make the program better and provide better services in the future. The researcher did not encourage successful outcomes only but attended to draw out negative impressions of the program. The same applies to the data collected during the observations. The researcher provided positive and negative behaviours of the participants to reflect a real picture of the data collected.

Thick description was conducted to achieve credibility. It involves deep and detailed information about the gathered data of a phenomenon (Creswell and Miller, 2000; Denzin, 2001). Obtaining meaningful and rich answers from the interview questions and rich, detailed events from the observations allowed the researcher to deliver knowledgeable and insightful interpretations and transfer the answers and the observed events and produce written experiences and feelings to the reader to imagine through his/her own lens. Thick description was also obtained through prolonged engagement involving conducting multiple interviews (three interviews throughout the program duration) and a series of observations generating meaningful and significant data to achieve a full picture of the experience of the program (Lincoln and Guba, 1986). Moreover, interview questions were generated by the principal investigator “researcher”. They were approved by the study supervisor to facilitate the interviews and made sure it is relevant to the purpose and aims of the research study (Lincoln and Guba, 1986). The researcher asked the questions using simple words for parents to understand and also asked the questions in different ways to check for the credibility of responses. Also, to ensure the credibility of the interview questions and answers, the investigator typed their answers during the interviews, and two research assistants were present in the same room to type every word said by the interviewees. Answers copied by the investigator and the research assistants were compared, and no corrections were made. Also, member check was conducted (Creswell and Miller, 2000; Lietz et al., 2006; Lietz and Zayas, 2010; Lincoln and Guba, 1985, 1986; Padgett, 2016; Shenton, 2004; Smith and Sparkes, 2013). After comparing interview transcripts by the individual participant, answers were sent by email to parents. Parents agreed on the accuracy of the events and recognised their perspectives, and

none of the parents made any corrections. To make sure that the findings represent what the parents truly meant, the researcher translated and reported the parent's answers as were said and the interpretation of answers was accurate to the description of the primary participants (Drisko, 1997).

Reflexivity was considered to increase the research credibility. It refers to the degree of which the researcher can influence the findings either intentionally or unintentionally (Fontana, 2004; Jootun et al., 2009). It is considered a continuous process of extending the researcher's understanding of how his/her interests and positions can affect the research process and that can enhance the research quality. Research suggests that reflexivity should be part of qualitative methods to increase credibility of the collected data by reflecting on the research process and being aware of the researcher's own values and views that may influence the findings (Fontana, 2004; Jootun et al., 2009). One of the strategies to achieve reflexivity is Bracketing. It is a cognitive process that involves one's putting all ideas and judgements aside to maintain objectivity (Jootun et al., 2009). In the present study the primary investigator read professional assessment reports about each participant that includes a diagnosis, strengths and weaknesses and present level of performance before the beginning of the program. In addition, parents provided a brief about their children and confirmed all the qualities and areas of needs reported in the reports. Before starting the program and conducting the phases of the research study and dealing with the children, the researcher has put all the information provided by parents and read in the assessment reports and judgements aside to report participant's true abilities as displayed during the program and remained open to data as it was revealed (positives and negatives).

Reflexivity was also achieved by conducting self-critique. It is described as focusing on own's beliefs making sure that it is not influencing the stages of the research study (Dowling, 2006; Furman, 2004). It was obtained by continuously being engaged in self critique by focusing on my own beliefs and that it is not affecting the stages of the research and the data collected (Furman, 2004). The primary investigator was fully aware that she wants to complete the research study as planned but not necessarily by "looking good". Instead, the researcher was fully aware of natural responses and progress of participants. Moreover, the researcher was always critically analyzing the elements applied (type of exercise, inclusion, teaching strategies, physical structure) and looking for faults to correct and avoid in the future. Another form of self-critique is being open to others and embrace different points of views (Dowling, 2006). To achieve this level of openness, the researcher had clear assumptions about the

benefits of exercise and inclusion on ASDs while simultaneously being ready and open for different views and opinions from the parents, variable results within each group and in between groups and variable behaviors from participants. Reflexivity also requires the researcher to be aware that one's can be intimately involved in the process and the product of the research (Horsburgh, 2003). In the present study, the researcher was always aware of her responses as well as her relationship with the participants. The researcher applied self-inspection by responding to moments fairly and dealing with all participants in the same way. For example, when participants displayed challenging behaviors during the sessions, the same behavior management strategies were applied to all participants. The same applies to pleasant behaviors. In addition, all participants received the same teaching strategies while exercising and applied accommodations when needed by specific individuals. Self-inspection was also obtained by rechecking response when dealing with parents during the interviews. For example, the researcher responded to parent's questions and concerns in the same way without favoring anybody over another and used to check the responses after each interview.

My role as a researcher who had direct contact with the children and the parents in the research setting was to collect data, facilitate participant's engagement by following the research study plan (refer to p.g.94-95) as well as applying physical structure, teaching strategies and directing trainers and research assistants to follow the designated plan. Furthermore, my role was to implement the research methods as well as report participant's behaviors, progress during their engagement and views of their experience (Jootun et al., 2009).

Transferability

Transferability refers to the applicability and usefulness of research findings to theory, practice and future research (Lincoln and Guba, 1985). It was also defined as the degree to which the findings of a research study fit other settings and situations outside the study and found meaningful (Sandelowski, 1986). Thick description is one of the strategies relevant to achieve transferability to other settings, practice or future research (Creswell and Miller, 2000; Devers, 1999; Lincoln and Guba, 1986). Describing the findings of this study in details by describing interview answers and thematically analysing it and discussing it thoroughly can allow the reader to understand how findings may apply to other settings and related to other groups. In the present study, the researcher described the answers and the study context in details and related it to other studies and settings, as suggested from previous research (Devers, 1999). For example, the researcher documented the challenges faced by children with autism when engaged in previous exercise programs, the positive and negative elements that were applied

to these programs, the elements and teaching procedures used in the present exercise program and the benefits of the present exercise program on the overall functioning of children with ASD. These findings along with parent's suggestions and recommendations can be applied and transferred to other children with ASD and other exercise programs that provide similar services. The same applies to the observation notes collected that were described in detail from week 1 till week 10 including positive and negative behaviors and progress observed in children's social and emotional, language and communication and physical skills. These findings were organised and focused on the points that were within the argument of the study. Then, it was translated and written creating a story describing clear scenes in sections to be told to the reader in details focusing on specific aspects to construct a picture that reflects the data collected to help the reader make sense of what the participants did during exercise sessions and understand how findings may be applicable to other settings considering differences in participants characteristics and program (Lincoln and Guba, 1985).

Auditability

Another criterion to evaluate qualitative research tools is auditability. It refers to the extent research procedures are documented for an outsider to follow and criticise the research process (Creswell, 2013; Creswell and Miller, 2000; Lietz et al., 2006; Lietz and Zayas, 2010; Padgett, 2016). Two strategies were used in the present study to increase auditability. The first one is keeping an account of the research procedures. In the present study, the researcher kept an account of the research procedures by providing detailed documentation of the interview questions and answers, the observation sessions and the motor functioning test results throughout the research process (Creswell, 2013; Creswell and Miller, 2000; Lietz et al., 2006; Lietz and Zayas, 2010). Another strategy that was used to increase auditability is an audit trail. Audit trail consists of keeping a written document of the research procedure reporting events that occurred throughout the duration of the project (Lietz and Zayas, 2010). Research suggests that such written accounts can clarify any unclear concerns and answer questions and strengthen the conduct of the study (Lietz et al., 2006; Lietz and Zayas, 2010). The researcher kept a written document of the research procedure from the beginning until the end of the research project reporting events that occurred throughout the project. In this study, the researcher has maintained an audit trail by keeping a word document that included detailed events of research meetings and the decisions that were made. The document was sent to the supervisor to add to the document at any time. Creating and providing such a document was efficient to maintain what occurred in detail from the beginning to the end.

Confirmability

Confirmability refers to others as professionals; readers able to confirm the findings of the research project (Drisko, 1997; Lincoln and Guba, 1985; Shenton, 2004). The researcher must conduct certain steps to prove that the findings are the result of the participant's real experience, ideas, opinions rather than the researcher's. Confirmability can be achieved by clearly linking the findings to the gathered data (Drisko, 1997; Lincoln and Guba, 1985; Shenton, 2004). Strategies that were discussed above as member check (p.g.88) and audit trail (p.g.91) can be used to increase a study's confirmability and allow others external to the research team to evaluate and confirm the research procedures and findings. One more strategy was added to achieve confirmability and fulfil the research aims, which is a negative case analysis. This strategy is commonly used to prove the grounded theory to the research study, fulfil research questions and aims and ensure reflecting the real experience of the participants (Padgett, 2016). It is usually achieved by seeking contrasting evidence (Padgett, 2016). For example, when the researcher was exploring parent's views and opinions about the exercise sessions specifically the positives and the negatives of the sessions, the parents favoured all sessions and the elements applied and were pleased overall. Negative case analysis required the researcher to continue asking them the questions in different ways and emphasise on the negatives (the least they liked about the sessions) until some were mentioned and represented in the findings. Another example of negative case analysis/seeking contrasting evidence can be the documented observations. The researcher represented the observation material and the field notes very clearly and provided details about the participant's behaviors and progress from the beginning until the end to construct a picture that reflects the real data collected. It is important to note that negative case analysis was achieved by the researcher by including all the unpleasant/negative behaviors displayed by the participants with mild and moderate autism as it was much more compared to pleasant/positive behaviors at first few weeks of the program.

In summary, the present research conducted different relevant available strategies to increase the trustworthiness of the mixed methods research project. Evidence is provided that the researcher adopted research enhanced credibility and reactivity/bias, auditability, transferability, and confirmability in accordance with the model lens of the project (Creswell & Miller, 2000). Research suggests that projects are expected to employ a number of strategies that seems relevant and critical to the research project and non is expected to employ all strategies of trustworthiness (Creswell, 2013; Creswell and Miller, 2000; Lietz et al., 2006).

Ethical considerations

Issues of Confidentiality, right to withdraw, consent forms and data storage were all considered and adopted from The University of Leeds Research Data Management. All data were anonymised, and the researcher has looked at the University of Leeds research data management guidelines. In regard to the participant's personal information, each participant was given a code that is only known to the researcher, and the same code was used for all aspects of data collection. Participants (parents and children) had the right to withdraw at any time. If the participant contacted the researcher to withdraw; the researcher would have identified and removed the relevant data set. If a participant wished to continue but did not want the data to be included in the research, they could continue participating. However, their data would not be collected or considered. Participants had the right to withdraw from the study without any explanation by contacting the researcher using the contact details provided on the information sheet. However, they were informed that once published, it is impossible to withdraw, but all data will be anonymous. Data analysis began after the data has been collected. Any participants who have withdrawn were not included. Informed consent was sought before participation in the study from the parents of the children, the leisure centre and the special institute. All parties were provided with an information sheet prior to them giving agreement to participate in the study. Also, a meeting with the parents, the director of the institute and the manager of the leisure centre took place before participation in the study to provide them with all the information needed and ask all the questions required.

The data was first stored initially on an encrypted flash drive and then was transferred to the M drive at the University of Leeds. The data is only stored on the M drive at the University of Leeds. Data was loaded daily on a flash drive after it was collected and after the project was over, it was all transferred to the lead researcher's (Mayan Omair) M drive at the University of Leeds. Consent forms and any hard copies are stored in a secure location at the special Institute in Jeddah. If any copies should be required, they will be scanned and stored on the M drive at the University of Leeds. It was not expected that distress would be caused by involvement in the study, but this was carefully monitored by the researcher and team involved. Also, some individuals are known to the child watching the sessions, and they assisted the participants when needed. Participants were also given time out or allowed to stop when needed. There were sufficient professionals available to ensure that this could happen and would apply suitable pedagogical methods when needed. In case of distress or bullying: professionals involved in the sessions monitored all participants and children would be given time out or

allowed to stop if needed. The trainers and the researcher directed non-autistic children on how to deal with autistic and non-autistic participants and the trainers were their role models. Pedagogical methods that are well known to be calming and motivating for children with autism were applied. Also, parents were there to help when needed as they knew how to deal with their child in such a case.

Summary of the research study plan

The study consisted of three phases: Phase 1 involved the recruitment of participants and once recruited, the baseline measures were taken which was conducting the motor functioning test and developing participants’ profiles along with semi-structured interviews with the parents. Phase 2 involved implementing the 10-week training program including jogging, swimming and mixed games sessions as well as observing participants during activity sessions and conducting interviews as described in (table 4.4) below. Phase 3 involved conducting a measure which was the motor functioning test post the end of the program. The table below summarises the phases of the research study specifying the procedures/methods conducted in each phase.

Table 4.4 Summary of the data collection methods including (type of method/intervention, week number when methods were conducted and groups).

| Phase | Method | Week # | Experimental group 1 (autistic) n=8 | Experimental group 2 (autistic n=7 & non- autistic n=6) |
|---------|------------------------------|-----------------------------------|---|---|
| Phase 1 | • Participant’s recruitment | Prior to the start of the program | √ | √ |
| | • Participants’ profiles | | √ | √ |
| | • Semi structured interviews | | √ | √ |
| | • M-ABC | | √ | √ |
| | Activity sessions | 1 | √ | √ |
| | observation | | √ | √ |

| | | | | |
|---|---|--------------|-------------|-------------|
| Phase 2 (10 weeks program) | Activity sessions | 2 | √ | √ |
| | Activity sessions observation | 3 | √ √ | √ √ |
| | Activity sessions | 4 | √ | √ |
| | Activity sessions, observation Interviews | 5 | √ √ √ | √ √ √ |
| | Activity sessions | 6 | √ | √ |
| | Activity sessions observation | 7 | √ √ | √ √ |
| | Activity sessions | 8 | √ | √ |
| | Activity sessions | 9 | √ | √ |
| | Activity sessions observation interviews | 10 | √ √ √ | √ √ √ |
| | Phase 3 | • Post-M-ABC | 11 | √ |

Chapter 5:

Exercise program

The previous chapter has outlined how the children taking part in the exercise program were assessed and provided an overview of the measures taken pre, post and during participation in the exercise program. This chapter provides an overview of the teaching procedures applied during the sessions and how the exercise program was delivered.

Pedagogical considerations (teaching procedures)

Based on the recommendations and findings of previous research, the following teaching procedures were carefully chosen to be implemented during the sessions of the program; these included; verbal cueing, self-monitoring boards, poster boards and exercise charts, modeling and physical guidance (Kern et al., 1982; Lang et al., 2010; Schultheis et al., 2000; Todd and Reid, 2006). In the next section, each teaching procedure is explained including its definition, description, indicative examples and the additional activity used with each method.

Verbal directives and verbal cueing

Verbal directives are clear, direct verbal statements that direct individuals to do an activity or a skill (Cannella-Malone et al., 2011). Clear and short verbal instructions are always recommended during exercise sessions involving individuals with autism spectrum disorder (Pope et al., 2012; Schultheis et al., 2000; Srinivasan et al., 2014; Todd and Reid, 2006). In addition, it is recommended that verbal directives are combined with verbal cueing, modeling and physical guidance (Schultheis et al., 2000; Srinivasan et al., 2014; Todd and Reid, 2006). A study by (Todd and Reid, 2006) examined the impact of an exercise program on three adolescents with autism emphasizing on three teaching procedures; verbal directives and verbal cueing, self-monitoring boards and edible reinforcement. In specific to verbal directives, the

study reported that it was an effective strategy as it kept participants on track during walking and jogging. The study concluded that exercise could positively impact individuals with autism and their physical activity levels can be increased when using the right teaching procedures.

In the present study, verbal directives were used during the three activity sessions that directed participants during jogging laps, performing games, swimming, warming up and cooling down. It was also used to direct them to perform appropriate behavior and stop inappropriate behavior and redirected them if they strayed out of the activity area. For example, clear, direct statements as “lift your knee up” while jogging was provided for participants when needed. Also, verbal statements as “hop with one leg, run faster, bend your wrist while throwing the ball, kick stronger, shoot higher” were provided during mixed games sessions. Verbal directives as “splash the water with your hands, catch the ball, touch the water with your chin” are examples of verbal directives that were used during the swimming sessions.

Verbal cueing is a form of external reinforcement by directing and encouraging verbally (Todd and Reid, 2006). Verbal cueing/encouragements as statements are commonly utilised during different assessment procedures or exercise sessions to urge patients to perform to their greatest potential and keep them attentive (Bickers, 1993). Research suggests that verbal cues provided by adults to children during exercising are an effective form of encouragement as it can sustain the engagement in exercise especially for children with autism (Firman et al., 2002; Hughes et al., 2002; Todd and Reid, 2006). The study of (Bickers, 1993) examined the effects of verbal encouragements during exercise on motor performance on a group of subjects. They reported that verbal encouragements significantly increased the motor performance in the experimental group compared to the control group. In addition, a study by Cannella-Malone et al (2011) considered verbal directives and verbal, cueing were used by the teachers and the assistants during the exercise routine when needed with boys with autism and emotional disorders (Cannella-Malone et al., 2011). They concluded that these strategies were easy to implement and helped students develop their skills.

In the present study, verbal cueing/encouragements and verbal directives were combined. Verbal cueing was usually provided right after verbal directives to encourage participants to perform the desired movement and to congratulate them for trying and/or for mastering the skill. Verbal cueing was provided by the researcher, trainers and assistants who accompanied the participants during the three activities. Phrases such as “good job”, “keep going”, “you are a champion”, “super” were used during the activities and used even more if participants

stopped moving or were slowing down as well as to congratulate them for completing the sessions.

Modelling and physical guidance

Modelling is a form of observational learning which is defined as observing the behaviour of a model where learning takes place as a consequence of direct experience (Bandura, 1969, 2017). Diverse terms were applied to matching behaviors such as “modeling”, “imitation”, “observational learning”, “copying” and “role-taking” (Bandura, 2017). Teaching is all about showing/modelling behaviour or a task that the observer has not learned yet. In many situations, the behaviours/tasks are repeated or reproduced in an identical form after modelling or showing was presented (Bandura, 2017). Observational learning through modeling facilitates natural behavior acquisition and acquiring new skills (Bandura, 1969; Brody et al., 1978). Observational learning has been noted as an effective teaching method with children with disabilities in acquiring early language (Egel et al., 1981; Goldstein and Moussetis, 1989; Lovaas et al., 1966), self-help skills (Hall et al., 1992; Schoen and Sivil, 1989), appropriate play skills (Elliott and Vasta, 1970) and motor skill development (Baer et al., 1967). Research suggests that modeling is an effective teaching strategy used with children with autism since they learn more by observation when compared to typically developed age-matched children (Shipley-Benamou et al., 2002). A study by (Pan, 2010) used modeling as a teaching strategy combined with other strategies such as poster boards and verbal reinforcement and reported that the use of these strategies reinforced the development of children’s social skills and aquatic skills. Another study by (Fragala-Pinkham et al., 2008) conducted a swimming program for children with autism and the aquatic staff mainly used modeling and verbal directions as teaching strategies. This study reported that using modeling and verbal directions facilitated children’s engagement and the acquisition of aquatic motor skills. They concluded that the teaching strategies helped the children succeed in the activities.

In the present program (the current study), modelling was used during the three activity sessions, where each activity/skill was demonstrated first by the trainer and the researcher. Then participants were asked to perform the same skill. For example, activities/movements such as (i.e. how to jog and complete a lap, performing a swimming skill as floating and balancing, racing, kicking and bouncing a ball, ...etc.) were performed first by the trainers and then the participants were asked to do the same. Modeling activities was ongoing and repeated when needed.

Physical guidance, it is a teaching strategy commonly used adjacent to modeling. Physical guidance defined as guiding the movement of the learner to support him or her while practising the skill to eventually perform it by him/herself (Allison et al., 1991; Celiberti et al., 1997). In specific to exercise, it is considered an effective teaching strategy to keep participants exercising at a target pace for the planned amount of time, and it is gradually faded. In addition, physical guidance is beneficial as it reduces errors and with practice, it guides participants to learn the right motor movements (Winstein et al., 1994). Studies by (Fragala-Pinkham et al., 2008; Pan, 2010, 2011; Todd and Reid, 2006) used modeling accompanied with physical guidance in teaching children with autism motor skills during exercise sessions such as swimming and aerobics. All these studies reported that physical guidance and modeling are highly recommended teaching strategies when working with children in general and children with ASD in particular as it helped participants successfully perform the activities.

In the present study, physical guidance was used during the three activity sessions to assist participants by the trainer, researcher and the assistants. It was usually provided after modelling the activities for participants who had difficulty performing the movement on their own. The trainers, assistants and the researcher used physical guidance (e.g. hand over hand while throwing or catching a ball, lifting the hand up to the desired level while jogging, lifting the knee up to the desired level while warming up, holding their hand and lifting it to the desired level to hit the ball with the racket, holding their hand to hop higher into the plastic doughnuts, holding the body while balancing or floating in the water,... etc.) to guide the participant through the desired movement until the participant learned to do it without guidance.

Self-monitoring board

Self-monitoring or self-monitoring boards refers to using a material (board) to observe one's behavior and record the occurrence of a specific behavior in some way such as replacing stars, happy faces and or numbers (Todd and Reid, 2006). Two actions occur during self-monitoring; self-observation and self-recording. Self-monitoring is considered an external reinforce as it motivates participants to participate in an activity initially. Research suggests that self-monitoring using self-monitoring boards promotes independence and increases the level of participation in educational programs (Agran et al., 2005; Hughes et al., 2002). It was also suggested that this strategy could increase physical activity during exercise and promote a physically active lifestyle (Agran et al., 2005; Hughes et al., 2002; Todd and Reid, 2006). Todd and Reid (2006) examined the impact of a physical activity program that included self-monitoring as a teaching strategy combined with verbal cueing and edible reinforcement to

sustain physical activity in adolescents with autism (Todd and Reid, 2006). The study reported that using verbal cueing and edible reinforcement lessened and faded with time. However, participants kept using the boards, and it sustained the participant's participation in the physical activity program. Another study recommended using schedules and self-monitoring boards with children with autism and referred to it as effective strategies during exercise sessions and that it should be included when designing exercise programs for children with autism (Schultheis et al., 2000). The studies that used self-monitoring boards argued that individuals with autism usually lack the motivation to participate in any new activity and in exercise in particular (Schultheis et al., 2000; Todd and Reid, 2006). Therefore, continuous monitoring and self-recording a behavior can teach participants to keep track of their performance, keep them motivated as well as increase their independence as the activity progress (Todd and Reid, 2006). (Schultheis et al., 2000; Todd and Reid, 2006) also discussed that the boards were like a record-keeping device and it was reinforcing though the happy faces were not exchanged for reinforcers; instead, it was a reinforcer upon completing the predetermined distance. Self-monitoring was described by (Deci and Ryan, 2000) as an external-to-internal motivational continuum on which an individual can move through. They explained that some people may participate in exercise in the presence of an external motivator but in time, internal motivators may substitute the external motivators and it can keep on increasing participant participation. The data of Todd & Reid (2006) is consistent with this idea as participant's performance progressed during the program though edibles were faded and they were showing more intrinsic motivation while still using the self-monitoring boards.

In the present study, self-monitoring boards were used during jogging sessions only because it was previously used by research studies implementing exercise programs and proven to be an effective strategy (Agran et al., 2005; Ganz and Sigafos, 2005; Todd and Reid, 2006). Also, jogging was a new sport for the participants in this study. Therefore, self-monitoring boards were chosen to increase their participation and keep them motivated to complete jogging laps as well as record and count the number of laps themselves in each exercise session. Foam board was used and divided into four vertical sections, where each is for an individual participant, and the name of each was at the top of his/her section. Participants recorded each completed jogging lap by placing one happy face that was 7 cm in diameter under their names on the board. One happy face indicated completing one whole lap. The happy faces came in different colors, and each participant chose the colour of the happy face s/he prefers. Velcro dots were

attached at the back of each face for easy placement and removal on and off the board. More than one board was used according to the number of participants.



Figure 5.1 Jogging session's self-monitoring board

Poster boards and exercise charts

Poster boards using visual cues (picture symbol, written words, labels, numbers, photos of objects) indicating the order of activities or skills required for a specific class or a duration of time and to be completed during class time. According to research, poster boards are an effective intervention procedure for children with ASD, especially when engaged in exercise (Sherrill, 1998). Sherrill argues that it encourages their cognition in terms of thinking about and understanding the concepts of “what”, “when” and “where”. Sherrill also argues that it keeps participants focused and it also lessens the occurrence of disruptive behaviours. As a result, children with autism spend more time on task, which in turn result in a successful exercise program. The literature supports Sherrill’s argument and suggests that using visual supports as boards and schedules with children with autism can help them navigate their days and anticipate upcoming events (Cohen and Sloan, 2007). The Treatment and Education of Autistic and Related Communications-Handicapped Children (TEACCH) program developed the use of schedules and poster boards indicating the order of activities required for a specific class and to be completed during class time (Schopler et al., 1995). TEACCH noted the benefits of developing poster boards and schedules as helping children with memory and attention problems, helping children to be more organised and reducing wasting class time, promoting independence and increasing self-motivation. (Schultheis et al., 2000) conducted a study that

provided each student with autism with a large poster board including a list of assigned activities using activity cards. They found poster boards to be beneficial as students were independent during the exercise session, more organised and completed the assigned activities on time. Another study by (Pan, 2010) examined the impact of an aquatic program on the social behavior and aquatic skills of children with autism and used poster boards as a teaching strategy. They reported that it was an effective strategy as it made the program’s requirements clearer to the participants and the trainers and kept the aquatic sessions organized.

In the current study, this teaching procedure was used during the mixed games and the aquatic sessions only because the sessions consisted of several different activities and it was only logical to use such strategy to keep the sessions and the participants organised. For the mixed games sessions, large poster board was used listing the assigned games in order. Each game had a name, number and a brief description. Poster boards were divided into 8 sections; each section included activity name and number and a brief description. Each activity was written in a large font and a colour associated with a coloured number that was read right to the left (Arabic). The same coloured number and activity name were placed at the designated activity area on the ground. Poster board for the aquatic sessions was used to list the assigned activities (category; content) in order (floor activities, one-to-three direct instruction, water aerobics and cooldown). The board was divided into 3 horizontal sections: phase, length in minutes and content routine and 4 vertical sections were each is for a category (see table 5.1 below). Each category was written in a large coloured font and next to each was the length in minutes and content described briefly.

Note: See below an example of the content of the poster of the aquatic sessions.

Table 5.1 Aquatic session’s poster board content sample

| Phase | Length (min) | Content |
|-----------------------------|-----------------|--|
| 1. Floor activities | 10 | View schedule Warm-up activities (stretching arms, legs and chest) Splashing water with hands or feet |
| 2. One-to-three instruction | 30 | Water orientation skills a. Intro to the water environment (touching chin, ears, mouth to water, pouring water on the head) b. Breathing skills (placing head in water without consuming much water) |

| | | |
|---|----|---|
| | | <ul style="list-style-type: none"> c. Floating (learning positions and rotating from one another supine, standing and prone position. d. Balance and control movement (allowing the trainer to move them through the water in the supine/prone position e. Stroke skills (leg kicks with instructor support or holding pool deck. Moving arms with instructor support) f. Learning swimming styles starting with the basic (front/backstroke, freestyle stroke) |
| 3. Water aerobics (at the shallow end) | 15 | <p>Running in place- jumping jacks- hopping on one foot-jumping in place-jumping forward, backward & sideways</p> <p>Noodle kicks, noodle jumps, swimming through, under, over hula hoops</p> <p>Race as a team using noodles</p> <p>Catching & throwing balls between participants to keep it away from the trainer</p> <p>shoot balls into hoops</p> |
| 4. Cool down (stretching in the water) | 5 | Marching in place, arms & legs stretching (use pool wall if needed) |

In regard to exercise charts, refers to using a material (chart) to keep a record of a number of activities required during a specified period of time (Schopler et al., 1995; Schultheis et al., 2000). It is a strategy commonly used during exercising to keep a record of the activities required during a period of time (Schopler et al., 1995; Schultheis et al., 2000). It is usually used to help participants understand what they are expected to do, record their participation by placing stickers or marking the activities after being done with each, keep track of their progress throughout the session, keep them organized, keep them self-motivated and reinforce independence (Schopler et al., 1995; Schultheis et al., 2000). A study by (Cannella-Malone et al., 2011) used exercise charts as one of the teaching strategies to teach students with autism during exercise sessions. Participants were asked to place a star next to the activity on the chart after completing each activity. It was found that at first participants used to place it on their own and continued to be engaged in the intervention but with time they got engaged in the activities and had to be reminded to place the stars next to each activity. The study concluded that exercise after a few weeks was rewarding on its own and their participants needed no stickers either any prizes to continue exercising. In contrast, Schultheis et al., (2000) and Todd and Reid, (2006) noted that participants kept placing the happy faces and it was positive reinforcement. They argued that using exercise charts and schedules was mainly because

individuals with autism usually lack the motivation to participate in any new activity and exercise in particular and they also they prefer to understand what they are expected to do (Schultheis et al., 2000; Todd and Reid, 2006).

In the current study, exercise charts were used during mixed games sessions only. It was used because the sessions consisted of a number of activities and for the participants to keep a record of the activities completed. Also, it was used because mixed games activities were new to the participants. Therefore, it was useful to use the charts to understand what they are expected to do, keep track of their progress throughout the session as well as reinforce them at the same time. Another reason for using it is that parents of participants clearly noted during their interviews that their children follow instructions when receiving tangible reinforcement. The charts were divided into eight horizontal sections (eight exercises) were each is for an activity (activity name and number) and 4/5 vertical sections were each is for an individual participant. The name of each was at the right of his/her section (see figure 5.1 below). Each participant had the assigned number of activities (8) in order and an empty section under each to place the happy face after completing each exercise routine. One happy face indicated completing one activity. The faces came in different colors, and each participant chose the colour s/he prefers. More than one exercise chart was used according to the number of participants.

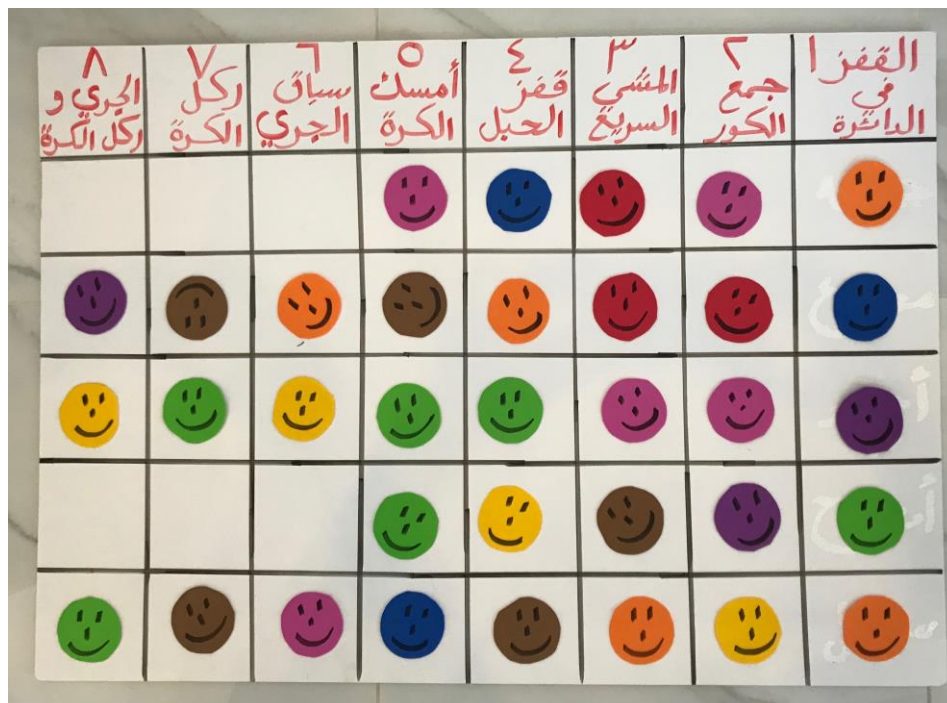


Figure 5.2 Mixed games session's exercise chart

Teaching guidelines

In addition to the four teaching procedures mentioned above a number of teaching guidelines that facilitate the learning process was implemented during the three activity sessions. According to research, there are a number of teaching guidelines that should be considered when teaching physical education to children with special needs to support the trainer in steering the learning process as well as enable participants to learn, progress and reach their full potential (Utley and Astill, 2001). The present program adopted a number of teaching guidelines that were previously discussed in the literature review (chapter 3).

Task modification

As shown by research, children with ASD may be delayed in their motor development and coordination and display movement difficulties and weak muscles (Reid and Collier, 2002; Zhang and Griffin, 2007). They show some degree of delay in at least one area of motor development (fine and gross motor functioning, motor coordination, motion planning, balancing) (American Psychiatric, 2000; Pan, 2008, 2011; Pan et al., 2011). They experience difficulty in object control, ball skills, balance and manual dexterity (Berkeley et al., 2001; Manjiviona and Prior, 1995; Mari et al., 2003). For this reason, offering modified instructions for these children can facilitate their participation, increase their engagement and motivation levels and develop their motor abilities (Pope et al., 2012; Todd and Reid, 2006). The literature suggests that modifying tasks and the equipment used, can fulfil the child's needs and be successful at increasing engagement in exercise /sport (Hughes, 1996; Jansiewicz et al., 2006; Ming et al., 2007; Pope et al., 2012; Stephenson and Carter, 2009). Employing modified instructions can start by choosing skills based on student's abilities (Schwartz et al., 1998). For example, the teacher can set a number of mixed games like shooting, hopping, kicking, racing and allow the student to perform the activities at his/her level (Schwartz et al., 1998). The child may not be able to hop on two legs at first, so the teacher can let him/her hop using one leg, and with practice and time, s/he will be able to hop using two legs. (see task modification examples of the current study in the paragraph below).

In the present study, the intensity of activities/tasks, equipment, time and rules of tasks/activities were modified when needed depending on the participant's ability. For example, in regard to intensity sessions used to move from moderate to mild intensity and gradually move back to moderate to vigorous when needed until the participant mastered the

required skill or start with mild intensity and move on to moderate (i.e. jogging pace, racing pace, using lightweight balls, swimming intensity). If jogging at a moderate level was hard on the participant or the participant showed any signs of discomfort (i.e. flushed face, an abnormal increase in breath rate), they moved back to mild jogging for 15 seconds. If the participant was still showing signs of discomfort after the (15 seconds) of mild jogging, s/he was then asked to slow down to a walking pace for another (15 seconds). After that, the participant was encouraged to start jogging at a mild pace and move on to moderate until completion of the lap. Another example of modifying the intensity of activity was adjusting racing speed during mixed games sessions. One of the activities in the mixed games session was racing. If a participant was not able to race at a fast pace, s/he was encouraged to start with slow/mild pace and then move to fast pace. During water aerobics, some participants were not able to run in place, so they were asked to march in place and gradually move to run with time and practice

Modification of equipment was also considered. Some children with mild and moderate autism experienced individual constraints as low muscle tone, overweight, sensory sensitivity. The researcher applied some modifications to engage these participants and improve their performance. For instance, for the ones who experienced low muscle tone and reduced muscle strength some tasks during mixed games sessions that included throwing and catching balls, shooting a hoop, kicking a ball was modified by using lighter weight balls and then systematically increased the weight as the participants increased strength. Some participants found the basketball used during shooting hoops activity very heavy, the trainers modified the task constraint by practising with a small ball that allowed their bodies to be more relaxed (relaxed grip and knees) and handled the ball better while dribbling, then moved on by using the basketball when they were physically ready. One participant was overweight and found it difficult to run with a fast pace, hop, jump in place, such activities were modified to low impact activities as marching in place instead of jumping jacks or jogging instead of running and with time-intensity was increased. One participant experienced sound sensitivity, he was provided with one to one instruction using a low toned voice, and he was allowed to cover his ears with his hands whenever other participants were loud.

Sometimes, time and activity rules were modified during the activity sessions. For example, after the first month from starting the program, participants showed more interest in doing more laps even when the time was up. Therefore, they were allowed to continue jogging for a few minutes more to satisfy their needs. On the other hand, some participants used to refuse to

continue jogging after completing 10 or 12 laps even when they still had time. In such cases, trainers used to encourage them to continue, and if they insisted on not jogging, they were left to rest and take a break. For example, during the mixed games sessions, some participants found it difficult to hop forward, backward and sideways, so they were instructed to hop in one direction only and over time another direction was added until they were able to hop at all directions. Another example of modifying the rules was during an activity in mixed games sessions. Some participants with moderate autism found it difficult to hop into hula hoops, so they were instructed to step into the hoop and with time and physical guidance they were able to hop into it.

Some children experienced low motivation during the jogging and mixed games sessions. The activities were modified and related to participant's interest when low motivational levels were experienced. For example, one participant was instructed to jog and run around plastic cones being told that he was a superhero. Everyone wanted to see his powers because he was interested in superheroes. Some children with moderate autism felt discouraged during the first few weeks of the program and did not want to jog a number of laps around the track during the jogging sessions and displayed aggressive behaviors when confronted with the task. The trainers modified the presentation of the task by instructing the child to run like a train and whistle really loud when completing a lap when participants observed their speed/pace and performance, that changed their perception and started to like jogging around the track.

Establishing a routine

It is known that individuals with autism have a strong preference for routine and it could be a strength because it was suggested that this population once settled, can be very committed to the routine and display honesty and punctuality (Webster, 2016). Having sequenced and consistent activities and program components (e.g. environment, materials, professionals) helps the children get comfortable during the sessions and remember the sequence of the events from session to session and from week to week (Lang et al., 2010; Prupas et al., 2006). An aquatic program done by Prupas et al. (2006) used structured teaching and followed a routine. Swimming sessions were always at the end of the day and the pool of the recreational centre. Also, the physical environment was consistent from session to session, using the same equipment and sequence of activities. They noted that following a routine and the consistency between sessions had a positive effect on the participants by reducing anxiety levels and allowed them to understand the flow of the sessions, as well as no specific equipment, is

associated with a specific skill. Other studies supported following a routine by following the same instructional routine and assigning an instructor to a participant or a group of participants throughout the program to lessen anxiety levels and encourage children to participate in the activities (Pan, 2010, 2011).

In the present study, a routine was established in terms of where to exercise, equipment used, the flow of the sessions/content and the team of professionals. Jogging and mixed games sessions took place at the same jogging track at the leisure centre during the whole program duration, and the swimming sessions took place at the swimming pool at the same venue. All activity sessions started with warming up then the activity and ended with cooling down using the same teaching procedures as mentioned above. Another way to establish a routine was exercising with the same trainers and assistants during the program period, as suggested by previous research (Pan, 2010, 2011). The organisation and instructional routine ensured consistency for the participants, reduced potential anxiety for some participants with moderate autism and ensured a smooth transition in the sessions as proven by previous research (Pan, 2010, 2011; Prupas et al., 2006).

Reinforcement

The usage of external reinforcement is one of the most important teaching procedures when teaching children with disabilities and children with ASD in specific as it motivates them to complete a task and increases the occurrence of pleasant behaviours (Firman et al., 2002; Hughes et al., 2002; Srinivasan et al., 2014; Utley and Astill, 2001). Different types of positive reinforcement can be given during exercise to engage children with ASD during their participation and motivate them to finish the exercise. Reinforcements such as (verbal cueing, edible reinforcement, verbal and gestural reinforcement and reinforcement boards) are often used with individuals with ASD and were proven to be successful (Firman, Beare, & Loyd, 2002; Hughes et al., 2002; Srinivasan, Pescatello, & Bhat, 2014). A study conducted by (LeBlanc et al., 2003) examined the impact of reinforcement and video modelling as teaching strategies on perspective-taking skills on 3 children with autism. Results revealed that both strategies were effective as 2 out of 3 children were able to master the tasks required after the intervention. They concluded that video modelling is best paired with reinforcement as both together gave significant results arguing that video modelling showed the participant the new pleasant behaviour and tangible reinforcement was stimulating to copy/imitate the correct answers. Another study examined the impact of different teaching strategies as reinforcement and prompting on modifying social behaviors of three preschool children with autism (Gena,

2006). Reinforcement as tokens verbal and praise was delivered upon appropriate responding (e.g. asking and answering the question, showing affection toward peers, giving commands and inviting a peer to play). Results are in agreement with prior research noting that children increased their social initiation and responding to peers after reinforcement and prompting procedures were implemented where prompting was a correcting procedure and verbal reinforcement was influencing participants to interact with their peers during group games and activities.

In the present study, positive and meaningful verbal and tangible reinforcement was provided. Reinforcements such as (verbal cueing, edible reinforcement, gestural reinforcement) were usually used during the sessions. For example, the trainers, assistants and the researcher used to shout out “good job”, “great performance”, “super boy/girl”, “hooray” after the participant finishes a jogging lap, activity and warm-up/cool-down movement. Gestural reinforcement was also used as clapping, tap on the shoulder and high fives after mastering/finishing a task. Edible reinforcement was also used with only five participants with moderate autism and it was reduced over time (explanation for using edibles provided in the paragraph below). Research suggests that healthy edible reinforcement can be used with children with autism to ensure adherence to exercise (Srinivasan et al., 2014). A study by (Nicholson et al., 2011) examined the impact of exercise on the academic performance of children with autism and used edible reinforcement as a kind of reinforcement. They reported that using edible reinforcement increased participant’s participation in exercise. Similarly, studies by (Todd and Reid, 2006; Todd et al., 2010) examined the impact of jogging and cycling on children with autism and used edibles as one of the main teaching strategies. They reported that edible reinforcement was an effective strategy to engage children with autism in exercise as it increased participant’s participation in the exercise programs.

In the present study, healthy edibles were used with five participants with moderate autism. Edible reinforcement was used with these participants for a number of reasons. According to their parents, it was the kind of reinforcement used with them in the private centre they attended, and it was the only kind of reinforcement that makes them respond to instructions, complete a task and display pleasant behaviours and then it can be faded/decreased. Another reason was that these children displayed very challenging behaviours on the first three weeks of the program such as not following instructions, refusing to attend, refusing to enter the field for the jogging and mixed games sessions (more details concerning their behaviours are

discussed further in chapter 6). Their parents were allowed to exercise and accompany them during jogging and mixed games for the first week only and some it was extended to the second week of the program. Starting with the third week, parents were not allowed to exercise with them during jogging and mixed games sessions as the researcher wanted them to get used to the team members and the environment as well as to build trust with the team members. Parents were allowed to wait outside nearby where they can see them. Therefore, when parents were not allowed to exercise with them, they felt upset and edible reinforcement made them accept exercising and being around the team members. Another reason was that all of them were hard to handle and displayed aggressive behaviours toward self and others and edible reinforcement makes them calm and easy to handle as reported by their parents. For the first month around the second week of the program, edibles that participants preferred such as very small pieces of biscuit, dates and nuts for the ones who were not allergic, as well as sips of their favourite juice were provided in addition to the other kinds of reinforcement previously discussed. During the first month, participants received edible reinforcement upon completion of each jogging lap and activity in the mixed games sessions. At week 5 and onwards, they started getting more active and engaged during jogging and mixed games sessions even when edible reinforcement was reduced. On week 5,6 and 7 edible reinforcement was reduced, and they received edibles upon completion of 3 to 5 jogging laps and 2 to 3 activities in the mixed games sessions. It was offered on a decreasing basis during the program as they continued placing happy faces as well as receiving other kinds of reinforcements. Toward the end of the program at week 8, 9 and 10, participants received no edibles during exercising and were provided with it upon completion of the whole jogging and mixed games session.

The previous section has outlined the teaching procedures applied in the sessions. The following section provides an overview of how the exercise program was delivered discussing the setting, equipment and the procedure of each exercise (jogging, mixed games, aquatic).

Intervention (activities)

The intervention group completed a program that consisted of three physical exercises taking place over a 10 weeks' period; these activities were classified into three groups: 1. Jogging 2. Aquatic and 3. Mixed games. Jogging sessions were 25 minutes long, aquatic sessions were 60 minutes, and mixed games sessions were 50 minutes long. Duration of sessions was determined by the existing physical activity guidelines and recommendations for school-aged students and youth by organizations in the U.S (e.g., Department of Health and Human Services), and the

guidelines of the national training program for children with special needs in the UK (Sugden et al., 1998) and in accordance with previous research (Adamowycz, 2008; Pan, 2010, 2011; People et al., 2010; Todd and Reid, 2006; Todd et al., 2010). Exercise sessions took place 3 times a week, with each exercise taking place once per week.

Jogging sessions

The jogging sessions took place once a week at an outdoor sports field (running track) in the leisure centre. Jogging was the first activity carried out every week of the program and ran for 10 sessions. Each session lasted 25 minutes and was scheduled into the participant's after-school activities weekly schedule. The first 5 minutes consisted of stretching and warming up activities to prevent injuries and modeling the activity (how to jog and complete a lap and then place a happy face under their names on the self-monitoring board). The jogging workout was 15 minutes long counting occasional mild jogs/walking to rest. It was followed by 5 minutes of cooling down (slow walking and stretching). As shown in figure 5.1 below, the jogging pace started as mild and moved on gradually to moderate at the start of each session. Jogging pace was adjusted from moderate to mild jogging if a participant showed any signs of discomfort (i.e. flushed face, an abnormal increase in breath rate) for (15 seconds). If the participant was still showing signs of discomfort after the (15 seconds) of mild jogging, then they were then asked to slow down to walking for another (15 seconds). After that, the participant was encouraged to start jogging at a mild pace and move on to moderate until completion of the lap. Verbal cueing, modeling and physical guidance, reinforcement and self-monitoring board were used during the sessions.

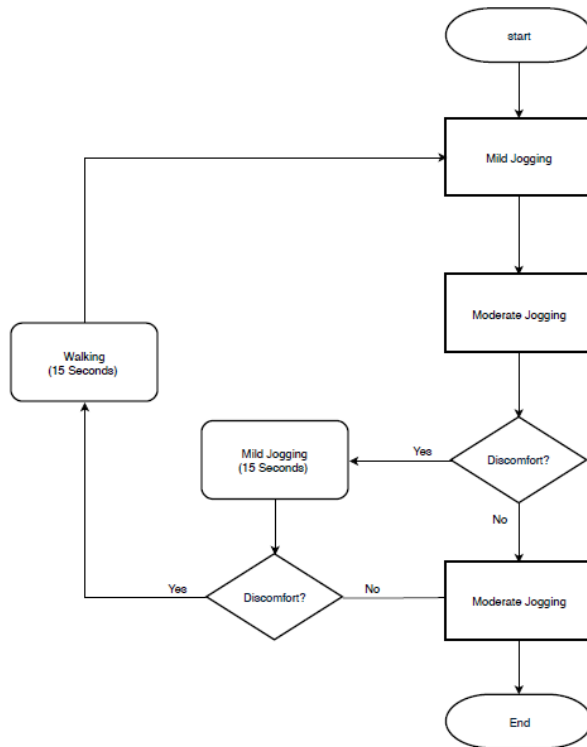


figure 5.3 Jogging workout flow chart

Participants attended a jogging practice session before the beginning of the program to familiarise them with the activity and the context. They were invited with their caregivers to jog on the sports field at the centre before the program began. The trainer briefly explained what jogging is and demonstrated a few laps. The researcher and the trainer then asked the participants and their caregivers to jog together performing the same movements while providing them with verbal cues and guidance. The self-monitoring board was also introduced at the practice session (see page 82-83). The researcher introduced the self-monitoring board to the participants and showed each how to place a happy face under his/her name after completing a lap (reaching the start/finish point). The researcher and the research assistants were at the start/finish point to guide the participants when reaching the board. Participants were helped and instructed through this procedure until they could stick it on the board independently. By the end of the session, some participants were able to jog independently with verbal cues, reinforcement and physical guidance when necessary; some required one to one instruction and assistant at all times.

Equipment

The following equipment was used for all jogging sessions. One red flag pole, one blue flag pole, coloured tape, foam board, happy face markers and velcro dots.

Setting

The outdoor running/jogging track in a sports field located at the leisure centre was used. The start /finish point was marked on the floor track with coloured tape and also marked with a red flag pole (4.5 m height). The circuit was marked using two flag poles: one red and one blue. One red flag pole was placed at the start/finish point on the right side of the jogging track, and the blue flag pole was placed on the opposite left side of the track to mark the mid-way of the circuit (for participants to know that they crossed half the lap distance). Also, the jogging area (lane) was marked with white paint all along the track for the participants to follow this line to finish the laps. The self-monitoring board was placed on the floor next to the start/finish point. The circuit was 90 meter long.

Procedure

Participants arrived at the location dressed in appropriate clothing accompanied by their caregivers. Upon reaching the running track the researcher, trainers and the assistants greeted the participants and began encouraging them by asking them “are you ready to exercise?”. Before the beginning of the workout, participants were directed to gather at the centre of the running track at a marked area forming a circle to start the warming up. The trainer started with the warming up movements such as walking in place, jumping jacks, knee-ups, low/high kicks. The trainer used to model each warming up movement and then ask the participants to copy. The researcher and the assistants were next to the participants and provided modeling of the warming up movements as well as physical guidance when needed. For example, the researcher and the assistants used to show them how to lift their knees up and provide physical support as helping them to lift it to the desired level to guide the participant through the movement until the participant learned to do it without guidance. When the warm-up minutes were over, the trainer and the researcher provided verbal cues by saying “let’s go, let’s see how many laps we can do today?”. Then participants were directed to move to the marked start/finish point of the track to start jogging. The trainer started jogging and asked the participants to observe his movement.

Meanwhile the researcher was standing nearby the participants explaining the trainer’s movements (moving the legs and bending the arms keeping a straight back). After modelling

was provided, the participants were asked to copy the trainer's movement and jog around the circuit at a specific pace starting with mild and gradually moving to moderate. Participants were asked to jog following each other and following the trainer and the researcher and the assistants who were jogging alongside the participants and were also monitoring and giving feedback. The trainer, researcher and the assistants made sure that during the exercise, participants were not showing any signs of discomfort such as excessive breathing. Participants were encouraged to follow the white line on the ground to reach the finish point. Also, they were notified every time they passed by the blue flag pole and encouraged that they completed half the distance and would soon finish a whole lap. Throughout the sessions, the trainer, assistants and the researcher used verbal cues (i.e. "good jogging, keep going, you can do it"), modeling and direct instructions (how to move their legs along with their arms) and physical guidance when needed.

Participants were asked to place a happy face on the self-monitoring board after finishing each lap indicating completing one whole lap (see above). However, a few weeks after starting the program (week 4 onwards) participants felt that they could continue jogging for 4 to 5 laps and some for even more before stopping to place the happy faces and taking a break. As a result, participants counted the laps while jogging and then placed the number of happy faces accordingly. For the ones with moderate autism who were nonverbal, the research assistants used to count for them the number of laps completed. Each participant was expected to finish a total of 10 jogging laps or more depending on each participant's fitness level in 15 minutes' length jogging period. After finishing the jogging period (15 minutes), participants were asked to move to the centre of the track at the marked area forming a circle for the cooling down. At the end of each session, participants counted the happy faces which represented the number of laps completed and were congratulated for completing the session.

Mixed games sessions

The activity took place once a week at an outdoor sports field (running track), the same venue where the jogging activity took place in the leisure centre. Mixed games were the second activity carried out every week of the program and this ran for 10 sessions. It consisted of offering a range of exercises as part of an activity circuit with participants moving from one activity to another. It included activities/games such as racing, shooting a hoop, hopping, throwing and catching a ball and kicking a ball. Each session lasted for 50 minutes and was scheduled into the participant's after-school activities weekly schedule. The sessions included 16 sports activity/games (see table 5.2 below), 8 activities in each session alternated every

week (see figure 5.2 below). The first 5 minutes consisted of stretching and warming up activities to prevent injuries and was followed by the 8 activities that were 40 minutes long and were followed by 5 minutes of cooling down activities (stretching). Participants were engaged in a series of 8 activities which were completed in a set order in each session. Each activity had a station (a place where the exercise is done), and when the time was up, everyone moved to the next station/activity. For example, a station was designated for hula hoop jumps; the next area was for throwing and catching a ball. Each activity was undertaken for five-minutes, including 4 minutes for performing the activity and 1 minute for placing the happy face on the exercise charts and moving on to the next game. Experimental group 1 n=8, was divided into two groups of (4) in some activities as catch the ball, kick the ball, collecting balls into buckets to play in pairs (see table 5.2). Experimental group 2 n=13, was divided into two groups of (6/7) in some activities as catch the ball, kick the ball, collecting balls into buckets, hitting the ball with a racket to play in pairs (see table 5.2). In some activities such as hopping into plastic doughnuts, running through plastic cones, hula hoop jumps each group of 6 or 7 was divided into two groups of (3/4) to make use of the activity time, and each participant has more than one practice attempt (see table 5.2). Verbal cueing, modeling and physical guidance, poster boards and exercise charts were used during the sessions (see pedagogical considerations section above).

Participants attended a mixed games practice session prior to the beginning of the program to familiarise them with the activity. They were invited with their caregivers before the program began. The trainer briefly explained what mixed games are and demonstrated some of the activities. The researcher and the trainer asked the participants to perform the same activities and provided them with verbal cues and guidance all along. The poster board and the exercise charts were introduced at the practice session. The researcher explained the content of the board referring to the assigned activities in order mentioning the name, activity number and description of each activity. Exercise charts were also introduced to each participant and each shown how to place a happy face next to the game after completion. The researcher and the assistants accompanied the participants and guided them until they reached the charts and placed the happy face on it. Participants were helped and instructed through this procedure until they were able to stick it on the chart independently. By the end of the session, some participants were engaged in the mixed games and understood the nature/flow of the sessions, and some were still getting used to the sessions/activities/procedure and needed one to one instruction.

Equipment

The following equipment was used for all mixed games sessions. Two timers, a whistle, happy face markers, velcro dots, poster boards and exercise charts. Exercise equipment is listed below (see table 5.2).

Setting

The jogging track was prepared before the arrival of participants. Each activity area/station was set and prepared with materials/equipment before starting the session as each activity setup described in table 5.2 below. The poster board was allocated in a corner close to the first activity using a room divider to stick it to as well as the exercise charts for all participants. Only the necessary equipment (exact number) was provided to complete each activity to avoid distractions and overwhelming participants.

Table 5.2 Games, description and equipment

| Games/activity (40 minutes of exercise routine) | Description | Equipment |
|---|--|-----------------------|
| 1) Hula hoops jump | Group 1(10 hula hoops, 5 for each group), group 2 (20 hula hoops, 5 for each group) were placed on the floor forming a straight line, no space in between each, with 1 m distance between the two lines of hula hoops. Participants were asked to jump into the hoops from one to the next until reaching the end of the line, and then turn around and come back and wait in line for their turns to come again. The same procedure was repeated until the time was up, and in each round, the fastest participant was announced. | 20 hula hoops |
| 2) Collecting balls into buckets | 50 coloured balls were scattered around the ground. Groups were asked to collect as many balls as they can into a bucket assigned for each and then counted which group had the larger number of balls. | 50 balls 2 buckets |
| 3) Fast walking in place | Participants were asked to form a circle standing on flat feet and were asked to walk as fast as they can in place for 40 seconds and rest for 20 seconds. The process was repeated until the time was up. Participants were encouraged to cheer each other verbally to complete the activity. | None |
| 4) Hopping over a jump rope | Two jump ropes were placed on the floor in a straight line with 1 m distance in between. Participants in each group were all asked to jump over it from one side to another as fast as they can. Participants were counting the number of jumps to motivate each other and then cheer for the winner. Participants took rest when needed. | Two jump ropes |
| 5) Catch the ball | Assigned groups faced each other keeping 1 m distance in between each participant. Group members were asked to throw and catch the ball to each other. After each minute, participants were asked | 8 balls |

| | | |
|---|---|-----------------------------|
| | to take a step backwards to increase the distance and continued throwing and catching for 4 minutes. | |
| 6) Racing | All participants raced together starting from a marked line on the ground until reaching the opposite marked line on the ground on the other side of the track, turned back and ran back to the start line. | None |
| 7) Kick the ball | Participants were asked to stand facing each other (group 1 facing group 2) keeping 2 meters' distance in between them. They were asked to kick the ball to each other in turns for 4 minutes. After each minute, participants were asked to take a step backwards to increase the distance and continue kicking until the time was up. | 8 balls |
| 8) Running & kicking the ball | Participants were asked to run while kicking a ball, going back and forth the designated area for the activity. | 13 balls |
| 1) Running through plastic cones | Group 1(20 cones, 10 for each group), group 2 (40 cones, 10 for each group). Yellow plastic training marker cones were allocated on the ground forming two straight lines, 10 cones each line (10 m length) keeping 1 m distance between each in line and 2 m between the two lines. Two participants, one from each group played against each other. Participants ran through the cones until reaching the 10 th cone and returned back through the cones until reaching the first cone. The same procedure was repeated until the time was up. | 40 training cones |
| 2) Bouncing the ball | Participants were asked to stand facing each other (group 1 facing group 2), keeping 2 meters' distance in between them. The one who had the ball started bouncing it until reaching his partner to give him/her the ball and went back to stand in place. The other participant did the same, and the same procedure was repeated for 4 minutes. | 8 balls |
| 3) Hopping forward, backward & sideways | Participants were asked to form a circle standing on flat feet and jump one step forward and one step backwards with their feet for 40 seconds. Then they rested for 20 seconds and performed the same activity again but sideways. The procedure was repeated to finish two rounds sideways and two rounds forward and backwards. | None |
| 4) Crawling through fabric tubes | 2 fabric tubes were placed on the ground, one for each group. Two participants, one from each group played against each other in turns. Participants were asked to crawl through the tubes as fast as they can, and once they reached the end, they came out and returned back running for the next participant to play and waited in line for their turns to come again. | 2 fabric tubes |
| 5) Hitting the ball with a racket | Group 1 faced group 2 keeping a 2 m distance between each participant. Participants in group 1 held rackets where group 2 threw the balls for participants in group 1 to hit it with the racket for 2 minutes. The same procedure was repeated for another 2 minutes of switching roles. | 8 rackets 8 tennis balls |
| 6) Hopping into plastic doughnuts | Group 1 (10 plastic doughnuts, 5 for each group), group 2 (20 plastic doughnuts, 5 for each group). Plastic doughnuts were placed on the ground forming a straight line no space in between each, with 1 m distance between the two lines of plastic doughnuts. Participants were asked to hop into the doughnuts with both feet until reaching the end. Then came back to performing the same activity. | 20-plastic doughnuts |

| | | |
|----------------------------------|--|----------------|
| 7) Throwing a ball into the wall | Participants were asked to throw a ball into the wall and try catching it from 1 m distance and increased the distance gradually after each throw. | 13 balls |
| 8) Shooting hoops | In turns, participants were asked to throw the basketball into the hoop. They were asked to bounce it for a few seconds and then aim for the hoop. | 1-2 basketball |

These activities were suggested to help participants improve their flexibility, eye-hand coordination, balance, fitness level and learn how to perform new activities/skills (i.e. hula hoops jump, racing, throwing & catching ball...etc.) (Cannella-Malone et al., 2011; Todd and Reid, 2006). Also, exercising in the form of group games is suggested to make exercise sessions more enjoyable and encourage participants to stay active as well as increases their motivational levels and social engagement (Cannella-Malone et al., 2011; Todd and Reid, 2006). Exercising with a group can provide children with autism an opportunity to socially engage, learn and practice social skills (Webster, 2016). Research suggests that sport group games such as running, jumping, dribbling, kicking and catching can be an ultimate opportunity for children with ASD to get socially stimulated and learn from their peers as they miss being included in many daily tasks such as playing in a park or at recess with peers that naturally develop social skills in typically developed children (Guest et al., 2017).

The figure below explains how the 16 activities were divided into two groups of 8 activities were each group of activities was alternated every week with the other group of activities from week 1 until week 10. The top section of this figure represents the week numbers and the activities conducted in each week in order. As it shows below, the same activities conducted in the session during week 1 were repeated in weeks 3,5,7 and 9 and alternated with the other 8 activities in weeks 2,4,6,8 and 10.

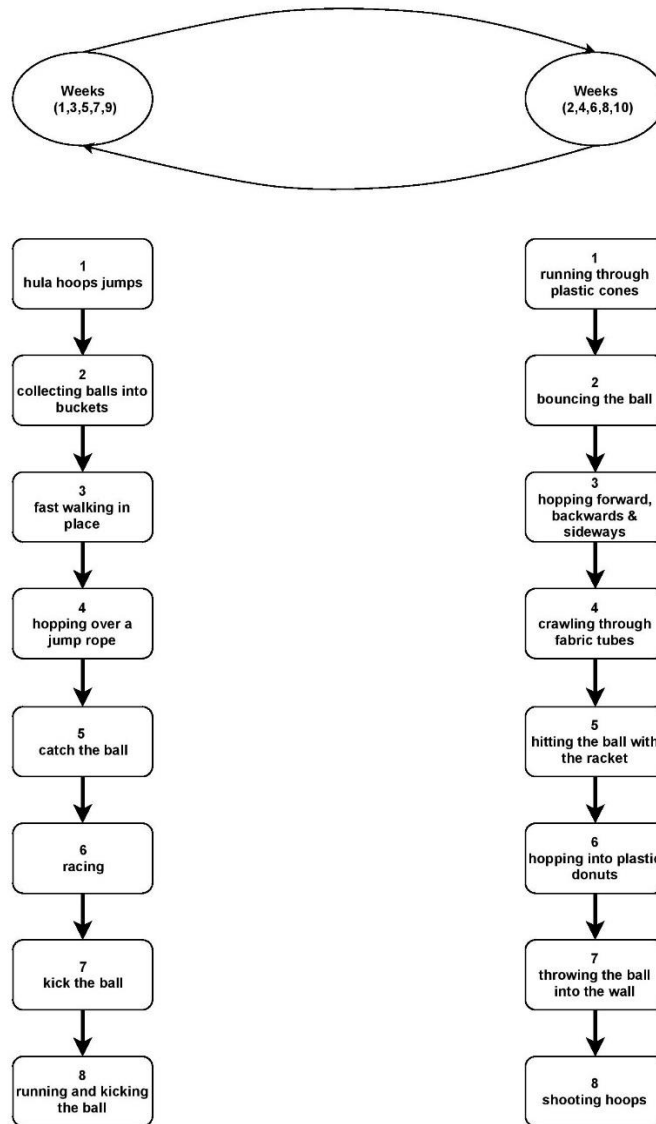


Figure 5.4 Mixed games sessions activity circuit.

Procedure

Participants arrived at location accompanied by their caregivers dressed in appropriate clothing. Upon reaching the activity area at the field, the researcher, trainers and the assistants greeted the participants and began encouraging them by asking them “are you ready to exercise?” After that, the trainer explained the exercise routine to the participants referring to the poster (pointing out the activity name and number) and also mentioned that the activities have to be done in order. Following this, participants were introduced to their exercise charts focusing on the order of activities and the empty section where the happy faces were placed

after completing each exercise. Right after, participants were gathered at the centre of the track forming a circle for the warming up activities. After that, the participants were directed to move to the designated area for activity number 1 to start with the activity circuit. The trainer explained the activity and provided a demonstration (modelling) and then asked the participants to perform it. Modelling and explaining time was not counted. The assistants were directing each participant and providing modeling and physical guidance when needed. Also, the trainer and the researcher exercised alongside the participants to monitor time and participant's performance as well as provide physical guidance and verbal cueing/directives when needed. Each had a timer, timing 5 minutes for each activity including 4 minutes for performing/practising the activity and 1 minute to place the happy face next to the activity they completed and return back to proceed as directed with the next activity on the chart. The trainer and the researcher used to whistle when 4 minutes were over to notify the participants that activity time was up and it is time to place the star on the exercise charts. The same procedure was followed with the rest of the activities until completing all the assigned activities. If any participant showed any signs of discomfort (flushed face) during the exercise session, they were asked to walk in place for (15 seconds) and if was still tired or out of breath they were asked to sit for another (15 seconds) and then proceeded with the activity. Following the 40 minutes of mixed games, the participants were directed to gather at the centre of the track forming a circle for the cooling down activities. At the end of each session, participants used to count the happy faces on their charts and were congratulated for completing the session.

Aquatic activity sessions

The activities included and the design of the aquatic program was based on the Humphries Assessment of Aquatic Readiness HAAR (Humphries, 2008). The warm-up activities and the one-to-three direct instruction activities were designed based on the skills (content) of the five stages of the HAAR that was developed according to the bases of the Halliwick method (Martin, 1981). This method is based on scientific principles of the way body moves in a hydro environment, and it is divided into four phases: water adjustment, water rotations, movement control, and moving in the water. Therefore, the design of this program utilises learning physical movements in the water, how to move in an aquatic environment that leads to the natural progression of how to swim. The HAAR checklist was used in a number of studies and reported to be safe for all people with or without disabilities (Pan, 2010, 2011). It was also reported to be valid and highly reliable giving high-level results of inter-observer agreement (above.90) (Humphries, 2008). The program also utilized engaging in water aerobics that was

developed according to what was found in existing research (Fragala-Pinkham et al., 2008; Pan, 2010, 2011) and the activities chosen to match the principles of HAAR and were developed to achieve the same goals (aquatic and motor skills development and enhancement of social interaction skills).

The aquatic activity took place once a week at an outdoor pool at the leisure centre. Aquatic sessions were the third activity carried out every week of the program and ran for 10 sessions. Each session lasted 60 minutes and was scheduled into the participants after school activity schedule. The swimming session was divided into 4 phases (floor activities, one-to-three direct instruction, water aerobics, cool down activities) (see table 5.3 below). The first 10 minutes consisted of floor activities (visual schedules, warm-up and water adjustment). Then, it was followed by 30 minutes of one-to-three direct instruction. After that, water aerobics took place for 15 minutes and was followed by 5 minutes of (cooling down, and review schedule). Exercise intensity was moderate to vigorous, and participants were offered to rest when needed using the pool wall/side poles. Four swimming instructors and four assistants worked with the children and were all introduced to the program before the study began. Each group was divided into three/four groups of 2 or 3 during phase 2 only, and each was assigned to a trained instructor and an assistant throughout the program for participants to feel comfortable and get used to the group. Grouping participants were determined by the researcher for the swimming instructor and the assistant to focus on each child and provide appropriate time and effort for each to ensure the development of skills and effectiveness of the program. Also, all participants had limited breathing skills, balance, floating and stroke skills based on parents reports and the instructors and the researcher's observation during the practice session. Therefore, it was best to work as one to two or one to three maximum to allow individualised instructions and for the instructors to be able to follow participant's progress of the skills at his/her own pace and taking into consideration the challenges that might occur during the sessions associated with the environment and participant's disability (the water, the skills taught, personal traits). In addition, the program was implemented on a one-to-two and one-to-three instructor to student ratio based on previous research studies (Attwood, 1997; Best and Jones, 1974; Fragala-Pinkham et al., 2008; Huettig and Darden-Melton, 2004; Killian et al., 1984; Pan, 2010, 2011; Rogers et al., 2010; Yilmaz et al., 2004). During phase 3, each group was divided into two groups, where each group had an instructor and two assistants. As participants worked to gain independence in the water during phase two, they were influenced to become part of a group during phase three to develop social skills and aquatic motor skills yet having constant one to

one attention of the instructor and the assistants. Water aerobics activities (see table 5.3) focused on strengthening the muscles like in running in place, jumping jacks and hopping. It also focused on group games like racing and keeping the ball away from the coach providing participants to get physical and interact with their peers creating a physical, social environment to positively impact their social development and physical health. Verbal cueing, modeling and physical guidance and poster boards were used during the sessions (see pedagogical considerations section above).

Participants attended a swimming practice session prior to the beginning of the program to familiarize them with the activity and the context. They were invited with their caregivers to swim at the pool at the centre before the program began. The trainer briefly explained the content of the aquatic program for the parents and their children and the equipment needed. The poster board was also introduced at the practice session (see the section above). One swimming instructor briefly explained each phase to the participants (warming up, water orientation skills, group aerobics and cooling down) while another instructor was performing some of the skills in each phase in the water as instructed by the other instructor. The researcher and the instructor then asked the participants to join the other instructors and the assistants in the pool and follow the trainer's instructions. Participants were asked to perform some water orientation skills as instructed by the trainers. Participants were provided with verbal cues and guidance along the way. The researcher and two assistants were out of the water and nearby to supervise and offer help when needed while participants were in the water with the instructors. By the end of the session, all participants entered the water and performed some skills, some participants were able to get into the pool independently, follow instructions and were comfortable exercising in a hydro environment were some needed assistant all the time.

Equipment

The following equipment was employed. Tape, pool ropes, pool foam rollers, floatation devices, head caps, earplugs, goggles, water noodles, hula hoops and balls. Floatation devices were provided for those who were unable to swim well (this included a belt, aquatic noodle, kickboard). Also, head caps, earplugs, and goggles were provided as needed by participants to minimise irritations and increase their tolerance to the wet environment. Addressing sensory difficulties and their sensitivity toward certain environmental factors (water and noise) was important to maximise their engagement levels (Fragala-Pinkham et al., 2008).

Setting

The outdoor swimming pool located at the centre was used. The physical environment was organised by establishing clear boundaries by marking the areas so that the participants understood where they may or may not go. An area on the floor on the pool deck was marked with tape to indicate where the warming up activities took place. In addition, each group had a specific area in the water to exercise with marked water boundaries (i.e. ropes, foam rollers). The Poster board was placed in a corner close to the warming up activity area.

Table 5.3 Aquatic sessions protocol

| Phase | Length (min) | Content | Goal |
|-----------------------------|-----------------|--|---|
| 1. Floor activities | 10 | View schedule Warm-up activities (stretching arms, legs and chest) Splashing water with hands or feet | Warm-up to prevent injuries Water adjustment Reinforce communication and social interaction |
| 2. One-to-three instruction | 30 | Water orientation skills A. Intro to the water environment (touching chin, ears, mouth to water, pouring water on the head) B. Breathing skills (placing head in water without consuming much water) C. Floating (learning positions and rotating from one another supine, standing & prone position. D. Balance & control movement (allowing the instructor to move them through the water in the prone/supine position E. Stroke skills (leg kicks with instructor support or holding pool deck. Moving arms with instructor support) F. Learning swimming styles starting with the basic (front/backstroke, freestyle stroke) | Water orientation and swimming skills |

| | | | |
|---|----|---|---|
| 3. Water aerobics (at the shallow end) | 15 | Running in place- jumping jacks- hopping on one foot-jumping in place-jumping forward, backward & sideways Noodle kicks, noodle jumps, swimming through, under, over hula hoops Race as a team using noodles Catching & throwing balls between participants to keep it away from the trainer shoot balls into hoops | Aquatic & motor skills development and social interaction |
| 4. Cooldown (stretching in the water) | 5 | Marching in place, arms & legs stretching (use pool wall if needed) | Cooldown to prevent injuries |

Procedure

Participants arrived at the swimming pool dressed in appropriate swimming suits accompanied by their caregivers. Participants were grouped together and introduced to the routine referring to the poster board and the order of the session emphasising on starting with phase one until ending with phase four. Right after, all participants gathered at the marked area on the pool deck to start with the floor activities (warm-up activities). One swimming instructor was directing the participants providing modeling, and verbal directions and the researcher and the assistants were warming up alongside the participants providing physical guidance and verbal cues when needed. After that, each trainer and his assistant asked his assigned group to enter the pool and assisted who needed help and started with water orientation skills while providing verbal cues, modeling and physical guidance. Following this, groups were gathered to start with phase 3 (water aerobics) where each group had one instructor and two assistants and that was followed with phase 4 (cooling down). At the end of each session, one of the trainers reviewed the schedule with the participants specifying the skills they worked on and mastered. Also, the trainers encouraged participants to improve their swimming skills at the next session. They reinforced them verbally and physically (e.g. high fives, claps, tap on the shoulder) for completing the session. Once water orientation skills were mastered, the trainers moved to learn swimming strokes. Once a swimming stroke was mastered, the trainer moved to learn a new stroke style. Research suggests that if participants are at an elementary level, it is best to start with breaststroke and elementary backstroke and If they are at an intermediate level, then they can start with front crawl, back crawl or sidestroke (Fragala-Pinkham et al., 2008; Rogers et al., 2010).

Chapter 6: Results

The previous chapter has provided an overview of the teaching procedures applied in the exercise sessions and outlined how the exercise program was delivered. This chapter provides an overview of the analytic methods/frameworks employed during the analysis of the data collected from the MABC-2, semi-structured interviews and observations. Within this chapter, the full results of each aspect of the study are also presented.

Motor functioning assessment

The Movement Assessment Battery for Children-2 Movement ABC-2: (Henderson et al., 2007) was used to compare the test results in a group of boys and girls with mild and moderate autism and age-matched typically developing boys and girls (participants in the study) pre and post the intervention to examine the exercise program's impact on their motor abilities/competence.

Analysis

The scores of the individual items were recorded and the raw scores for each task in the three domains of motor competence: manual dexterity, aiming and catching and balance were converted to standard scores for each child based on the age of the participant using the MABC-2 conversion tables (see appendix 6). Then the total test score (TTS) for the whole MABC was calculated for each individual by summing the 8 item standard scores (see appendix 7). The mean improvement of all participants was calculated as well as performance in percentages. A one-way ANOVA was conducted to compare groups scores pre-and post the exercise program and group performance on each task and no significant difference was found.

Results

Figure 6.1 shows the mean total test score pre-to post-intervention. These results indicate that all children with autism in both groups and the typically developing children in group 2 showed progress. The results indicated that the inclusion group showed better scores pre- and post-intervention approaching significance. The children with and without autism scored 53.3 and 62.1 (TTS) on an average pre and post-intervention, respectively, compared to 39.5 and 48.5 (TTS) scored by the segregated group. Moreover, the improvements presented in figure 6.1 represent an average increase of 16.5% for participants in the inclusion group when compared with that of 22.7% in the segregated group. The improvement is the percentage change of the TTS post to pre-intervention.

The improvement is calculated as follow:

$$\text{improvement} = \frac{(\text{post intervention} - \text{pre intervention})}{\text{pre intervention}} \times 100$$

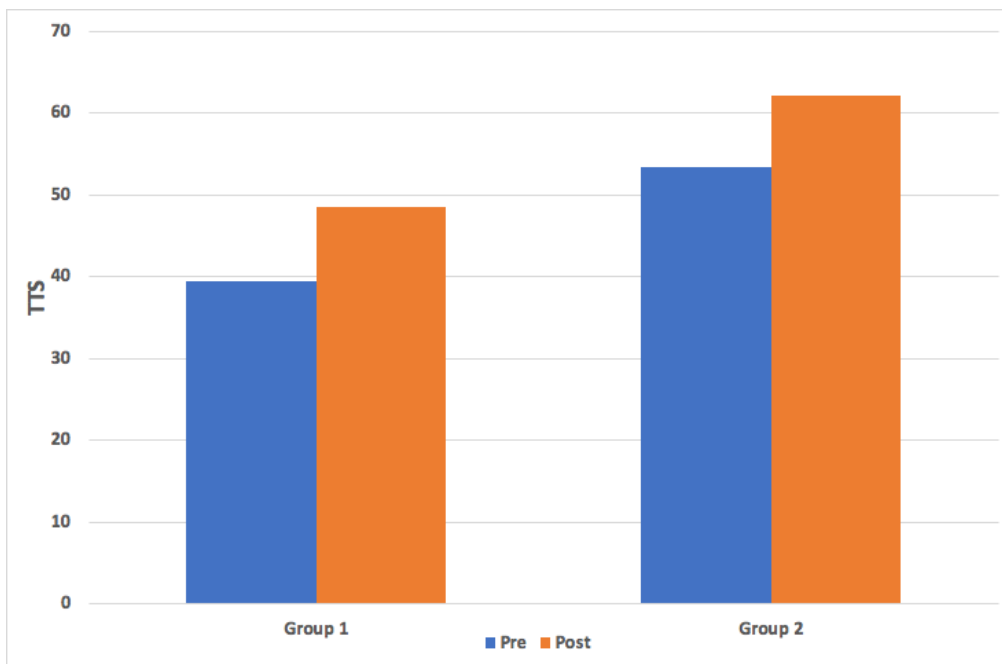


Figure 6.1 The mean pre-to post-intervention total test score (TTS) in the two groups (group 1 segregated, group 2 inclusion)

In specific to children with autism, there was a significant difference between their pre-and post-scores (TTS) 33.4 and 42.6, respectively, with a mean improvement of 27.4% in group 2 (inclusive group), with one child improving by as much as 65%. The improvement in the inclusive group was higher compared to group 1 (segregated group) 22.7%, as shown in figure 6.2. Participants in both groups who were identified with mild and moderate autism appear to have benefited from participating in exercise where the inclusion group had a slightly higher improvement by 4.7% compared to the segregated group. Moreover, the typically developed children showed an improvement of 10.9%.

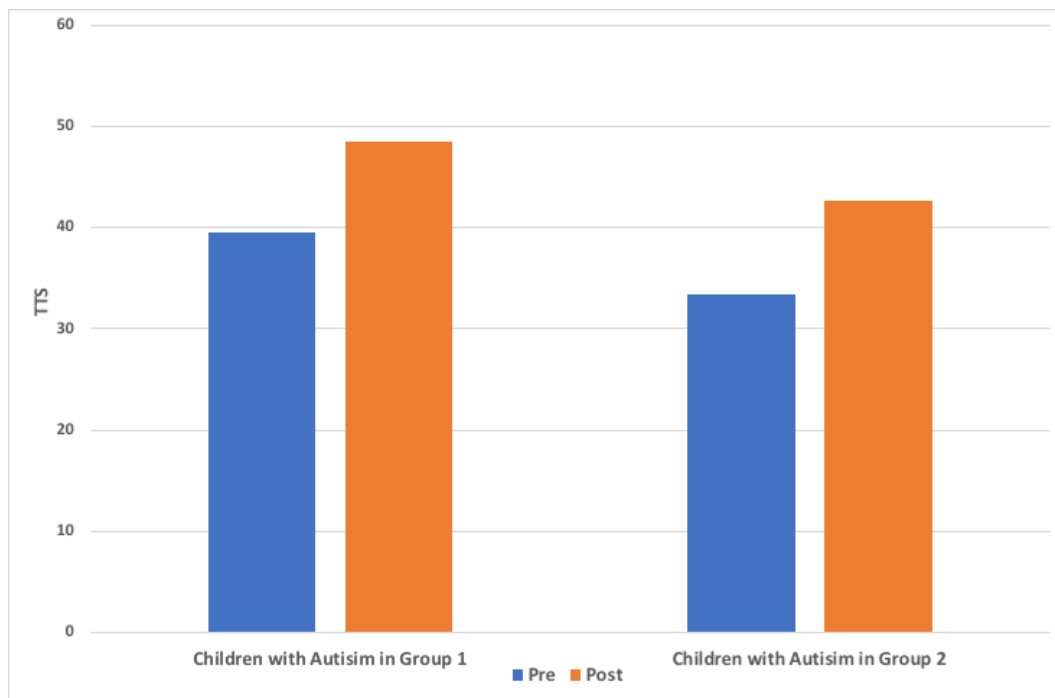


Figure 6.2 The mean pre-to post-intervention total test score of children with autism in (group 1 segregated, group 2 inclusion)

In addition, statistical analysis of the test components (the tasks) showed differences between the two groups; this can be seen in figure 6.3. On manual dexterity, the mean increase was 27.3% in the segregated group and 16% in the inclusive group, while in aiming & catching it was 36.1% in the segregated group, and 20% in the inclusive group and for balance task, it was 27% in the segregated group and 16% in the inclusive group. These findings suggest that children in the segregated group elicited higher improvement than that of the inclusive group. However, children in the inclusive group elicited higher scores than that of the segregated group across in all tasks, as shown in figure 6.3. Since typically developing children in group 2 scored high pre-the intervention; therefore, their improvement post the intervention was not high compared to children with autism. Repeated-measures one-way ANOVA analysed results; it revealed no statistical significance between the two groups. Total test scores were entered separately, and both showed no significant difference ($p=0.27>0.05$). Moreover, if the autistic children are compared with well-developed children the results showed a significant difference ($p=0.0005$). Post hoc analysis showed no effect between the pre and post TTS for both groups ($p>0.05$).

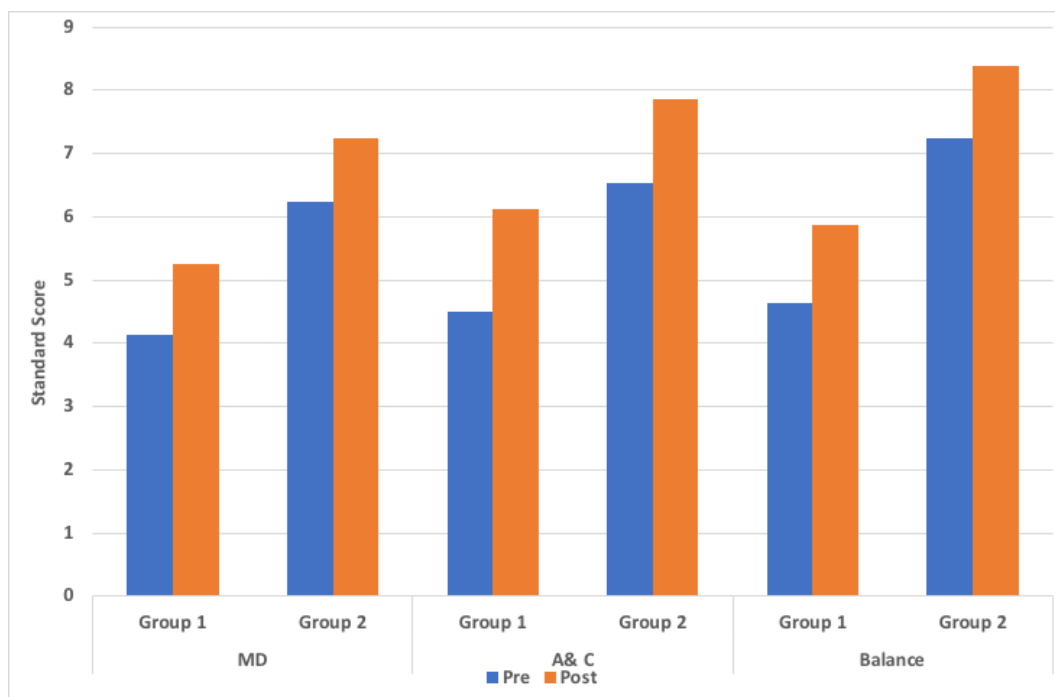


Figure 6.3 Pre-and post-mean standard scores across all tasks in the two groups (group 1 segregated, group 2 inclusion)

Manual dexterity (MD), Aiming and Catching (A&C), Balance

The previous section presented the full results of the Movement Assessment Battery for Children-2 Movement ABC-2. The following section presents the full results of the semi-structured interviews.

Semi-structured interviews

Analysis

A thematic analysis framework was employed to guide the interview data analysis (Braun and Clarke, 2006). This method facilitates the organisation of data and provides a detailed description of the data. It consists of identifying, analysing and interpreting the text to report pattern and themes within data (Braun and Clarke, 2006). Both inductive and deductive approaches were used to thematically analyse data by using open and axial coding (Corbin, 2008). Open coding involved reviewing the data as a whole, the responses of each participant in specific, generating codes and organising groups of codes into categories. Axial coding involved focusing on connections between codes and linking similar meaning units together under a broader theme. Rereading the transcripts was an important step to ensure that all

relevant data had been coded (Stake, 2013). Similar codes were placed together, generating categories (inductive) to summarise accounts for each participant and followed by broader themes (deductive) emerging to examine its relation to the research aims (Quinn, 2002). The analysis focused on data within the scope of the research aims; the impact of exercise on children with autism spectrum disorder when included with typically developing children versus segregated, the impact of mixed games sessions compared to individual exercise (jogging and swimming) on the physical, cognitive, social and emotional, language and communication skills and behaviors of children with ASD, determine the influence of elements applied to exercise setting as structured teaching procedures, physical structure and organisation of setting on improving participant's performance. Cross-case analysis was applied to make comparisons between themes emerging from each case (Stake, 2013). The focus was on identifying commonalities (shared/similar experiences) and differences (differences found in which participants described their experiences) across cases.

Results

In the following section, the findings of the analysis are presented. The data analysis resulted in 8 themes related to the impact of exercise on children with autism. The themes emerged from the data collected from section 1 of the interviews that were conducted prior the start of the program representing parent's views, and previous experiences of their children in physical activity programs included four themes:

1. Engaging and disengaging elements applied to the exercise setting.
2. Challenges faced by children with ASD when engaged in exercise.
3. Satisfying and dissatisfying factors of exercise-based programs.
4. Barriers to exercise.

One theme emerged from the data collected from section 2 of the interviews that were conducted during the program at week 5 representing parent's views and opinion of the present program included:

5. Positive and negative elements of the exercise sessions.

Three broad themes emerged from section 3 of the interviews that were conducted post the intervention that represents the overall impact of the program on the child's skills and parent's recommendations included:

6. Benefits of exercise.
7. Recommendations.

8. Qualities of the program.

Theme 1. Engaging and disengaging elements applied to exercise setting

According to the parents, all of their children liked to receive reinforcement in different ways which is an important teaching strategy when dealing with children with autism. However, in previous exercise programs that their children were engaged in, it was felt that the lack of reinforcement negatively impacted participants engagement in the activity. Some professionals used one kind of reinforcement, either verbal or edible, and it was not consistent neither chosen upon the child's preference. As a result, their children were not engaged enough, and reinforcement was not as effective as it is supposed to be. Parents mentioned a kind of assessment called formal and informal stimulus preference assessment that is usually used with children with autism to motivate them to engage in a new activity and increase pleasant/target behaviours that determines the highly preferred stimulus items to use with the child and the least preferred to exclude (e.g. edible, visual, activity, tangible, aroma). This formal and informal assessment was used with their children during one to one session in the private centre and it was a successful way to increase the occurrence of the target behaviour. Parents noted that this kind of assessment should be used during exercise to motivate their children to exercise. For more details about paired stimulus preference assessment please refer to (Carroll and Klatt, 2008; Miguel et al., 2001; Roane et al., 1998). One couple mentioned that their child liked being engaged in exercise, but he sometimes lost interest in the activity and sometimes would not respond because of the kind of reinforcement was not his preference.

A mother discussed her experience with her son MK, by saying:

He is pretty stubborn when it comes to reinforcement. We try to get him to do things by using different kinds of reinforcements like verbal, physical, tangible, and we try our best to avoid edibles, but it is not always successful. She noted that MK would not follow any instruction unless he was given candy or something edible. During his participation in any program, they used to refuse using edible reinforcement as a strategy to engage him. It was frustrating to him, and he used to get aggressive toward himself and others. (MK)

Parents reported that their children like exercising but the teaching procedures used were the issue. They mentioned that some programs used verbal cueing, modelling and exercise charts, but it was not aged appropriate and did not consider individual symptoms. A couple said,

“Exercising was a disaster; it was overstimulating for her, so many unwritten rules, very long verbal instructions and very fast modelling. No, it did not work for her; she was just roaming around.” (JA)

Some parents noted that the type of exercise itself was not engaging. All of the parents wanted their children to exercise all year long, and they valued exercise whether or not they liked the type of exercise/sport. After trying and participating in different activities, the parents were convinced that the child should indicate a desire for the type of exercise they wanted to participate in. They felt that it would make them stay engaged and focused. For example, most parents reported that their children preferred swimming for any other activity. A mother noted that her son would much rather swim or spend all day in the water than walk. Similarly, a couple shared that whenever there is a pool, their son would throw anything in it just for him to go in and get it and never come out. Parents noted that if their children were swimming, then they would not really care about reinforcement, because the type of exercise itself is reinforcing and rewarding. Their children also act differently in the water compared to any other setting. A couple mentioned that their boy YH would be so much engaged while swimming, follows instructions and showing facial expressions that he usually does not show in any other setting.

Some parents noted that the physical structure of the exercise setting could be either engaging or disengaging. A mother stated, “Physical boundaries are very important for our children to have clear visual boundaries marking the space for specific activities.” (MG) According to parents, a physical structure such as setting physical boundaries increase their children’s independence and influence them to finish the task. A couple mentioned that their child feels more secure when boundaries are provided, and it reduces his off-task behaviours. A father illustrated how their son is devoted to physical boundaries when he said, “He gets overwhelmed if there are no clear boundaries for him to follow and he keeps on asking questions about where to stand and where to go to set boundaries for himself.” (AM)

In summary, parents discussed three elements that they thought were important to engage their children in previous exercise programs that they were engaged in. However, these elements were misapplied, and it disengaged their children instead, which are: teaching strategies (e.g. reinforcement, modelling), the type of exercise and structure (e.g. physical structure).

Theme 2. Challenges faced by children with ASD when engaged in exercise

Parents explained that one of the autistic children’s core symptoms is experiencing deficits or delays in the development of motor skills. Parents discussed how being autistic is accompanied

by weak physical strength, poor fitness and abilities, which made engaging in exercise more difficult and challenging. Some parents mentioned that it (physical weakness) makes it harder for them to go on the trampoline, to jump, to hop and to play.

They added that their children have limited motor coordination and motor planning. They also indicated that they display muscle weakness and clumsiness. As a result, their physical abilities are often challenged when engaged in exercise. A couple related by saying, “Our boy never catches a ball, and he moves his hands after the ball passes through. It is always difficult for him to reach out for something and be able to get it from the first time.” (AB) Similarly, a couple said, “Our girl finds it difficult to stop moving when being told or when facing a person or an object. Usually, she bumps into things or people then she stops.” (JA) Similarly, a mother said, “My boy loves basketball, but he finds it very difficult to dribble the ball and move at the same time, he either uses his arm and hand or his legs.” (AM)

In addition, pain and fatigue were also highlighted because it interferes with completing tasks. A couple said, “Our child usually gets tired easily and faster compared to other children, and he also asks for more breaks than others. When they asked their child, he said, “I just cannot do it without taking a break or slowing down, if I do not do so I would be very tired.” (MG) A couple who had a nonverbal girl reported that they noticed that their daughter stops the activity and falls on purpose and that was her way of saying “I am tired, I need a break” she does it frequently.

Parents discussed muscle weakness and that it made exercising more difficult for their children. Parents always noticed that their children differ in how they perform the activities when compared to other children. Many parents related by saying, “Their muscles are not that strong, and it is harder for them to hop or jump compared to other children.” A mother related by saying, “My boy cannot jump or hop as high as other children.” (YH) Similarly, another mother commented, “My autistic child jumps on the trampoline but not as high as his younger brother; his brother jumps higher than the fence where AB can only jump half of the fence or less.” (AB) Similarly, a couple said, “Our autistic boy has weak legs, unlike his brother. When they race, his brother is faster, steadier and balanced where AM is clumsy and much slower.” (AM)

Social interactions were also highlighted as a challenge to children with ASD in an exercise setting. On the one hand, relationships and social interactions between parents and their children got better and stronger every day as they learnt how to deal with them and help them. However, autism put a strain on their relationships with peers and their social interaction with

others. Parents indicated that they are always supportive and try to include their children in formal and informal activities. Nevertheless, other children do not know how to deal with them, and they do not understand their behaviors. Parents explained how it is always difficult to interact with others unless they are trained or experts in the autism field. A couple recalled, “We are always asked, “why isn’t he talking?” “why isn’t he playing with me?” “why he is not answering my questions?” They went on to comment that, “The most difficult is group games if it is unstructured. Children expect you to follow their lead or initiate a game or a conversation, but with our children, the case is different. You have to be direct and show them how to play.” (MK) Some parents mentioned, “Our children have minimum opportunities to interact with other kids and be around others. It is very upsetting for us because they are unable to get involved, and when they do, it would not be that easy.” A couple related by saying, “Our girl usually gets really happy when being around other kids keeping her proximity of course but she seeks their attention in her own way by touching them and then running away. It is challenging because other children do not understand what she is doing, and some get afraid.” (JA)

Feeling secure and trusting others was another challenge faced by children with ASD in many situations. According to parents, their children do not trust people easily as they do not feel secure, especially if they are unfamiliar with the person. It is very difficult for them to adjust to new situations; usually, it takes a long time for them compared to others. YH’s mother recalled, “When my child was first engaged in an exercise program, it took him a month to get used to the trainer and the setting, and he refused to stay, and he did not allow the trainer to touch him neither was following instructions. However, after a while, he felt secure knowing the trainer and established a good relationship with him.” (YH2) Another couple mentioned that they had to stay with their daughter for the first few sessions for her to trust the team. Then, they had to stay close where she can see them and later on, they were able to leave and come back later to pick her up. Another couple said, “Our son gets really aggressive and anxious when put in new situations and has to be dealt with care until he gets used to it.” (MA)

In summary, parents of children with autism mentioned a number of challenges that faced their children in previous exercise programs that they were engaged in which are poor physical abilities and limited motor coordination, pain and fatigue, muscle weakness, social interaction and feeling secure.

Theme 3. Satisfying and dissatisfying factors of exercise programs

All parents described factors that made them satisfied or indeed dissatisfied with an exercise program. The type of activity was the main factor mentioned by all parents. Parents reported that mostly the only activity/sport offered for their children is swimming. Some said, “it is either swimming or nothing.” Parents also mentioned that the special centres mostly offer occupational therapy or activity sessions that include activities such as throwing, catching and balancing with very mild intensity. A couple related by saying, “We want our boy to be engaged in sports such as swimming, football and aerobics. The sessions he is receiving in the centre are more of an occupational therapy than work out.” They went on to comment that, “We noticed that if it is a sport/activity he likes we do not have to try hard to convince him to try and be active, but when the type of exercise is not satisfying and not intense he would absolutely refuse.” (MG)

All parents with no exceptions mentioned that their children loved to spend the day in the water (at a pool or water park), and they want to make use of that for their children to learn real swimming. However, swimming sessions are not always available for their children and if available only for short periods not all year long. Parents want their autistic children to be exposed to a variety of exercises and sports to gain the well-known benefits of exercise better. Most of the parents were concerned about their children living a sedentary lifestyle because of the limited number of programs designed for this population. A couple related their concern about their child saying, “He is overweight, we think exercising is the best solution for this matter but exercising twice a week is not enough. We want him to swim, jog, play ball and be busy at least 5 days a week. He marks the dates of the swimming sessions on his calendar, and say “why isn’t it every day?” (YH)

Parents of children with moderate autism were also concerned about their children maintaining their weight, especially that they prefer edibles as reinforcement, especially sweets and they were not physically active. A mother related her concern about YH weight saying, “Mostly YH responds to directions when offered edible reinforcement; I think the only exercise will keep him in check. Because of the way he is eating candy and sweets. I think he would gain so much weight if he did not start and continue exercising.” (YH 2) A couple also indicated that they noticed their child’s improvement in following directions when he was active and that he received fewer edibles on the weekends when he swam for hours, “The only physical exercise MK was doing is swimming during the weekend. That is why we could tell that swimming had an impact on his ability to follow directions during and after swimming without edible

reinforcement. The change was noticeable in him on the weekends when he swam versus when he did not. We love to see him swim during the week for his benefit.” (MK)

The parents perceived that exercise helped maintain weight and for some lose weight. They all saw improvement and were all looking for opportunities for their children to stay active and engage in exercise. All parents concluded that the type of exercise was either satisfying or dissatisfying for their children and them as parents. They all mentioned how their children indicated a desire to engage in a particular sport/activity that made their participation much easier. A mother recalled, “When my boy started swimming sessions, he was so engaged, and he was taking it seriously and wanted to become a champion and be on a swim team. I used to get a very happy hearing that, but swimming sessions stopped for some reason and it was hard to get him into another activity after that.” (SL)

Another factor that was discussed is pedagogy. According to parents, the teaching procedures used during the sessions are what mainly satisfy or dissatisfy them and their children. MK’s mother said, “The way you deal with my child is the key to engage him and satisfy him and me.” Parents mentioned that for a program to be successful and satisfying, teaching procedures should be tailored to the child’s needs. A couple reported their child’s positive experience by saying, “He was not excited about exercising at all, but when he found that the tasks are organised, and the trainer is using constant reinforcement and modelling, he loved it and wanted to stay longer even after the session was over.” (AM) Parents also indicated that verbal instruction should be short and clear followed by modelling. A mother related by saying, “long instructions distract my child and make her hyperactive because she is not following!” (JA) Another couple shared their child’s positive experience by saying, “Our child started copying the coach and the way he speaks after a few weeks from being in the program because he used direct verbal instructions and cueing. He used to drag us to the door and asks us to go to practice.” (SL) Another couple shared a negative experience by saying, “Our child is nonverbal, and he likes to see more than hear. The coach was giving too many instructions at once, and it made him frustrated and disengaged. Two weeks after, he started throwing tantrums refusing to get into the field.” (AS) This couple went on and recommended that instructions better be simplified and broken down into small steps/tasks when dealing with children with autism.

Another factor that was discussed is the duration of programs. Parents noted that most programs available are very short and are not available all year long. Parents mentioned that their children are devoted to routine, and when engaged in an exercise that they like, they want

it to last forever. Parents want their children to exercise all year to have a positive impact on their overall health, but this cannot be achieved if programs are only offered for a few weeks! A mother noted that her child loves being physically active and that it brings joy to him but gets really sad when it is over. MG's mother said, "MG used to walk every other day with his father, and he used to come back very happy telling me about what he saw on the streets while walking and how sometimes he was faster than his father. Then his father got really busy at work and stopped taking him for walks. His mood and attitude both fell significantly at that period." (MG) Also, parents noted that exercising for long durations or all year long can influence an active lifestyle for their children and can encourage them to participate more in organised and unorganised activities making exercise a habit. SL's father said, "Our boy was looking forward to last summer because he knew about the program taking place then, and when it started, he was so excited, and he used to sleep wearing his working out clothing." (SL) In summary, parents discussed three factors that made them and their children either satisfied or dissatisfied with previous exercise programs that their children were engaged in which are the type of exercise, pedagogy and the duration of programs.

Theme 4. Barriers to exercise

Cost.

One of the barriers that were mentioned by most parents is cost, particularly for those coming from a poor social class. Couples discussed that sports programs, when available, are very costly, and it is usually controlled by the private sector that is unsupervised by the government. A couple shared, "We really want our boy to play sports, but it is pretty expensive, and we do not have enough for him to participate all year! Once you get into it, you realise it is an expensive intervention." (MA) Parents discussed that participating in a proper sport with a specialised trainer can cost thousands of riyals even at a recreational level. A couple shared, "We know that there are plenty of sports that can greatly benefit our child, especially if hiring a private coach. However, we have to be realistic and take into consideration the cost of the trainer, facility and equipment if needed." (AB)

Funding for exercise programs for children with special needs is rarely available. This population need funding through scholarships, grants and sponsors. According to parents, funding could be available, but they do not know how and where to obtain financial assistance. Some couples mentioned that they created a group of parents to look for funding for their children to participate in exercise. They all reported that we found ways to obtain appropriate

funding through sponsors, but it was not consistent. A couple stated, “We had a meeting with a sponsor, and they promised to pay for our child’s activities once we find a program, and they did but after a while and due to an economic crisis, they asked us to cut the expenses and we could not as the price for the activity was fixed. So, we stopped taking our child.” (MK) A mother said, “This type of intervention (sports) is overlooked when it comes to children with special needs, that is why funding is so hard to find because not many people believe in exercise for individuals with special needs.” (MG)

Location.

In addition to cost as barrier to exercise, commuting to exercise sessions was also a barrier in terms of time (the time sessions offered at) and location/distance (the time it takes to get to the location/distance of location) because there are often limited opportunities for participation in exercise programs for special needs. Therefore, parents do not have much of choice, they either participate even if the time of the session and the location do not suit them or they just do not participate. Specifically, a mother discussed how she had to coordinate rides to get her son to practice since his father is busy and cannot take him, “It was more than 30 minutes’ drive from our house, and because of the long-distance I had to stay and wait until he finishes.” (MA)

The location of programs also created a complication. A couple discussed by saying, “The availability of programs and a suitable location depends on where you live. It is very hard for some people because they live in an area in a city where they do not have resources like others who live in a resourceful area of the city.” (NB) This couple resided in a big city with some exercise programs for children with autism but mostly all are taking place in the north, and they lived in the south. They also mentioned that some of their son’s peers did not have an opportunity for participation in exercise because they were not living near an active sporting community. In relation to private special centres and mainstream schools, whether private or public, there is a lack of programming offered. Thus, some parents of children with ASD kept looking for specific programs for their children. Most of the parents stated that their children attended a special private centre, and not all offer exercise in their intervention plan, but even if they offer it is usually low intensity. They do not offer a variety of activities. Their children do not have equal opportunities to be engaged in exercise compared to their peers. As a result, travelling was a necessity due to the limited access to opportunities.

Time management.

Another barrier that was discussed was time management. In regard to parents having time to work, take care of their children, complete their house chores, have a social life and take their children to practice was something that required careful planning. A mother spoke about needing to effectively manage her time to be successful as a mother to her child with ASD while simultaneously successful with her other children and other aspects of her life. Another couple spoke about managing their time effectively to wake up early, drop kids to school, go to work, rest after school and work, juggle home works and maintain a physically active life by saying, “It is all about finding balance, our children are everything to us, but then there is household, our jobs, being a parent and finding time for extracurricular activities. If it was up to us, we would take them to practice every day. We are always trying to find the balance and keep all parts of life in line together, so it is all about time management.” (NB) Trying to manage time and balance a busy schedule was a shared experience and an issue for many parents.

To conclude, three barriers to exercise were shared by parents of children with autism which are cost, location and time management.

Theme 5. Positive elements of the exercise sessions

When parents were asked about what they liked most about the jogging, mixed games and the swimming sessions in the present program, they all first discussed the **pedagogy**. They all mentioned that the teaching procedures used were very effective, age-appropriate and consistent. In specific to reinforcement, they discussed that offering different kinds depending on each child’s needs was very considerate and thoughtful. Parents related by saying, “Each child is different, but all of them need continuous reinforcement. Verbal, physical, tangible, and for some edible were very rewarding and effective because we saw our children following instructions and paying attention when receiving the reinforcement.” Similarly, YH mother related and said, “The smile on my boy’s face when placing the happy face on the reinforcement board was so rewarding. I noticed that all the children seemed happy and excited to place it because they knew they deserved it. My boy was enjoying exercising because he was provided with supportive verbal cueing, tangible reinforcement and modelling.” Other teaching procedures that were discussed were the direct verbal instructions consistent with

modeling and physical guidance. Parents mentioned that both were effective teaching strategies used with children with autism. Most of the parents noted that their children were learning through observation during the sessions and it facilitated natural behavior acquisition and acquiring new skills that they were never exposed to. A mother mentioned that direct verbal instructions and modelling taught her child to focus and give his best to imitate the exercise and perform skills that she thought were hard. She also said, “Short verbal instructions followed by modelling made each exercise/game clearer to the participants to follow.” (MG)

One of the most important elements mentioned by parents (whose children were in group 2) was **inclusion**. Parents expressed that they were extremely happy with their children being included with typically developing children and learning different skills from them. SL’s mother said, “Being engaged together in group games and learning play skills from their peers was very rewarding. Non-autistic children used to direct them, show them the right way of performing the activity and encourage them.” All parents mentioned that they try to include their children with autism with other children all the time in social events and at playgrounds, but it does not work most of the time because neither the setting nor the community is supportive. They mentioned that parents and their children aren’t patient when it comes to dealing with their children and they judge them right away, and that gives them as parents and their children a sense of rejection and their children end up playing and spending the time alone though they are surrounded with children. During the current exercise program, children with ASD were surrounded with people and children who understood who they are and offered an inclusive opportunity for fun, cooperative exercise and a learning experience to practice various skills with children with and without disabilities. Parents mentioned that though autism is a broad spectrum, their children were successfully included during exercise, and it seemed very natural though it was structured. A couple related to their boy being supported and included in group 2 (inclusion group) by saying, “Having supportive trainers, peers and structure in addition to exercise was a positive element to his participation in the activities. The trainers were not only focusing on the exercise but also on the children’s behaviors and the overall environment, and that made the children comfortable and made them deal with their peers in a pleasant, positive way.” (YH) A mother emphasised on the successful inclusion in the current program by saying, “Our children were surrounded with other children and were all directed and reinforced in the same way to exercise and behave properly. Consistency in the structure, routine, instructions, the team of professionals and peers made them experience inclusion the right way.” (MA) Parents emphasised the importance of being surrounded by

children that go through the same thing that their children go through as well as being around children who are typically developed. A mother related by saying, “Being around children with similar and higher abilities, similar goals, similar schedules and experiences enabled AB to focus and enjoy exercise while being supported by his group who understood him.” (AB2) Another couple stated, “The exercise group was like an extended family.” (AH)

Parents noted that what they liked most about the mixed games and the aquatic sessions is **being grouped** and paired with other children and that practising the activities was with aged-matched children not with a trainer as they were used to in their one to one session in the private special centres. They mentioned that it was really beneficial because their children got to try and practice many times and were offered help when needed, that gave them a powerful sense of achievement and responsibility. Also, parents indicated that group games were very stimulating because it offered different fun structured activities combined with different materials, teaching procedures and interacting with children that stimulated their social, cognitive, language and physical abilities.

AH’s mother related to her boy being paired, saying:

“My child is nonverbal, and he keeps his distance (proximity) when dealing with strangers, but with children in his group and during the group play he kept close proximity and was trying to perform the activities as his peers were showing him. He had a smile on his face at all times, and he did not want to leave the field. He used to stay close to other children even after the sessions were over.” (AS)

A couple also shared, “We were so happy seeing SL interacting and making friends with autistic and non-autistic children and playing football after the sessions were over.” (SL)

Another positive element that was discussed by parents was the **type of exercise** offered. A couple said, “We liked most that the sessions introduced new skills/activities to our children and that at first, they were performing the modified movements and with time they mastered most of the skills.” (MG) A mother shared, “jogging is a completely new sport to my daughter, and I was hesitant about it, and I did not know how she is going to handle it, but her reaction was unexpected!! She loved it and showed interest and improvement with time.” (JA) Another mother said, “Learning how to jog required mastering a number of sub-skills like breathing, coordinating hands with legs and adjusting the pace. All were new to my child, yet he was paying attention and were competitive to other children.” (MG) All parents noted that all the activities in the mixed games sessions were new, interesting and age appropriate. It focused on

different muscle groups yet was fun in the form of group games. They also noted that racing was so much fun, and they used to wait for it and asked to make it longer. A couple related by saying, “What I like most is that my child kept practising the same games at home and used to engage us with him and there were skills that he never performed before and acquired pretty fast.” (MK) Similarly, another couple said:

“Water aerobics was so much fun, I have never seen my child that happy and engaged. Though it is new because he was familiar with the materials (i.e. balls) and the participants, he was determined to learn and play. He became a better swimmer/player. The environment was so supportive of him to learn new skills, and he was so proud of himself and used to keep talking about what he did.” (SL)

Negative elements of the exercise sessions

One negative element was mentioned by the parents, which is the duration of the jogging and mixed games sessions. As previously mentioned in chapter 5 (pg. 91&94) the jogging session was 30 minutes long and the mixed games session was 50 minutes long. According to parents, sessions duration was short, and they requested to make it longer (1 hour instead of 30 minutes or 50 minutes) similar to the swimming session. Most of the parents said that they want their children to spend more time exercising and being physically active. Some parents even suggested providing the three activity sessions all together on the same day (one after another) three times a week instead of one activity per day. A mother said, “I want AS to spend an hour or more exercising to get out all his energy and spend more time with children his age.” (AS) A couple related by saying, “Can all activity sessions be given on the same day, so YH spends up to 3 hours of practice?” (YH)

In closing, when parents were asked about what they liked most about the jogging, mixed games and the swimming sessions in the present program, they discussed four elements which are pedagogy, inclusion, group games and the type of exercise offered. One negative element of the sessions was mentioned by parents which is the duration of the jogging, and mixed games sessions that they believed was short and requested to make it longer.

Theme 6. Benefits of exercise

While the program was still running, during week 5 the parents spoke of the benefits of the program in terms of the progress and the development of their children, and it was mainly in three areas;

Psychological, cognitive and hyperactivity level.

Parents emphasised on how exercise improved their children's mood and made them happier, decreased their stress level and their aggressive behaviors (**psychological health**). A mother related by saying, "Exercising and especially swimming made AM very happy unlike before exercising where he was always sad because no one understands him! Maybe just getting into the water itself and the way the senses work there, and then the endorphins, made him more relaxed and less angry." (AM) Another mother also related by saying, "I have never seen JA that happy and smiley. After swimming and all the other sports, she comes home happy, relaxed, calm and less aggressive. Whatever it is, it made a huge difference! It is the sensory part of getting into the water of moving their limbs and heads." (JA) A mother noted that her boy stopped his self-harmful behaviour saying, "My son stopped biting himself and others a few weeks after starting exercising. He used to bite himself and others whenever feeling stressed, anxious or overwhelmed. An obvious benefit of exercising was reducing his aggressive behaviour toward self and others." (MA) Similarly, another couple noted that their boy stopped his self-harmful behaviour saying, "Self-hitting and throwing things have lessened a few weeks from starting the program. He used to hit himself, walls and any door whenever asked to follow instructions." (MK)

Parents also discussed the development in their children's **cognitive skills** (attention span, following directions and sensory perception). A mother noted that exercising made a huge difference, she said, "My son's attention span increased, and he became more focused. His auditory and visual perception developed, and he began following more instructions compared to before." (SL) A couple related by saying, "Our boy improved and became more attentive to details especially at home, he began asking questions, and his attention span increased." (YH) Another couple of parents of children with mild autism mentioned an improvement in school, as noticed by the classroom teachers. They said, "We were told that MG was functioning better, and his schoolwork improved after being engaged in the program. He gave more attention to details and gave more correct answers when asked during class activities." (MG) Similarly, a mother said, I was told by AM's teacher that his off-task behaviours decreased, and his attention span increased during the lessons." (AM) A couple also related by saying, "Our boy's attitude toward school changed to the better, and we were informed that he was more attentive

in class and his academic evaluation was improving”. (AH) Another couple reported, “Being physically active made his ability to understand better, and he began doing things that he could not do before.” (NB)

Some of the parents were concerned about the activity level of their children (**hyperactivity**). A mother spoke about her son’s hyperactivity by saying, “AS is very active and never stays at one place for long. Since he started exercising, I noticed a decrease in his activity level showing less jumping, running and fidgeting.” (AS) A couple related their concern about SL’s hyperactivity level by saying:

“He is very hyper-active. Since he started exercising, we noticed that his activity level lessened. He started asking fewer questions and staying at the same place up to 30 minutes which never happened before. Being less hyper-active helped him in school. He was functioning better, and his teacher was surprised, his schoolwork improved considerably when he was physically active.” (SL)

The same questions that were asked during week 5 while the program was still running were asked during week 10 the last week of the present physical activity program. Parents were asked ‘Have you seen any progress in your child? Moreover, ‘Did involvement in the program enhance any skills?’. They were asked the same questions to determine whether the progress was continuous or even more evident as the program carried on. During week 5 as mentioned above, parents only noticed a change in three developmental areas **cognitive, psychological and hyper-activity level**. At the end of the program, parents discussed improvement in the overall functioning of their children mentioning enhanced skills in six areas **social, psychological, language and communication, physical, cognitive and decreased repetitive stereotypical behaviors**.

A couple spoke about the **social** benefits of exercise for their son, saying, “In particular, swimming and mixed games sessions had unexpected social lessons. Playing group games made him interact and ask questions to peers and trainers. It also made him supportive by showing his peer how to perform the activity and cheer his peer after trying. He learned to initiate conversations and suggest games.” (SL) Another couple related to the enhanced social skills by saying:

“I loved seeing my child initiating conversation and following other’s lead in playing group games. After the sessions, most of the children were not ready to leave, and my son was one of them. The researcher used to give them a football or any of the materials

and all of them asked to play together and wanted to spend more time playing. My son used always to ask “can I join the group?” “Can I stay for more?” (MG)

Similarly, another mother said, “My child became friends with his cousins and siblings. While the program was running, he used to tell them to come and play sport with him and used to say, “it is so much fun, am sure the trainer will allow you.” (AM)

A mother spoke about the **psychological health** benefits of exercise for her daughter saying that it was clear that her mood improved when she was active and kept on improving until the end of the program, “Exercising had a great impact on her mood and stress level. It was a noticeable change in her when she was exercising versus when she wasn’t. Before she was very hard to deal with throwing tantrums all the time, but after, she became calmer and happier. I loved seeing her exercising, and I hated to see the program end for her benefit.” (JA) Another couple related that exercise improved their son’s mood, saying, “Before exercising NB showed no facial expressions and used to get upset easily and throw tantrums when angry, but after exercising he became calmly happy with a smile on his face and his tantrums decreased drastically.” AM’s mother said, “AM came back home from swimming so happy and so energetic to tell us about the activities and what he did. He used to say, “I can’t wait for next week’s session.” Another mother related by saying, “He never leaves my hand when we are outside and usually holds it very tight. After weeks from starting the program, he used to let go of my hand once we arrive at the centre and run to the track or the pool.” (AH) Most of the parents mentioned how happy their children became after being active and that from week 5 onward they used to be very excited on the days of exercising and even more excited on their way to the sessions. They all mentioned how happy they were seeing the smile on their children’s faces and their enjoyment of arriving at the location.

Parents spoke about the **language and communication** development of their children. Most parents of the nonverbal children indicated that their children improved their communication and language by showing more eye contact, pointing to what they want, nodding their heads and being fully engaged. They also noted that their children gained a new vocabulary. A mother spoke of the language and communication benefits of the activities saying, “My child had limited vocabulary, but toward the end of the program, she began saying “I want” “candy” “bye” and “yes, no” and it is thrilling. These are some of the words that were used by the trainers during the sessions when dealing with her. It was sad for it to end; I wanted my daughter to stay active.” (JA) A couple related by saying, “Our son is nonverbal but his eye contact drastically improved, he started pointing at what he wanted and started understanding

facial expressions. He is more attentive and engaged compared to before.” (NB) Similarly, one of the mothers said, “Before being active, he used to repeat lots of what he hears. After being engaged in the program, he stopped perseverating and began answering questions and asking for the things he wanted. Being physically active was beneficial in reducing his perseveration.”

(MA) Another mother related to exercise improving language abilities by saying:

“AS was nonverbal when he started the program and he used to communicate through sounds only, but at week 8 he started saying a couple of words and that was surprising! After that, he was trying to say some words not correctly pronounced, but he tried until he said it right. He was able to say “bye” “thanks” “candy” and “I want”. Also, he was able to maintain eye contact with me, the trainers and the volunteers.”

Parents of verbal children mentioned that their children had many new words and engaged more in talking and expressing their ideas and asked more meaningful questions. A mother related by saying, “SL’s started to ask questions related to the cartoons he watches, things happening at home and the exercise program “why is it ending?” “where am I going to swim after it finishes?”. (SL) Also, he is always using and repeating the words\phrases used by the trainers during exercising when speaking to us at home.” AM’s mother related by saying, “he started speaking in Arabic more and using the words he is hearing while exercising by the trainers.”

Parents also discussed the improvement in **physical skills** in terms of increased physical fitness levels, motor functioning and muscle tone. All parents mentioned how their children improved their fitness levels and that this was demonstrated by them doing more jogging laps, breathing properly and asking for fewer breaks during the sessions. Also, the parents noticed that their children became stronger, strengthening their arms and legs. In addition, it was noticed that they were able to maintain posture and perform some activities that they were not able to perform and perform some activities with less effort. A mother said, “When my son first started jogging, he was very weak with improper posture, but after a month and up until the end he improved his posture and was more stable on grounds compared to when he first started.” (YH) Another mother related by saying, “At first my son was running and sometimes walking, but with time I have seen the change. He learned how to jog properly with good posture, and I was surprised when he started doing up to 7 laps with no breaks in between.” (MG) Parents were also pleased with the improvement they have seen during the mixed games and the swimming sessions. A couple discussed the physical benefits of the mixed games by saying, “He had a poor ability to throw, catch and kick a ball, but with time and practice his coordination

improved and it was amazing seeing him run while kicking the ball all around the field.” (AB) Similarly, a father said, “Nothing used to interest him, but during the mixed games sessions, he showed interest in the materials and the games and his coordination and speed improved.” (AB2).

In regard to **cognitive skills**, parents perceived improvement, and a couple shared, “It positively impacted my son’s attention span, perception, performance and engagement level in many tasks. His ability to understand and follow instructions enhanced too. He can perform the same problems that he could not two weeks ago. This was surprising and made us determined to find a program for him to participate at all year long.” (SL) Another mother related that PA improved her daughter’s ability in following instructions, “I do not repeat the order more than twice now, were before I used to tell her what to do more than 5 times with no reaction! Now, she gives me her full attention and follows directions brilliantly.” (JA)

Exercise also decreased the occurrence of **self-harmful behaviors** and **repetitive stereotypical** behaviors. Four couples, whom their children were engaged in such behaviors noted that it was reduced. It was noted that the decrease was during and following exercise. One of the children stopped biting, the other stopped flapping, and the other two stopped hitting themselves. A mother was related to the decrease in her son’s harmful behaviour by saying, “He used to bite his hand a lot especially when stressed and he has scars all over his hands. He also had a rubber toy that he used to bite too. After weeks from starting the program, I noticed the decrease in his behaviour and toward the end of the program, he stopped using the toy.” (MA) Another couple related and said, “His flapping used to occur whenever excited. It decreased after being engaged in the program, and he is using his words instead.” (YH)

In summary, parents perceived that being physically active helped their children with autism improve their overall functioning noticing enhanced skills in six developmental areas social, psychological (improving their mood, decreased stress level and aggressive behaviour), language and communication, physical, cognitive (increased their attention span, following instructions and developed their perception levels) and decreased repetitive stereotypical behaviors and hyperactivity level. They were seeing such improvement and were determined to keep their children physically active.

Theme 7. Recommendations

All parents with no exception recommended offering the program all year long for the benefit of their children, and they also wanted to lengthen the duration of the sessions to one hour and

more. A mother related by saying, “I want this program all year long; I want to see him improving even more.” (AS) Another mother said, “I want my daughter to be busy in sports all year long; she deserves this kind of intervention as it is fun and beneficial at the same time.” (JA)

Parents also recommended providing the program in different locations to reach as many children as possible in different areas and for the program’s location to be governed depending on where they live. Another recommendation that was discussed was offering a variety of activities to the program such as football and basketball in addition to swimming, jogging and mixed games. Parents discussed providing group sports for their children to have an opportunity to participate in different sports and learn new sports and new skills as they were in the mixed games sessions and the water aerobics. A couple said, “MG loves football, add more group sports to your program.” (MG) Similarly, another couple said, “We want our child to be exposed to different kinds of sports, individual and group sports. Add group sports to your program, and we are certain that our children will excel in it.” (AB)

In closing, parents recommended to offer the program all year long and add team sports such as football and basketball for their children to be exposed to different kinds of sports and learn new skills.

Theme 8. Qualities of the program

When parents were asked if they would recommend this program to other parents, they answered with a definite yes discussing the following reasons/qualities:

Benefits of the program

All parents discussed the positive impact that this program had on their children. AM’s mother said, “After participating in this program, my child became more physically active, happy, focused, fit and social. Exercise shows results faster than the kind of intervention he is receiving in school and at the special centre.” AG’s parents shared, “We were not expecting this drastic and obvious change and would love for other children to participate and enhance their skills as our child did.” A mother related to the positive impact exercise had on her child (RB) by saying that it improved his relationship with his siblings. In addition to the cognitive, physical, psychological benefits, her child became closer to his brother and sister because he had something to share with them and she thought why not engage them all in exercise!

Team impact

Another quality that was discussed is the team of professionals who dealt with the children and the role they played within the sport setting. Parents noted that the researcher, trainers, research assistants and the volunteers were all following the same teaching methods, and they all knew how to deal with children with autism. They also talked about the relationship their children had with the team members and the way they communicated with them and how they were so comfortable around them. For example, children were really attached to their trainers and used to hug them when they arrive and before they leave. They also used to ask them to play with them even after the sessions were over. Team members had a positive influence on the children as children began copying them in the way they talk, behave and even their coaching style. A mother said, “My boy speaks like his trainer at home, and he even reinforce us for doing pleasant behaviours as his trainer doing with him.” (SL) Another mother said, “I heard AM saying to his siblings that the trainers in the sports program are the best trainers in the world.” (AM)

Program structure

Parents discussed the overall structure of the program, including the physical setting, content structure and the pedagogy. Parents noted that the physical environment (field and pool) was well prepared and organised using materials to create boundaries and direct the children while exercising and using exercise charts to establish a routine and help children understand the requirement of the sessions. A mother related by saying, “What I loved about the sessions is the consistency of the setting and the materials used, and that made SL very comfortable. It was like a second home to him.” (SL) Another couple related, “Our children were introduced to new materials and were given the freedom to explore it and then play with it unlike in the special centres where sometimes they offer many materials but restricting the children to touch it. In this program, they were exposed to new materials needed for performing the activities and were directed to play with it.”

Parents were pleased with the variety of activities offered, the organisation of tasks included in the sessions and the flow of the sessions. A mother said, “This is the first time that YH played different activities at the same time while all were equally planned and structured. I was surprised by how the sessions where running following the exact structure every time and the team members where punctual.” (YH) Another mother related by saying, “Offering a rich program made me and my child feel cared for. I felt that he is finally offered opportunities as other children his age especially in sports.” (EA)

lastly, they highlighted the use of effective teaching procedures that were previously mentioned (see pg. 116-118) and that it was most suitable for their children's needs. One of the mothers related by saying, "I liked the combination of teaching procedures used as I was seeing MK following instructions and mastering the skills." (MK) Another couple said, "Brief, direct instructions accompanied with modeling and the reinforcement was brilliant." (AS3)

In summary, parents of children with autism mentioned a number of qualities of the present program that weren't found in previous programs that their children were engaged in which are the benefits of the program (the positive effect it had on their children, team impact and program structure including setting, content and pedagogy).

The previous section presented the full results of the semi-structured interviews. The following section presents the full results of the observations.

Observations

Analysis

The data analysis process of the observations gathered was guided through developing an outline of the information gathered and recorded. Then the information was organised accordingly focusing on the points that were within the argument of the study (Heyman et al., 2014; Lincoln and Guba, 1985). The analysis of the present study focused on the data gathered using the observation sheet and related field notes that consisted of organised categories **social and emotional, language and communication** and **physical skills** (see appendix 2). This data then was organised by focusing on the sub-skills observed under each category and adding relevant events to each that were collected from field notes. After data was organised, it was translated and written creating a story describing clear scenes in sections to be told to the reader in details focusing on specific aspects to construct a picture that reflects the data collected and to make sense of what the participants did during exercise sessions (Heyman et al., 2014; Lincoln and Guba, 1985).

Results

In the following section, the findings of the analysis of the observations are presented. Data collected on each group (group 1 segregated, group 2 included) is presented during the three activity sessions jogging, mixed games and aquatics on weeks 1, 3, 5, 7, and 10. Data analysis

focused on the change in participant's physical, language and communication and social and emotional skills, specifically on the development of these skills throughout the duration of the program. For more details on how observations took place and how information was recorded, please refer to (pg. 55-62) in chapter 4 (methods).

The following behaviors/skills were observed during week 1:

Jogging session

At the beginning of the jogging session, children in **group 1** (the segregated group) with mild and moderate autism were hesitant to join since it is a new situation/setting for them, but they clearly wanted to explore the environment. All of them were running around the field and touching the reinforcement boards. **Children with mild autism** were all verbal speaking Arabic and English. Socially, they displayed some play behaviors such as maintaining proximity to their peers and trainers most of the time (within 1 foot). Also, they greeted every member of the team as directed by their parents by shaking hands. During warming up, jogging and cooling down direct verbal instructions, modeling, physical guidance and verbal and gestural reinforcement were applied constantly. During warming up, participants were observing the trainers and imitating the movements but losing focus at sometimes as they were still wanting to explore the environment. Participants were directed and reinforced by the trainers to pay attention and it was successful. During the transition from warming up to jogging, some participants asked the team members about their names. In addition, they responded to interactions from trainers all the time but not from peers (e.g., They answered questions when asked about their names and if they were feeling okay). The transition from warming up to jogging and then to cooling down was very slow. Children were moving very slowly, and some took longer time than others and the trainers had to physically guide them to the next activity area. Children with mild autism displayed some emotional behaviors (self-regulation) during exercising such as allowing the team members to comfort them by tapping on their shoulders or talk to them when agitated or stressed as it was a new situation for them. Two participants were hyperactive and used to self-regulate by running around the field to release their energy. All of them, requested for breaks during jogging and sought assistance from adults (physical guidance). All participants with mild autism were following instructions, following the group routine and remained with the group during warming up, jogging and

cooling down. It was observed that children used to follow directions right after using verbal directives especially when combined with modeling and physical guidance when needed. In addition, it was observed that verbal cueing used to motivate them to perform appropriate physical and social behaviors. Direct and short verbal instructions consistent with modeling and physical guidance were effective strategies that facilitated the natural behavioural acquisition and acquiring new skills that participants were never exposed to.

In specific to language and communication skills, participants displayed some conversational skills such as asking questions to gain information. For example, some of them asked “What is stretching?”, “Why do we warm-up and cool down?”. Also, they responded to questions such as “How old are you?”, “What is your name?”. During the breaks, they initiated conversations but not for long with the team members only about jogging and the difference between it and running. Most of them maintained appropriate eye contact with the team members and used appropriate voice volume. In regard to their physical skills, participants had poor motion planning and balancing skills. They were able to navigate directions from the start to the finish point with assistance all the time (trainers directing them verbally and some physically). Also, it was difficult for them to adjust their jogging pace either too fast or too slow. However, they were able to keep space between peer/trainer while exercising and control when to start and stop in the case facing an object or person. Children had poor postural stability and fitness skills. Most of them were able to keep their bodies in stable and balance position (straight back while arms and legs are moving) when physically guided and provided with verbal directions. It was difficult to continue the first lap and the trainers kept reinforcing them and encouraging them. They had to take a break after the first lap as they were very tired and were not able to carry out jogging without undue fatigue. Different kinds of reinforcement were offered (combination) depending on the child’s needs and preference continuously and consistently. It was rewarding and effective as children were paying more attention and trying to follow the instruction with a smile on their faces after receiving the reinforcement accompanied by modeling and verbal instructions. By the end of the session, participants completed 3 jogging laps only (see table 6.1 for the overall progress of the number of laps achieved week by week by the two groups). It was observed that placing the happy faces was effective and rewarding as they were all very excited to place the happy faces on the self-monitoring board without assistance and chose their favourite colour.

In regard to children with **moderate autism**, they refused to join in unless one of their parents was with them. Parents were allowed to join until their children feel comfortable around the

team members and trust them. Often, they were inattentive, not following instructions, and their behaviour was hard to control. Participants were running around whenever confronted with instruction and trying to disengage. Some were crying, and some engaged in self-harmful behaviours (e.g., hitting themselves and others, biting themselves). All of them needed one to one instruction. Socially, they displayed exactly the opposite social and emotional behaviors that were displayed by their peers with mild autism. They maintained far proximity to trainers and peers. They were not observing the trainers, either their peers and were holding their parents all the time. They were not responding to interactions from trainers and responded only to their parents. Emotionally, the children displayed aggressive behaviors toward self and others as mentioned above.

Moreover, the children were stressed and fearful. They did not allow the trainers to comfort them either touch them. In specific to their language and communication skills, three of them were nonverbal and tended to communicate through sounds, and one who was verbal had a very limited vocabulary. Participants had poor non-conversational skills. They did not orient the body to the speaker unless they were physically guided. All of them maintained poor eye contact. Also, all of them did not pay attention to the trainer's nonverbal language and comprehend what is being communicated (e.g., if trainer nods head means yes and shakes the head, that means no). Two of them started following instructions towards the end of the session with constant modeling, physical guidance, verbal directions and edible reinforcement (small pieces of biscuit upon responding to directions). In terms of their physical fitness, participants with moderate autism had poor motion planning and balancing skills. They were able to navigate directions with assistance all the time (trainers directing them physically). Also, it was difficult for them to adjust their jogging pace; they were too fast. In addition, they were not able to keep space between them and the trainer while exercising and could not control when to start and stop in the case facing an object or person. All the children had poor postural stability and fitness skills. Most of them were not able to keep their bodies in stable and balance position (straight back while arms and legs are moving) even when directed and had imbalanced posture and weak muscles. They received ongoing physical guidance from the trainers and their parents. They could not continue the first lap and took a break after completing half the distance and were very tired. By the end of the session, participants completed 2 laps only (see table 6.1 for the overall progress of the number of laps achieved week by week by the two groups). They showed no facial expressions while placing the happy faces on the self-monitoring board and received assistance to place it.

Children in **group 2** (inclusive group) with **mild** and **moderate autism** displayed similar social and emotional, language and communication and physical skills as their peers in group 1 during the first session. Participants with mild and moderate autism were also hesitant to join since it is a new situation/setting for them, but they clearly wanted to explore the environment. All of them were running around the field and touching the reinforcement boards. Concerning the social skills of children with **mild autism**, they were directed by their parents to greet every member of the team and shake hands. They maintained proximity to their peers and trainers most of the time (within 1 foot). Children were observing the trainers and imitating the movements during warming up, jogging and cooling down but losing focus at sometimes as they were still wanting to explore the environment. During the transition from warming up to jogging, some participants asked the team members about their names. The transition from warming up to jogging and then to cooling down was very slow. Children were moving very slowly, and some took longer time than others and the trainers had to physically guide them to the next activity area. In addition, participants with mild autism responded to interactions from trainers all the time (e.g., They answered questions when asked about their names and if they were feeling okay). In addition to the previously mentioned behaviors, children with mild autism displayed more social skills compared to their peers in group 1. For example, children with mild autism started interacting with their peers who were typically developed toward the end of the session. When the time was up, they started talking and playing together. Moreover, they followed other peers play ideas. For example, one of the typically developed children brought a football with him and asked his peers with mild autism to play with him and they agreed. Furthermore, they raced and played tag. Children with mild autism displayed some emotional behaviors (self-regulation) during exercising. They allowed the team members to comfort them by tapping on their shoulders or talk to them when agitated or stressed as it was a new situation for them. All of them were able to request for breaks during jogging and sought assistance from adults (physical guidance). All participants with mild autism as well as the typically developed ones were following instructions, following the group routine and remained with the group during warming up, jogging and cooling down. In specific to their language and communication skills, most of them maintained appropriate eye contact with the team members and used appropriate voice volume. Participants displayed some conversational skills such as asking questions to gain information. For example, some of them asked: “What is stretching?” “Why do we warm-up and cool down?”. Also, they responded to questions such as “How old are you?” “What is your name?”. During the breaks, they initiated conversations but not for long with the team members about jogging and the difference between it and

running. Toward the end of the session, they were more talkative compared to their peers with mild autism in group 1. They were interacting with their typically developed peers and playing with them. In regard to their physical skills, children with mild autism as well as the typically developed ones had poor postural stability and fitness skills. Most of them were able to keep their bodies in stable and balance position (straight back while arms and legs are moving) when physically guided and provided with verbal directions. Participants with mild autism had poor motion planning and balancing skills. They were able to navigate directions from the start to the finish point with assistance all the time (trainers directing them verbally and some physically). Also, it was difficult for them to adjust their jogging pace either too fast or too slow. Yet, they were able to keep space between peer/trainer while exercising and control when to start and stop in the case facing an object or person. It was difficult children with autism and the typically developed to continue the first lap and the trainers kept reinforcing and encouraging them. They had to take a break after the first lap as they were very tired and were not able to carry out jogging without undue fatigue. By the end of the session, all participants in the group with mild and moderate autism as well as the typically developed completed 4 jogging laps in comparison to 2/3 laps completed by participants in group 1. They were all very excited to place the happy faces on the self-monitoring board without assistance and chose their favourite colour.

In regard to children with **moderate autism**, similarly, they refused to join in unless one of their parents was with them as their peers in group 1. Often, they were inattentive, not following instructions, and their behaviour was hard to control. Participants were running around whenever confronted with instruction and trying to disengage. Some were crying, and some engaged in self-harmful behaviours (e.g., screaming, hitting themselves and others, biting themselves). All of them needed one to one instruction at all times. Socially, they were not observing the trainers, either their peers and were holding their parents all the time. They were not responding to interactions from trainers and responded only to their parents. All of them maintained far proximity to trainers and peers. Emotionally, they were all stressed and fearful and demonstrated aggressive behaviours toward self and others as mentioned above. Moreover, they did not allow the trainers to comfort them neither touch them. In specific to their language and communication skills, four of them were nonverbal and tended to communicate through sounds, and one who was verbal had very limited vocabulary. Participants had poor non-conversational skills. All of them maintained poor eye contact and did not orient the body to the speaker unless they were physically guided. Also, all of them did not pay attention to the

trainer's nonverbal language and comprehend what is being communicated (e.g., if trainer nods head means yes and shakes the head, that means no). Three of them started following instructions toward the end of the session with constant modeling, physical guidance, verbal directions and edible reinforcement (small pieces of biscuit upon responding to directions). In terms of their physical fitness, all the children had poor postural stability and fitness skills. Most of them were not able to keep their bodies in stable and balance position (straight back while arms and legs are moving) even when directed and had imbalanced posture and weak muscles. They received ongoing physical guidance from the trainers and their parents. They could not continue the first lap and took a break after completing half the distance and were very tired. Participants had poor motion planning and balancing skills. They were able to navigate directions with assistance all the time (trainers directing them physically). Also, it was difficult for them to adjust their jogging pace; they were too fast. In addition, they were not able to keep space between them and the trainer while exercising and could not control when to start and stop in the case facing an object or person.

Mixed games session

During the mixed games session, all children in **group 1** (segregated group) were excited by just seeing the materials that had been prepared. They started exploring them before the beginning of the session. **Children with mild autism** displayed similar social and emotional behaviors as the ones displayed in the jogging session such as greeting the trainers, maintaining proximity to their peers and trainers (within 1 foot) and responding to interactions from trainers all the time (e.g., they answered questions when asked about their names and if they were feeling okay). They displayed new skills such as responding to interactions from peers at sometimes (e.g., they answered questions when asked about their names). During warming up and cooling down, they were observing the trainers and imitating the movements but losing focus at sometimes as they were still wanting to explore the environment. During the transition from warming up to the activity circuit, some participants asked the team members about their names. In addition, they were all comfortable playing near peers (parallel play) using the same materials (e.g., balls). They showed improvement by observing the trainers and their peers, unlike in the jogging sessions where they only observed the trainers. Also, participants imitated their peers physically and verbally. For example, one of the participants was moving while waiting for his turn to come from side to side and others imitated him. Another example of imitation was when one participant asked, "Can I be first?", others immediately said the same.

They displayed more social skills compared to the jogging session such as taking turns during the games though most of them were so impulsive and could not wait unless directed.

Moreover, all of them were comfortable playing associatively with others as they were calm when they were close to their peers during waiting for their turns and playing in pairs in some games (e.g., catch the ball). However, the transition from warming up to the activity circuit and from one activity to another in the circuit was not smooth and was slow most of the time. Some children had slow movement and had to be reinforced and physically guided to move to the next activity and others used to continue playing and refuse to move on. Emotionally, most of them displayed appropriate skills when directed. For example, the trainers told them that if you need a break, you can request for a break. Also, they were directed to use acceptable ways to express anger or frustration by stating it (e.g., trainers said “ If you feel angry, talk to us and use your words”). In addition, participants were directed to wait for their turns and accept making mistakes. All of them were following directions except for one. One of the participants was so competitive, and it was hard for him to accept not being first and losing in a game. He used to shout and feel sad if he was not the first one to play the game. Reminding him of the exercise chart and placing the happy faces as a tangible reinforcement was an effective strategy to channel his anger into positive energy as well as reminding him that collecting a happy face at the end of each activity is considered winning.

Concerning their language and communication skills, participants displayed conversational skills such as asking questions to gain more information (e.g. children asked, “What is this bucket for?” and “Is this a basketball or a football?”). In addition, they answered yes/no questions (e.g. Can you do it again? Do you like this game?). Moreover, they displayed non-conversational skills such as maintaining appropriate eye contact and orienting body to speaker at sometimes. In terms of their physical skills, children displayed appropriate abilities for children with autism at their age and similar to the ones observed during the M-ABC. They displayed fine and gross motor abilities such as picking up the balls, holding and throwing it but could not catch it. They also jumped and hopped, but most of them found it very difficult and could not do it continuously and some were able to hop on one leg only. Participants also displayed low fitness levels. All of them were not able to carry out with the activities without undue fatigue and without taking a break. Also, they had poor motor coordination skills by facing difficulty throwing a ball into a wall and catching it or to peer and difficulty in aiming. They completed the first 4 games of the activity circuit and did not finish the entire 8 activities as planned (refer to figure 5.2 pg. 98). Some participants wanted to continue to finish the rest

of the circuit, but time was up, and they were told that they could finish it next week. They were excited while placing the last happy face (4 faces in total one for each activity/game) and were counting the number of faces they collected with their peers.

Children with **moderate autism** were accompanied by their parents as in the jogging session as they refused to enter the field without them. They displayed similar social and emotional, language and communication and physical skills like the ones displayed during the jogging session. Often, they were inattentive, not following instructions, and their behaviour was hard to control. They were running around whenever confronted with instruction and trying to disengage. Some were crying, and some engaged in self-harmful behaviours (e.g., hitting themselves and others, biting themselves). All of them still needed one to one instruction with ongoing verbal cueing, physical guidance, modeling and reinforcement. After a few minutes, they started following instructions with the exception of one girl who threw a tantrum and displayed self-harmful behaviors until the end of the session.

Socially, all of them were still uncomfortable around trainers and peers. They maintained far proximity to trainers and peers. They showed improvement by observing the trainer and the parent only and imitated them physically with ongoing verbal cueing, modeling and reinforcement. They waited for their turns when they were held by the parent or the trainer; otherwise, they would disengage from the activity. They did not remain with the group during the activities and did not follow the order of the activity circuit. For example, when participants with mild autism were performing activity number 3, children with moderate autism were performing activity number 2 because they could not be very close to other participants. Emotionally, children with moderate autism displayed aggressive behaviors toward self and others at sometimes when they wanted to disengage or when stressed. In addition, they did not allow the trainers to comfort them either touch them. Their communication skills were limited with limited eye contact mainly to their parents and not to the trainers. Participants tended to communicate through sounds and some of them used to say “Yes and No” only. They were not able to orient their bodies to the speaker without being physically guided. Physically, children with moderate autism had poor fine and gross motor skills by finding a difficulty to pick up the ball from the first attempt and hold it for a proper amount of time. Also, they found it difficult to aim, throw and then catch the ball back when instructed to aim and throw to a target near them. Therefore, this activity was modified to throw to a near target and gradually moved to farther distance. Moreover, none of them was able to hop using both legs, so it was modified into high knees and moving forward with assistance and for some, it was modified to stepping

instead. Participants also had poor motion planning and balancing. For example, children found it difficult to adjust their speed during (fast walking in place) either too fast or too slow and most of them were slow. They displayed poor postural stability as well; they could not keep their bodies in a stable and balanced position unless physically guided. Their fitness level was low as they got tired quickly and took a break after each activity. They completed the first 3 games only out of the assigned 8 activities. They placed the happy faces (3 faces) with assistance by showing them where to put it and supporting their hands to stick it.

Children in **group 2** (inclusive group) with **mild** and **moderate autism** displayed similar social and emotional, language and communication and physical skills like the ones displayed by their peers in group 1. **Children** with **mild autism** displayed similar social and emotional behaviors as the ones displayed in the jogging session such as greeting the trainers, maintaining proximity to their peers and trainers (within 1 foot) and responding to interactions from trainers all the time (e.g., they answered questions when asked about their names and if they were feeling okay). In addition, they were observing the trainers and imitating the movements during warming up, activity circuit and cooling down. Furthermore, they were all comfortable playing near peers (parallel play) using the same materials (e.g., balls). They displayed more social skills compared to the jogging session such as taking turns during the games though most of them were so impulsive and could not wait unless directed.

Moreover, all of them were comfortable playing associatively with others as they were calm when they were close to their peers during waiting for their turns and playing in pairs in some games (e.g., catch the ball). However, the transition from one activity to another in the circuit was not smooth and was slow most of the time but better than group 1. The typically developed children were moving smoothly from one activity to another and they encouraged their peers with mild autism to move faster. In addition to the previously mentioned behaviors children with mild autism displayed more social behaviors in this session since they were included with typically developing children. The typically developing children were observing their peers with mild autism and correcting their movements while waiting for their turn to come or during playing in pairs. Consequently, children with mild autism started observing their peers during each game, followed their directions and imitated them physically by trying to perform the movements as much as they can. Moreover, their observation of their peers extended after the session was over. For example, the typically developed children started helping the team tidying up the equipment and the materials used during the session after the session was over. A few minutes later, participants with mild autism joined and started helping too. They were

following the directions of their peers and the trainers of what to carry and where to place it. In addition, another social behaviour that was observed and displayed by children with mild autism was playing associatively with other children (sharing) and organise play by suggesting a play plan. When the time was up, one of the typically developing children wanted to shoot the hoop by simply shooting and not engaging in a game (basketball). He grabbed the basketball and shared it with one of his peers and said: “let’s practice shooting”. Children with mild autism imitated him and were excited to join. Emotionally, most of them displayed appropriate skills when directed such as requesting for breaks, waiting for their turns and accept making mistakes.

Concerning their language and communication skills, participants displayed conversational skills such as answering yes/no questions (e.g. Can you do it again? Do you like this game?) and asking questions to gain more information (e.g. children asked, “What is this bucket for?” and “Is this a basketball or a football?”). Moreover, they displayed non-conversational skills such as maintaining appropriate eye contact and orienting body to speaker at sometimes. In terms of their physical skills, they displayed fine and gross motor abilities such as picking up the balls, holding and throwing it but could not catch it. They also jumped and hopped, but most of them found it very difficult and could not do it continuously and some were able to hop on one leg only. Participants also displayed low fitness levels. All of them were not able to carry out with the activities without undue fatigue and without taking a break. Also, they had poor motor coordination skills by facing difficulty throwing a ball into a wall and catching it or to peer and difficulty in aiming. In terms of the activity circuit, children with mild autism completed the first 5 games of the activity circuit. They did not finish the entire 8 activities as planned (refer to figure 5.2, pg. 98).

Concerning children with **moderate autism**, they displayed similar social and emotional, language and communication and physical skills like the ones displayed by their peers in group 1 as mentioned above. Similar to their peers in group 1, all of them still needed one to one instruction with ongoing verbal cueing, physical guidance, modeling and reinforcement. They were inattentive, not following instructions and their behaviour was hard to control. They were trying to disengage whenever confronted with instruction. After a few minutes, they started following instructions with the exception of one girl who threw a tantrum and displayed self-harmful behaviors until the end of the session. Socially, all of them were still uncomfortable around the trainers and peers as well as maintained far proximity to trainers and peers. They showed improvement by observing the trainer and the parent only and imitated them physically

with ongoing verbal cueing, modeling and reinforcement. They waited for their turns when they were held by the parent or the trainer; otherwise, they would disengage from the activity. They did not remain with the group during the activities and did not follow the order of the activity circuit. For example, when participants with mild autism were performing activity number 3, children with moderate autism were performing activity number 2 because they could not be very close to other participants.

Emotionally, children with moderate autism displayed aggressive behaviors toward self and others at sometimes when they wanted to disengage or when stressed and did not allow the trainers to comfort them either touch them. Their communication skills were limited with limited eye contact mainly to their parents and not to the trainers. Participants tended to communicate through sounds and some of them used to say “Yes and No” only. Physically, participants had poor motion planning and balancing. For example, children found it difficult to adjust their speed during (fast walking in place) either too fast or too slow and most of them were slow. They displayed poor postural stability as well; they could not keep their bodies in a stable and balanced position unless physically guided. Also, children with moderate autism had poor fine and gross motor skills by finding a difficulty to pick up the ball from the first attempt and hold it for a proper amount of time. Also, they found it difficult to aim, throw and then catch the ball back when instructed to aim and throw to a target near them. Therefore, this activity was modified to throw to a near target and gradually moved to farther distance. Moreover, none of them was able to hop using both legs, so it was modified into high knees and moving forward with assistance and for some, it was modified to stepping instead. Their fitness level was low as they got tired quickly and took a break after each activity. Concerning the activity circuit, they completed the first 3 games only as their peers in group 1. They placed the happy faces (3 faces) with assistance by showing them where to put it and supporting their hands to stick it.

Aquatic session

At the beginning of the aquatic session, all children in **group 1** were super excited to enter the pool. They wanted to skip warming up and being introduced to the routine and enter the pool. After warming up, the trainers moved to phase two (one to two/three instruction) and children were divided into groups with the assigned instructor and assistant. The trainers focused on testing the swimming skills of each child and decided that all participants at an elementary

level and need to practice water orientation skills which they lacked and gradually move on through the skills until they master the skills and be ready to learn swimming strokes (refer to table 5.3 p.g.123). Children with **mild autism** displayed appropriate social behaviors such as greeting each other and the trainer. Also, they maintained close proximity to peers and trainers and were observing the trainer as well as their peers. They imitated their trainers and peers in performing the movements during phase 1 (floor activities), 2 (one to two/three instruction), 3 (water aerobics) and 4 (cooling down). In addition, participants with mild autism responded to interactions from trainers and peers. For example, one child asked peer “Can you swim?”, the peer answered, “Yes, look at me”. Also, when a trainer used to say, “Can you copy me, or I want you to do the same”, children used to respond by trying to do the same movement/skill. Most of them were trying some moves individually (parallel play near peers) like checking what is underneath them, blowing bubbles, hopping and splashing. They displayed some group skills such as taking turns to perform the movements following the trainer. Also, children sought assistance from the trainers when they found one of the movements difficult to perform or for reassurance. For example, some participants held the trainer’s hand while performing (touching ears and mouth to water) and some participants used to ask for more modeling and physical guidance. Emotionally, participants were aware of their emotions and clearly expressing it by showing how happy they were by smiling all the time and saying it out loud, “We love the pool”.

Concerning their language and communication skills, they displayed some conversational skills such as expressing themselves by saying “We love the pool”. Also, they were asking and answering questions (e.g. “When are we playing with the equipment?”. “Can I dive in/can I jump?”. All of them were asking the trainers to look at them and to check their moves. They were following instructions and expressing what they want and do not want (e.g. they were afraid of the deep side and saying it clearly to the trainers). Concerning their swimming skills, participants were all able to enter and exit the pool without assistance except for one who was holding the trainer’s hand. They displayed appropriate fine and gross motor skills as they were all able to splash water with hands and feet without the trainer’s support except for two participants who needed physical guidance. The trainers focused on skills such as touching chin, mouth, ear to water and the children were following instructions but did not master the skills by the end of the first session. During aerobics at the shallow end, participants performed running in place, jumping jacks and hopping on one foot with assistance at sometimes as they faced a difficult balancing while performing the movements. They had poor motion planning

skills as they found it difficult to adjust speed their speed during slow and fast jumping in place and took a long time to transition from slow to fast and vice versa. Concerning their fitness level, the children did not show any signs of discomfort and were able to continue until the end of the session without undue fatigue. None of them requested a break and was active during all phases. When the time was up, they all requested to stay and did not want to leave the pool.

Children with **moderate autism** were also excited like their peers with mild autism and wanted to skip warming up activities and directly enter the pool. As mentioned above, after warming up, the trainers moved to phase two (one to two/three instruction), and children were divided into groups with the assigned instructor and assistant. Similarly, children with moderate autism were at an elementary level and needed to practice water orientation skills which they lacked and gradually move on through the skills until they master the skills and be ready to learn swimming strokes (refer to table 5.3 p.g.123). Socially, children with moderate autism displayed social behaviors that were opposites to the ones displayed by their peers with mild autism. They were comfortable in the water, but they wanted the trainers to touch them neither direct them, and they wanted to roam freely. They maintained far proximity to peers and trainers, but the trainers kept asking them to stay close and pulled them gently at sometimes when they did not respond. Participants were not observing the trainers at first during phase 1, but with ongoing modeling, verbal reinforcement and physical guidance they started to observe the trainers for some time by responding once or twice.

Similarly, during phase 2, participants were still inattentive at sometimes and kept trying to disengage and avoid the trainers to swim alone. All of the participants with moderate autism were trying some moves individually far away from their peers such as checking what is underneath them, blowing bubbles, hopping and splashing. In addition, they were not observing either imitating their peers as well as not responding to interactions from peers. For example, participants with mild autism were aware that their peers with moderate autism aren't responding neither following directions and they used to tell them to come close and listen to the trainer. Nevertheless, participants with moderate autism were not responding to the interaction from their peers. They did not display any play neither group skills compared to their peers with mild autism. The same applies to their language and communication behaviors. For instance, all of them had poor eye contact and did not orient the body to the speaker unless the trainers physically guided them. During phase 3 (water aerobics) that involved group instructions, children kept far proximity from their peers and were inattentive. Concerning their swimming skills, participants were all able to enter and exit the pool without assistance. They

displayed poor fine and gross motor skills as they were all able to splash water with hands and feet with the trainer's support and physical guidance. The trainers focused on skills such as touching chin, mouth, ear to water and because they were inattentive most of the time as mentioned earlier, they did not master the skills by the end of the first session. During phase 3 (water aerobics) at the shallow end, they did not perform any of the activities even when instructed as one to one. However, the trainers kept trying to engage them and manage their behaviours to feel more comfortable around them and get used to the environment and the routine. Concerning their fitness level, they did not show any signs of discomfort and none of them seemed to need a break though they were moving all the time until the end of the session. When the time was up, they tried swimming far away from the trainers as they wanted to stay in the pool and not leave.

Children with **mild** and **moderate autism** in **group 2** (inclusive group) displayed similar social and emotional, language and communication and physical skills like the ones displayed by their peers in group 1. In addition to the previously mentioned behaviors, participants with **mild autism** and the typically developed ones displayed some more social behaviors. During phase 3 (water aerobics), it was observed that there was more interaction between children with mild autism and typically developed children. For example, they used to look at each other and make comments about the movements they were performing to peers saying, "Look at me, I can jump". Also, they were initiating games during, and following other peers play idea. For example, during jumping jacks, one participant with mild autism said, "Can we try clapping our hands when we lift our arms up?", others got really excited and wanted to try it then one participant who was typically developed said, "We can high five each other too". In addition, participants who were typically developed used to seek assistance from the trainers and make sure that they are performing the right movement. As a result, children with mild autism started to ask the trainers and their peers who are typically developed for help. For example, water aerobics took place at the shallow end of the pool and while exercising the trainers and the participants used to move a little bit further toward the deep end. So, children with mild autism used to ask the trainers to hold their hands to make sure that the water was not deep or ask the trainers to go backwards near the shallow end. Also, if they noticed that their peers who were typically developed performing the move correctly, they used to ask them to show them how to do it so they can do it like them.

Children with **moderate autism** were also excited like their peers and wanted to skip warming up activities and directly enter the pool. In terms of their social skills, children with moderate

autism maintained far proximity to peers and trainers but the trainers kept asking them to stay close and pulled them gently at sometimes when they did not respond. They were all comfortable in the water and wanted to roam freely and not follow directions. At first, during phase 1 and 2, children were not observing the trainers during phase 1, but with ongoing modeling, verbal reinforcement and physical guidance they started to observe the trainers for some time by responding once or twice. In addition, they were not observing either imitating their peers as well as not responding to interactions from peers. For example, participants with mild autism were aware that their peers with moderate autism are not responding either following directions and they used to tell them to come close and listen to the trainer. On the contrary, they were trying some moves individually far away from their peers such as checking what is underneath them, hopping and splashing. They did not display any play neither group skills compared to their peers with mild autism. Concerning their language and communication behaviors, all of them had poor eye contact and did not orient the body to the speaker unless they were physically guided by the trainers. During phase 3 (water aerobics) that involved group instructions, children kept far proximity from their peers and were inattentive all the time. Concerning their swimming skills, participants were all able to enter and exit the pool without assistance as their peers in group 1. They displayed poor fine and gross motor skills as they were all able to splash water with hands and feet with the trainer's support and physical guidance. During phase 3 (water aerobics) at the shallow end, they did not perform any of the activities even when instructed as one to one. However, the trainers kept trying to engage them and manage their behaviours to feel more comfortable around them and get used to the environment and the routine. Concerning their fitness level, they did not show any signs of discomfort and none of them seemed to need a break though they were moving all the time until the end of the session. When the time was up, they tried swimming far away from the trainers as they wanted to stay in the pool and not leave.

The following behaviours/skills were observed during week 3:

Jogging session

Children with **mild autism in group 1** (segregated group) arrived at the location (field) and they were clearly happy and excited to begin. They started to run around each other when they were told that the session will start in 10 minutes. At the beginning of the jogging session, participants knew where to stand for the warm-up when they were told that it was time to start; they actually wanted to skip warming up and start jogging right away. It was observed in group 1 and 2 that physical structure using marked areas and following the same routine since week

1 fostered independence and increased on-task behaviors for many children. In addition, it made children get comfortable during the sessions and remember the sequence of the events from session to session and from week to week. Also, they were able to associate specific areas with specific activities. In addition, participants became familiar with the environment/structure and an increase in their independence while moving and performing the activities was observed. Children with mild autism during this week were able to move through the activity areas associating the activities with each of the marked areas. Consequently, they showed better abilities following the plan and making the transition to the next activity when directed. Moreover, the physical structure also fostered emotional security. During week 1, participants with mild autism seemed overwhelmed. It was observed during this week and after exploring the environment and using equipment to mark the activity areas, children were calmer, more comfortable and off-task behaviours were reduced. Socially, participants showed improvement by greeting team members and asking about their names without being directed by their parents, as observed during the first week. Children also greeted each other and asked about each other's names as well as initiated conversations with peers. For example, the participant said, "Would you like to run with me?" "Let's check the self-monitoring board.". During warming up, jogging and cooling down, they showed improvement by observing their peers and trainers all the time and not only the trainers as observed during week 1. Using verbal directives and verbal cueing combined with modeling made children observe the trainers most of the time and follow directions. It was also encouraging to perform the right movement that led to mastering the assigned skills in the upcoming weeks. It also increased their motor performance compared to previous weeks. Also, they showed improvement by imitating each other's movements (moving their legs along with their arms). Some participants were correcting each other's movements by saying "lift your leg higher" "do not stop moving your arms" and the others used to respond to these interactions from peers by saying, "look, I am trying", "oh, I forgot to move my arms".

They displayed appropriate emotional skills (e.g., understanding emotions, self-regulation). For example, two of the children with moderate autism were throwing a tantrum, and all the children with mild autism were attentive to that. They identified and justified their emotions by asking "why?" and answering, "maybe because they do not want to jog". an example of self-regulation was when one participant with mild autism came upset from home for no reason as his mother reported. He allowed the volunteers to comfort him by talking to him and hugging him until he felt better and able to exercise. Another example of self-regulation was that most

of them had high energy levels and ran around the playground to release their energy as well as requested a break when tired by saying “Can I take a break”, or “I am tired, can I sit?”. All of them asked the trainers for assistance when needed during jogging, warming up and cooling down. All children with mild autism displayed appropriate group skills. They remained with the group, followed the group routine as well as followed directions throughout the session.

In terms of their language and communication skills, participants displayed the same skills observed in week 1 in addition to displaying new skills such as initiating conversations when it was appropriate to do so (e.g., during breaks and not while jogging). For example, they used to ask each other about their favourite sports, toys, colours, video games and food. Also, they introduced themselves to new volunteers using an appropriate voice volume. They showed progress by responding to questions from peers and not only from trainers, as observed during week 1. Moreover, they showed progress in their non-conversational skills by paying attention to nonverbal language and understanding what is being communicated. For example, the trainers used to nod their heads sometimes either to agree or disagree on behaviour before talking and the participants understood what was communicated. Concerning their physical skills, by the third week, participants showed progress in motion planning and balancing by understanding the difference between jogging and running and adjusting their jogging pace (slower/faster). In addition, they were able to navigate directions from the start to the finish point with assistance at sometimes. Also, the children showed progress in their postural stability and fitness by keeping the body in a stable and balanced position for longer compared to week 1. Moreover, they took fewer breaks compared to week 1 and were able to continue jogging for longer with less fatigue compared to week 1. It was noticed that participants were giving more attention to the instructions. Using modeling and physical guidance as well as direct instructions when needed facilitated participant’s engagement and the acquisition of motor skills and made them able to develop the skills necessary to exercise and show progress with time. They showed an improvement in the number of laps completed as they all completed 10 laps as planned (refer to p.g.114). After counting the happy faces they collected, they were talking to each other and saying, “Maybe we can do more next time maybe 12 or 14!” it was observed that using the self-monitoring boards encouraged them to count independently and increased their motivation levels for the upcoming sessions.

Children with **moderate autism** participated without their parents. They did not want to join at first and started being aggressive. However, two of them started following one to one instruction after using edible reinforcement (small pieces of dates) as well as verbal directives

and cueing. Participants displayed better social skills compared to the previous weeks such as maintaining better eye contact and close proximity to trainers at sometimes but still no interaction with peers. They showed better observation of trainers and responded to directions. After a while, participants started losing attention and tried to escape and run away from the trainers. They were instructed to come back and received edible reinforcement again combined with tangible and verbal. They were given edible reinforcement upon the following instruction after trying to disengage or refusal to follow directions. It was noticed that using different kinds of reinforcement was effective as it provided encouragement to complete the tasks and kept them focused. In terms of their language and communication, it was still limited to communicating through sounds and pointing at what they need at sometimes. Also, they were unable to orient their bodies to the speaker unless they were physically directed. In addition, participants were not able to pay attention to the trainer's nonverbal language and comprehend what is being communicated (e.g., if trainer nods head means yes and shakes the head, that means no). In terms of their physical skills, they showed progress in motion planning and balancing by understanding the difference between jogging and running but still were not able to adjust their jogging pace without assistance, either too fast or too slow. Also, they were still unable to control when to start and stop if they came too close to a person and the trainers used to pull them to make them stop. Children showed progress in their postural stability and fitness by keeping the body in an upright position for longer periods compared to week 1. In addition, they were able to carry out jogging taking fewer breaks in between laps compared to week 1. Participants showed improvement in the number of laps completed as they completed a range of 6-10 laps compared to 2 laps only in the first session during the first week.

Note:

Please refer to pages 90-91 in chapter 5 for more details about edible reinforcement; the procedure and the reasons behind choosing this kind of reinforcement with some participants with moderate autism.

Children with **mild autism** in **group 2** (inclusive group) were so excited and displayed similar social and emotional, language and communication and physical skills like the ones displayed by their peers in group 1. Socially, they showed improvement by greeting the team members and their peers receiving no direction from their parents. In addition, they responded to interactions from trainers and peers most of the time. For example, they responded to questions asked by the typically developed children asking about their names and ages. All of them were observing the trainers and their peers during warming up, jogging and cooling down. In addition to the previously mentioned behaviors, it was observed that children with mild autism

displayed more social skills during warming up such as suggesting exercise movements. For example, they were suggesting movements during warming up and showing it to the trainers and their peers who were typically developed. Another social skill that was observed was imitating peers and encouraging others. Children with mild autism were supporting their peers with moderate autism and checking if they were doing the right movement after observing the typically developed ones doing that. Participants displayed appropriate emotional skills such as understanding emotions and self-regulation. For example, one participant was sitting down and refusing to jog but was comfortable being close to one of the volunteers. His mother reported that he was not in a good mood. He allowed the volunteer to comfort him by talking to him and hugging him until he felt better and able to exercise. Another example of self-regulation was that most of them had high energy levels and ran around the playground to release their energy as well as requested a break when tired by saying “Can I take a break”, or “I am tired, can I sit?”. All of them asked the trainers for assistance when needed during jogging, warming up and cooling down.

All children with mild autism displayed appropriate group skills. They remained with the group, followed the group routine as well as followed directions throughout the session. Participants with mild autism also displayed more language and communication behaviors during warming up compared to their peers in group 1. They initiated conversations around a specific topic. As mentioned above, they were suggesting movements during warming up and showing it to the trainers and their peers who were typically developed saying “Why don’t we run in place?”, another child said, “Can we do leg swings?”. Their language and communication also improved. They were more talkative compared to their peers in group 1 responding to conversations initiated by their peers who were typically developed. Children with mild autism and the typically developed ones seemed more comfortable compared to the previous weeks. Participants became familiar with the environment/structure and an increase in their independence, while moving and performing the activities, was observed. Children with mild autism during this week were able to move through the activity areas associating the activities with each of the marked areas. Consequently, they showed better abilities following the plan and making the transition to the next activity when directed. Moreover, the physical structure also fostered emotional security. During week 1, participants with mild autism seemed overwhelmed. It was observed during this week and after exploring the environment and using equipment to mark the activity areas, children were calmer, more comfortable and off-task behaviours were reduced. Concerning their physical skills, by the third week, they

showed progress like their peers in group 1 in their motion planning and balancing and postural stability and fitness. All participants in the group with mild autism as well as the typically developed showed improvement in the number of laps completed as they completed 10 laps as planned like their peers in group 1.

In regard to children with **moderate autism**, they displayed similar social and emotional, language and communication and physical skills like the ones displayed by their peers in group 1. All four participants refused to get in at first, but they started following instructions after a few minutes with only one boy throwing a tantrum and demonstrating aggressive behaviours (e.g., hitting) toward others until the end. All of them completed 10 laps as planned like their peers in group 1.

Mixed games session

During the mixed games session, children with **mild autism in group 1** (segregated group) were so excited upon arrival when they saw the materials and the setup of the activity circuit. They asked to skip the warm-up because they could not wait to start with the games. They were happy and smiley most of the time. Participants displayed appropriate social behaviors (play behaviors). They showed improvement by greeting team members and asking about their names, as observed during the jogging session. They also greeted each other and asked about each other's names. Children displayed a new play skill which was encouraging each other. For example, during hula hoops jumps participants in the group used to imitate the trainers and shout "keep ongoing", "you can do it", "go faster" to encourage their peer who is performing the activity. Another example of encouraging each other was during playing in pairs "catch the ball" where one participant saying to the other, "come on, throw it to me", "aim at me, you can do it". It was observed that children started encouraging each other after observing the trainers encouraging their peers. Also, when children started encouraging each other, they were verbally reinforced by the trainers and that influenced them to encourage their peers even more. Another play behaviour that was displayed was waiting for their turns. Children with mild autism were able to wait for their turn when directed once and verbally reinforced by the trainers compared to week 1 when the trainers had to stay next to them and hold some of them from their shoulders or hands to be able to wait for their turn. Being consistent and using direct, clear and short verbal instructions was effective and made children follow instructions and perform appropriate behaviours. They showed better observation skills as they carefully observed the trainers while modelling the games/activities as well as their peers while performing it.

In terms of their language and communication skills, children displayed the same skills that were displayed in the jogging session of week 3 in addition to showing some progress in verbal conversational skills. For example, while waiting for their turn, they asked questions such as “When am I starting?”, “Can you show me the move again when it is my turn”. Also, all of them were able to answer Yes/No questions asked by the trainers and the researchers such as “Did you like this game?”. Participants showed improvement in their physical skills as well by showing a better fitness level. They displayed less fatigue and signs of discomfort while performing the activities. They took a short break after performing 4 activities in a row. They placed 4 happy faces on the chart and that kept them motivated to continue the rest of the activities and think about the upcoming activities. Also, all of them needed less assistance compared to the first week of the program during hula hoop jumps, catch the ball and running and kicking the ball. Children showed some improvement in their fine and gross motor skills as well as their motor coordination. For example, some were able to catch the ball once or twice during (throw and catch the ball in pairs) where they could not during the first week. Also, most of them displayed better abilities in kicking the balls by aiming and kicking it stronger. They also jumped and hopped finding it less difficult compared to the first week. For example, some participants started by hopping on one leg and then moved on to hopping on two legs. They completed 8 games as planned which was an improvement compared to week 1. They placed 8 happy faces on the chart independently.

In terms of children with **moderate autism**, two children were still showing unpleasant social and emotional behaviors. They were still demonstrating aggressive behaviors toward self and the team members (e.g. hitting). They were taking a long time to adjust and get used to the routine compared to their peers with mild and moderate autism. Both of them were still trying to disengage and not remain with the group neither follow the group. In addition, both of them needed assistance and physical guidance at all times during warming up, activity circuit and cooling down. However, the other two participants with moderate autism showed progress in their social and emotional, language and communication and physical skills. Socially, they were attentive and observing the trainers during modelling during warming up, activity circuit and cooling down. Both participants followed one to one instruction and responded to instructions while maintaining better eye contact and keeping close proximity to peers and trainers unlike week 1. However, there was still no interaction with peers as observed in the jogging session. After a while, they started losing attention and tried to escape and run away from the trainers. They were instructed to come back and received edible reinforcement.

Constant reinforcement, verbal cueing, modeling and physical guidance were provided for participants with moderate autism. Consistency and using these strategies made the children attend to instructions and increase their engagement level. During the activity circuit, both of them were able to take turns when directed by the trainers and sometimes they had to hold their hands to wait for long. Emotionally, participants showed progress by allowing the trainers to comfort them when agitated by hugging them or sitting next to them. Also, they sat down and pointed to the grounds meaning they needed a break instead of running away and sitting far away as observed in the jogging session. In addition, they started being flexible and not throw a tantrum when told “No”.

In term of their language and communication skills, they showed improvement by displaying better non-conversational skills. Children showed better eye contact and paid better attention to demonstrations. Moreover, they showed improvement by showing better ability orienting body to the speaker for a short time with less physical guidance. However, they were not able yet to pay attention to the trainer’s nonverbal language and comprehend what is being communicated (e.g., if trainer nods head means yes and shakes head that means no). Regarding their conversational skills, it was still limited to communicating through sounds and pointing at what they need at sometimes as observed during the jogging session. For example, they used to point to the ground when they needed a break and point at their bags when feeling thirsty to drink some water. Physically, both of them showed improvement in their physical skills as well by showing a better fitness level. They displayed less fatigue and signs of discomfort while performing the activities. They took a short break after performing 3 activities in a row. Both participants showed progress in their fine and gross motor skills by being able to perform some of the games when modified and often with assistance. For example, they found it difficult to jump into the hoops from one to the next with both legs until reaching the end of the line. Therefore, it was modified into stepping into the centre of the hoops. Also, none of them was able to run in place, so it was modified into walking in place instead. In addition, participants showed progress in their motor coordination during the throw and catch the ball by displaying better abilities in aiming and throwing the ball harder for a longer distance almost reaching their peer but still are not able to catch it back. Children had poor motion planning and balancing as they displayed poor abilities in adjusting their speed during some activities (e.g., collecting balls into buckets, fast walking in place, hopping over a jump rope). Also, both of them were still unable to control when to start and stop if they came too close to a person and the trainers used to pull them to make them stop. They were always too slow when performing

the activities and could not move to faster pace easily. Both participants showed progress by completing 5 games out of 8 which was an improvement compared to week 1. They placed 5 happy faces with assistance by showing them where to put it and supporting their hands to stick it.

Children with **mild autism** in **group 2** (inclusive group) displayed similar social and emotional, language and communication and physical skills as their peers in group 1. In addition to the previously mentioned behaviors, it was observed that they displayed some more social and emotional and language skills as well as showed progress in previously learned ones. Socially, participants showed progress by initiating more conversations with the trainers and their peers. For example, they were talking to the trainers and their peers about the number of happy faces they are collecting at the end of the session. They also shook hands with everybody and returned greetings from peers and the trainers. They were listening to instructions as well as imitating the trainers when cheered and clapped for other participants and they started cheering and clapping for their peers with moderate autism and the typically developed ones. Regarding their conversational skills, they asked subjective questions as their peers who were typically developed. For example, they asked about certain games in the activity circuit and requested to make it longer than 4 minutes (the assigned time for each activity). Participants really enjoyed racing and ball games and whenever time was up, they used to ask to play more. Also, all of them were able to answer Yes/No questions asked by the trainers and the researchers such as “Did you like this game?”. Participants showed improvement in their physical skills as well by showing better fitness level, fine and gross motor skills as well as their motor coordination. In terms of the activity circuit, children with **mild autism** completed 8 games as planned similar to their peers in group 1 and placed 8 happy faces on the chart independently.

Concerning children with **moderate autism**, two of them refused to join the session at first, but after a while, they joined and entered the field. However, they were inattentive and refused to be engaged in the activities until the end of the session. The other participants with moderate autism displayed similar social and emotional, language and communication and physical skills as their peers in group 1. Socially, they showed progress by being attentive, observing the trainers during modelling during warming up, activity circuit and cooling down, following one to one instruction, responding to instructions while maintaining better eye contact and keeping close proximity to peers and trainers unlike week 1. However, there was still no interaction with peers as observed in the jogging session. Emotionally, participants showed progress by

allowing the trainers to comfort them when agitated by hugging them or sitting next to them, accepting being told “No” and requesting for breaks by pointing to the ground. In term of their language and communication skills, they also showed improvement by displaying better eye contact and orienting body to the speaker for a short time with less physical guidance. However, they were not able yet to pay attention to the trainer’s nonverbal language and comprehend what is being communicated (e.g., if trainer nods head means yes and shakes the head, that means no). Physically, all of them showed improvement in their physical skills as their peers in group 1 by showing better fitness level, fine and gross motor skills and motor coordination. Children had poor motion planning and balancing as they displayed poor abilities in adjusting their speed during some activities (e.g., collecting balls into buckets, fast walking in place, hopping over a jump rope). Also, all of them were still unable to control when to start and stop if they came too close to a person and the trainers used to pull them to make them stop. They were always too slow when performing the activities and could not move to faster pace easily. In terms of the activity circuit, they showed progress as their peers in group 1 by completing 5 games out of the assigned 8 games which was an improvement compared to week 1. The children placed 5 happy faces with assistance by showing them where to put it and supporting their hands to stick it.

Aquatic session

During the aquatic session, children with **mild autism** in **group 1** (segregated group) were very excited and were rushing during warm-up to enter the pool. They showed progress in previously learned social skills by maintaining close proximity to trainers and peers most of the time, being attentive and following instructions during phase 2 (one to three instruction) and 3 (water aerobics) as well as phase 4 (cooling down). Also, they were trying so hard to perform the movements and master the skills during phase 2 and 3. Moreover, children demonstrated that they were at ease with the coaches. In addition, during the aquatic session of the first week, most of them were trying some moves individually (parallel play near peers) like checking what is underneath them, blowing bubbles, hopping and splashing. During this session, participants showed progress by playing associatively with peers by sharing the equipment used during the session (e.g. balls, noodles). Moreover, children were better in taking turns during phase 2 when instructed by the trainer to observe their peer performing a skill (e.g. placing head under the water) and then do the same.

Concerning their language and communication skills, participants were initiating conversations with the trainers more than with their peers. They showed better skills in paying attention to

verbal and nonverbal language during phase 2 and 3. They were clearly happy during the session and kept on expressing themselves by saying “We love the pool”. Also, they were asking and answering questions (e.g. “When are we playing with the equipment?”. “Can I dive in/jump?”. When they used to ask such questions, the trainer used to refer to the posters to remind them of the sequence of the phases. Consequently, participants started to refer to the board and keep track of the activities and state the activities completed. It also made them determined to reach phase 3 and participate. All of them were asking the trainers to look at them and to check their moves. They were still afraid of the deep and expressing it clearly by saying that they do not want to go there.

Concerning their swimming skills, most of them mastered the introduction to water skills (e.g. touching chin, ears, mouth to water, pouring water on the head) but still working on breathing skills (placing the head in water without consuming much water). Trainers at the swimming sessions used to use very short verbal directions which made the students follow their directions, increased their motor performance and kept them on track. During aerobics at the shallow end, participants performed jumping jacks, running in place and hopping on one foot showing progress in their motor coordination by showing better abilities during running, jumping and hopping needing less assistance and physical guidance. During water aerobics, one of the trainers used to perform the aerobic movements outside the pool in addition to the trainers modelling inside the pool close to the participants. It was observed that using modelling inside and outside the water during aerobics facilitated children’s engagement and the acquisition and development of aerobic skills. Also, they showed progress in their motion planning and balancing by being able to adjust their speed during running at sometimes and they needed less assistance to balance while performing the movements. Participants were also introduced to noodle kicks and noodle jumps. They showed better fitness levels by displaying more muscular strength and flexibility during phase 2 and 3 as well as being able to carry out with the activities until the end of the session. When the time was up, all of them did not want to leave and requested to stay longer in the pool by saying “We are not tired, we want to play more”.

Children with **moderate autism** were all comfortable in the water, unlike during jogging and mixed games sessions. They seemed excited and wanted to skip warming up and enter the pool right away. None of them displayed unpleasant social behaviours such as being aggressive or refusing to enter the pool. However, they were still trying to disengage, and roam alone whenever confronted with instructions. Participants with moderate autism were taking a long

time to adjust and get used to the routine compared to their peers with mild autism. Socially, children showed progress by keeping close proximity to trainers and peers at sometimes. Also, they were showing progress by observing the trainers for longer compared to week 1 but not their peers. All of them were following one to one instruction and were attentive most of the time during phase 2 (one to three instruction) while maintaining better eye contact and keeping close proximity to peers and trainers unlike their behaviour during week 1. However, there was still no interaction with peers as observed in the jogging and the mixed games session. After a while, participants started losing attention and tried to disengage and get away from the trainers. They were instructed to come back and were physically guided to perform the skills. Children with moderate autism showed progress by being flexible and accept being told “No”. Also, they displayed a new behaviour which was taking turns during phase 2 when instructed by the trainer to observe their peer performing a skill (e.g. placing head under the water) and then do the same. During, phase 3 (water aerobics) they were still inattentive when instructed as a group and not as one to one as observed during the first week. Yet, they displayed a new behaviour which was parallel play near peers using the same or similar materials during water aerobics (e.g., playing with water noodles next to peer who is also playing with it). All participants with moderate autism were showing interest in the materials and playing with it more than performing the activities. Emotionally, they showed progress by not displaying any aggressive behaviours toward self and others, as mentioned earlier. In addition, they were calm and easy to handle compared to the land setting (jogging and mixed games).

Concerning their swimming skills, the children were showing progress on water orientation skills (e.g. touching chin, ears, mouth to water, pouring water on the head) but they did not master the skills. They were working on breathing skills as well (placing head in water without consuming much water). Their progress was slower compared to their peers with mild autism. During aerobics at the shallow end, participants remained with the group but needed assistance at all times and received one to one instruction. Participants performed jumping jacks, running in place and hopping on one foot displaying poor coordination as their movements appeared uncoordinated. They weren't able to simultaneously move their arms and legs in the same or different direction. Therefore, running in place was modified to walking in place and jumping jacks was modified to stepping to the sides. Also, they had poor motion planning and balancing. For example, it was difficult for them to adjust their speed during running and could not move from slow to fast either too slow or fast and they needed assistance to balance while performing the movements. All of them showed better fitness levels compared to the jogging

and mixed games sessions as they were able to carry out with the activities until the end of the session without asking for a break. Yet, they had low muscle tone and flexibility during phase 2 and 3. When the time was up, they did not want to leave and wanted to stay for longer as they refused to go exit the pool and tried to move away from the trainers. In regard to children with moderate autism, they displayed progress in their social, communication and physical skills as their peers in group 1.

Note:

Children with moderate autism did not receive edible reinforcement during swimming sessions because they were calmer and easy to handle compared to the jogging sessions as well as the mixed games sessions. The trainers applied the teaching strategies discussed in chapter 5 (refer to pg.79-90 for details) except for edible reinforcements.

Children with **mild** and **moderate** autism in **group 2** (inclusive group) displayed similar social and emotional, language and communication and physical skills like the ones displayed by their peers in group 1. In addition to these skills, it was observed that there was more social interaction between participants with mild autism and typically developed children. Children with **mild autism** showed progress by responding when another child calls their name. Their typically developing peers used to call them by name to show them their moves and most of them responded and interacted with them. Also, children with mild autism used appropriate attention-seeking behaviors when interacting with the trainers and their peers after observing their typically developed peers doing the same (e.g., calling name, tapping shoulder). In addition, children with mild autism were better in making the transition to the next activity when directed when compared to their peers with mild autism in group 1 as they were imitating the typically developed ones. They also displayed more language and communication skills compared to their peers in group 1. For example, they used to make comments about what they are playing to peers saying, “Look at me, I can breathe under the water”. They used to initiate games by saying, “let’s race and see who is faster”. Children with mild autism used to ask the trainers about the routine and especially the water aerobics. Concerning the swimming skills of children with mild autism and the typically developed ones, most of them mastered the introduction to water skills (e.g. touching chin, ears, mouth to water, pouring water on the head) but still working on breathing skills (placing the head in water without consuming much water). During aerobics at the shallow end, participants performed jumping jacks, running in place and hopping on one foot showing progress as they needed less assistance to balance while performing the movements. They were also introduced to noodle kicks and noodle jumps like

their peers in group 1. When the time was up, all of them didn't want to leave and requested to stay longer in the pool.

The following behaviours/skills were observed during week 5:

Jogging session

During the jogging session, children with **mild autism** in **group 1** (segregated group) were running and playing around with each other before the beginning of the session. By week 5, they knew the rules and knew where to go and where to stand by themselves without being directed. Following the same routine since week 1 made it easier for the children to know the organisation and the structure of the sessions. Moreover, it made the transition from warming up to jogging to cooling down smoother compared to previous weeks and easier to handle. Also, they were performing the warming up and cooling down activities as well as jogging with less verbal direction, cueing and physical guidance. Socially, participants had become good friends, and they were asking about the other participants who did not arrive yet. They acquired new social skills in addition to the ones displayed in the previous weeks as returning and initiating greetings with peers and playing associatively with peers (e.g., they were trying to jog next to one another). Also, inviting others to play. For example, while jogging there were groups of children outside the field visiting the leisure centre and the participants started shouting saying, "Come and join us". Emotionally, children with mild autism started using acceptable ways to express anger, frustration or fatigue (e.g., states being upset or asks to take a break or for water) and were able to deal with being teased in acceptable ways (self-regulation). The trainers used always to direct them verbally and model how to deal with anger as well as with other participants. This can be one of the reasons behind children's social and emotional development.

Moreover, they started showing progress in flexibility by accepting the consequences of their behaviours without becoming upset/angry and claiming and defending possessions. For example, one of the participants used to take his peer's water bottles and run away. The researcher used to ask him to bring it back and apologise to his peers and he used to refuse in previous weeks and she had to go and bring it herself and talk to him about it. During week 5, he showed progress by coming back on his own and saying "sorry" to his peers. Also, others learned to defend their possessions as instructed by the trainers and the researcher by saying, "this is my water bottle or my bag". All participants with mild autism also showed progress in

seeking assistance such as assisting peers in placing the happy faces on the self-monitoring boards.

In terms of their communication skills, participants developed new skills in addition to the ones displayed in the previous weeks such as making a range of comments related to the topic during conversations (e.g., some participants were talking about their favourite colour and how they choose it wherever they go), demonstrating the difference between asking for information and telling information and staying on topic by asking questions related to the topic or making comments. In addition, they started using “please” and “thank you” at appropriate times. Physically, participants showed progress in their postural stability and fitness. Their fitness level improved as they took fewer breaks compared to the previous week. Moreover, they were able to keep their bodies in a stable and balanced position. They were able to jog and continue with the task with less undue fatigue. During jogging, trainers used to provide them with verbal encouragement and a constant reminder about how to jog properly. It was observed that using these strategies increased children’s performance and developed their skills. Moreover, the children were showing progress by breathing properly (inhaling and exhaling regularly). In addition, they improved their eye-hand-leg coordination. They wanted to continue jogging even after time was up. They completed 15-17 laps which were a significant improvement compared to week 1 and 3 (see table 6.1 for the overall progress of the number of laps achieved week by week by the two groups). They were counting the happy faces out loud clearly proud of themselves and clapping for themselves and others. It was observed that using the charts kept participants motivated week after week and they were getting more independent and self-motivated each session by going by themselves after finishing a number of laps and placing the happy faces by themselves and counting the total at the end of the session. they were also very happy when placing it without assistance.

Children with **moderate autism** showed a huge difference by displaying pleasant appropriate social and language and communication skills, unlike the previous weeks. Socially, they were comfortable around the researcher, trainers and assistants maintaining proximity most of the time. They showed progress by observing and imitating the trainers during modelling and performing the movements during warming up, jogging and cooling down. It was observed that being consistent by using the same teaching strategies and following a routine since the first week made the children feel comfortable and able to follow instruction. In addition, children with moderate autism became more secure (emotionally) and not overwhelmed anymore. It appears to be because of physical structure. It was observed that the children paid

more attention and were closer to the activity area and it eliminated overwhelming feelings and off-task behaviors. Consequently, the children started to give their maximum time on a task that allowed them to practice and develop their skills. It was also observed that using constant modelling, verbal directions and reinforcement was an effective way to make the children perform appropriate social behaviors and be more attentive and engaged. They displayed a new skill which was observing and imitating their peers during warming up and cooling down. Participants with moderate autism showed progress by remaining with the group during warming up and cooling down as well as during jogging with fewer attempts to disengage and followed the group routine unlike their behaviors in previous sessions.

In regard to their language and communication skills, they showed progress by being more attentive and following instructions with fewer refusals. They also showed progress by maintaining eye contact for longer periods compared to previous weeks. All of them acquired new non-verbal conversational skills such as orienting their bodies towards the trainers for longer and paying attention to a trainer's nonverbal language and comprehend what is being communicated (e.g., if trainer nods head means yes and shakes head that means no). Concerning their physical skills, participants showed progress in their postural stability and fitness. Their fitness level had improved, where they took fewer breaks compared to the previous week. In addition, they were able to keep their bodies in a stable and balanced position most of the time. Moreover, they were able to jog and continue with the task with less undue fatigue. Moreover, they were showing progress by breathing properly most of the time (inhaling and exhaling regularly). In addition, they improved their eye-hand-leg coordination while being provided with modeling and physical guidance. It was observed that children with moderate autism displayed better motor skills right after receiving physical guidance. It was noticeable that modeling and physical guidance facilitated the acquisition of their motor skills and developing it as well. They completed (8-10 laps) which was an improvement compared to week 1 and 3 (see table 6.1 for the overall progress of the number of laps achieved week by week by the two groups). They were attentive during placing the happy faces and showing a smile on their faces but still needed assistance.

Children with **mild** and **moderate** autism in **group 2** (inclusive group) displayed similar social and emotional, language and communication and physical skills like the ones displayed by their peers in group 1. In addition to these skills, it was observed that children with mild autism showed more progress in their social skills. In specific, participants with mild autism displayed better play behaviors by happily following other peers play ideas. For example, after warming

up one of the typically developed children suggested jogging together with the other participants as a group (they start and finish the lap together). The trainers and the participants agreed to try, and they were so excited about the idea. Participants with mild autism and the typically developed ones followed him, and they all jogged at the same pace together. They called him “leader” and were able to complete 12-14 laps together which was an improvement compared to previous weeks. In regard to their physical skills, children with mild autism showed improvement in their postural stability and fitness by keeping their bodies in a stable and balanced position and carrying out jogging without undue fatigue. Moreover, they were showing progress by breathing properly (inhaling and exhaling regularly) receiving less verbal directions. In addition, participants improved their eye-hand-leg coordination during jogging while swinging their arms forward and backwards between waist and lower chest level and moving their legs needing less verbal directions and physical guidance. When the time was up, they counted their happy faces together and wanted to complete more laps to collect more happy faces. In regard to children with **moderate autism**, they showed a huge difference by displaying similar pleasant social and emotional, language and communication and physical skills as their peers in group 1, unlike the previous weeks. However, concerning their jogging laps, most of them stopped jogging after completing 8 laps and refused to continue.

Mixed games session

During the mixed games session, children with **mild autism in group 1** (segregated group) were full of energy and clearly happy. By week 5, participants knew the rules and knew where to go and where to stand by themselves without being directed. It was noticed in group 1 and 2 that the children became more independent after becoming familiar with the environment, physical structure and the materials. Children were able to associate materials and clearly marked areas with the activities required and remember what is required. Consequently, they started to successfully follow the assigned activities with less verbal instructions and physical guidance compared to the beginning of the program. They showed social improvement in play and group skills. For example, at the beginning of the session and after warming up children were organising themselves in groups choosing their friends as their group members. In addition, they were making comments about the games to their peers (e.g., naming the games) and organising play by changing the order of the games starting with the most to least favourite. Moreover, participants were showing more interaction when talking about play ideas and following other peers play ideas. For example, when moving from one game to another, they were talking about borrowing the materials used during the session (e.g., balls) and played with

it after the session is over.

They also showed improvement in their language and communication abilities as they were calling each other by name using appropriate voice volume. Also, children were asking about certain activities “When are we racing and playing ball?”. Some children with mild autism were explaining activities to their peers using the words that were used by the trainers. In addition, they were copying the trainers and encouraging their peers verbally (e.g., a child says, “You can do it”, “Faster”, “Good job”). It was observed that children were clearly happy and got more motivated after receiving verbal and physical reinforcement from the trainers such as words of encouragement or tap on the shoulder/ a clap. It also extended as mentioned above by copying the trainers and reinforcing/encouraging their peers. It also made them more determined to succeed. Physically, children with mild autism showed improvement in their fine and gross motor skills by performing some of the activities that they could not perform in previous sessions (e.g., hopping with two legs). They displayed better motor functioning by showing better eye-hand coordination during ball games (e.g., throwing, catching, picking up balls). Also, their fitness level increased by being able to perform the same movements continuously without taking a break (e.g., hopping forward, backward and sideways, racing, running in place). Moreover, all of them showed improvement in their motion planning as their speed was relatively increased during racing and performing the activities. Also, they were able to control when to start and stop in the case facing an object or person most of the time. Participants completed 8 games as planned. They were independent while placing the happy faces on the exercise charts.

Children with **moderate autism** showed a huge difference by showing pleasant social skills similar to the skills observed during the jogging session such as being comfortable around the researcher, trainers and assistants maintaining close proximity most of the time. Also, observing and imitating the trainers as well as their peers. Also, remaining with the group during warming up and cooling down as well as during the activities with fewer attempts to disengage and followed the group routine. It was observed during the previous weeks as well as week 5 that the team members used to use the same teaching strategies (e.g., verbal directives and cueing, reinforcement, modeling and physical guidance) consistently with children with moderate autism even when they were not attentive at the beginning of the program. Therefore, it was observed that children got used to the routine and the teaching procedures as well as the

team members that facilitated their engagement and learning for better performance in their social, language and physical skills.

Moreover, children with moderate autism showed progress in their communication skills similar to the skills observed during the jogging session. All of them were more attentive and following instructions with fewer refusals. During one to one instruction, they showed improvement by orienting their bodies towards the speaker for longer periods. In addition, while performing the movements, they paid attention to the trainer's nonverbal language and understood what is being communicated (e.g. if the trainer shook his/her head that means no and nodding head means yes). Concerning their physical skills, they showed improvement in their motion planning as their speed was relatively increased during racing and performing the activities but still were not able to control when to start and stop in the case facing an object or person. Also, children with moderate autism showed improvement in their fine and gross motor skills by performing some of the activities that they could not perform in previous sessions with less assistance. For example; they were able to pick up the ball on their own from the first attempt while directing them until throwing it into the bucket. Also, they were able to hop on two legs with assistance but still not continuous hops. They showed progress in their fitness skills by taking fewer breaks compared to previous weeks. For example, all of them were able to perform two to three activities in the activity circuit in a row before asking for a break. Another area that they showed progress at was motor functioning. Participants displayed better eye-hand coordination during ball games. For example, they were able to throw the ball harder at the designated aim or to peer. Some of them completed 5 games where others completed 8 as planned which was an improvement compared to previous weeks. All participants were still provided with assistance when placing the happy faces on the exercise chart by showing them their names and where to place it.

Children with **mild** and **moderate** autism in **group 2** (inclusive group) displayed similar social and emotional, language and communication and physical skills like the ones displayed by their peers in group 1. By week 5, participants with **mild autism** and the typically developed ones knew the rules and knew where to go and where to stand by themselves without being directed. Also, they were performing the warming up and cooling down activities as well as the games with less verbal direction, cueing and physical guidance. It was observed that children who were typically developed showed progress in their social skills by providing verbal encouragement to their peers with mild autism during the activity circuit. Subsequently, children with mild autism were trying hard to master the movements and determined to

succeed. For example, children with mild autism were able to perform some moves better compared to previous weeks such as hula hoop jumps, running in place and hopping forward, backward and sideways after being encouraged by their peers. They showed social improvement in play and group skills after observing their peers who were typically developed. For example, during the circuit, the typically developed children were organising themselves in groups choosing their friends as their group members. Consequently, their peers with mild autism started choosing teams too. Moreover, the typically developing children were organizing the games by changing the order of the games starting with the most to least favourite. One of the boys loved ball games and he wanted to use balls in every activity and children with mild autism were interacting with him and agreeing on playing with the balls all the time.

They also showed improvement in their language and communication abilities as they were calling each other by name using appropriate voice volume. Also, all children were asking about certain activities “When are we racing and playing ball?”. Typically developed children were explaining activities to their peers using the words that were used by the trainers. In addition, they were copying the trainers and encouraging their peers verbally (e.g., a child says, “You can do it”, “Faster”, “Good job”). Physically, children with mild autism as well as the typically developed ones showed improvement in their fine and gross motor skills, motor coordination, motion planning and fitness skills as their peers in group 1. All participants completed 8 games as planned. They were independent while placing the happy faces on the exercise charts.

Children with **moderate autism** showed a huge difference like their peers in group 1 by showing an improvement in their social, communication and physical skills. They were comfortable around the team members keeping close proximity most of the time. Also, they were observing and imitating the trainers as well as their peers. moreover, they remained with the group during warming up and cooling down as well as during the activities with fewer attempts to disengage and followed the group routine. Regarding their communication skills, all of them were more attentive and following instructions with fewer refusals. They showed improvement during one to one instruction by orienting their bodies towards the speaker for longer periods. In addition, they paid attention to the trainer’s nonverbal language and understood what is being communicated (e.g. if the trainer shook his/her head that means no and nodding head means yes) during performing the movements. Concerning their physical skills, they showed improvement in their motion planning, fine and gross motor skills, fitness

and motor coordination skills as their peers in group 1. Some of them completed 5 games where others completed 8 as planned which was an improvement compared to previous weeks. All participants were still provided with assistance when placing the happy faces on the exercise chart by showing them their names and where to place it.

Aquatic session

During the aquatic session, children with **mild autism** in **group 1** (segregated group) were excited and clearly happy as in previous sessions. By week 5, participants knew the rules and knew where to go and where to stand by themselves without being directed. They showed improvement in their social skills (play behaviors) by responding more to interactions from peers (e.g., answering questions, accept toy from a peer) and making comments about what he/she is playing to peers (e.g., am getting better at blowing bubbles). Children with mild autism showed improvement in their emotional skills as well. They showed better ability in identifying more likes and dislikes (e.g., stating that they like the shallow end more than the deep, they like entering the pool slowly instead of jumping). They showed improvement in their conversational skills by talking to each other and the trainers most of the time. Also, they were asking questions about the activities “When are we using water noodles?”, “When are you going to teach us how to swim?”. In addition, all of them were responding more to questions from trainers and peers. For example, the trainer asked, “Can you put your head under the water?” and participants answered, “Look at me, I can do it.”, “Of course I can”. Participants were following instructions and were more attentive during phase 2 (one to three instruction) and 3 (water aerobics) compared to previous weeks. It was observed that using the poster boards and going through the 4 phases of the session at the beginning of the session and referring to it after finishing each phase encouraged the children to think about the activities they will perform and made them more organised and determined to succeed. During this session, they showed progress by playing more associatively with peers by sharing the equipment used during the session (e.g. balls, noodles).

Concerning their swimming skills, all of them mastered the introduction to water skills (e.g. touching chin, ears, mouth to water, pouring water on the head) as well as breathing skills (placing the head in water without consuming much water). Modelling, physical guidance and verbal reinforcement were used during swimming sessions. In specific to reinforcement, trainers mainly used verbal reinforcement during phase 2 and 3. It was observed that it was a very effective strategy as it influenced the participants to follow directions and improve their performance. They were still working on floating skills (learning positions and rotating from

one another supine, standing and prone position). Moreover, they were introduced to balance and control movements (allowing the trainer to move them through the water in the supine/prone position). During aerobics at the shallow end, children were very active and competitive. They performed jumping jacks, running in place and hopping on one foot showing progress as they needed less assistance to balance while performing the movements. Also, they performed noodle kicks and noodle jumps as well as racing as a team using noodles. They played catching and throwing balls between participants to keep it away from the trainer as well as shooting balls into hoops. All of them showed improvement in their fine and gross motor functioning (better performance when running and jumping in place). Also, they showed improvement in their motor coordination by displaying better abilities in aiming and catching balls. When the time was up, they did not want to leave and requested to stay longer in the pool.

Children with **moderate autism** were all comfortable in the water and entered the pool without assistance. Socially, they showed progress by keeping close proximity to trainers and peers most of the time. They were observing trainers and peers while performing the movements. They were more attentive compared to previous weeks and following instructions during phase 2 (one to three instructions). Participants showed progress by playing near peers (parallel play) using the same or similar materials (e.g., playing with the ball next to a peer who is also playing with a ball). Concerning their emotional skills, they showed improvement and acquired a new skill. They were calm and easy to handle. All of them demonstrated fewer refusals and attempts of disengagement. Children with moderate autism acquired a new skill which was identifying likes and dislikes. They started identifying likes and dislikes such as showing no fears of the deep end of the pool neither jumping also showing interest in some games more than others. For example, they were attentive and showing interest during throwing and catching balls and shooting balls into hoops more than jumping and running in place.

Concerning their swimming skills, all of them mastered the introduction to water skills (e.g. touching chin, ears, mouth to water, pouring water on the head) but still working on breathing skills (placing the head in water without consuming much water). Also, participants were still working on floating skills (learning positions and rotating from one another supine, standing and prone position). They were introduced to balance and control movements (allowing the instructor to move them through the water in the prone/supine position). During water aerobics at the shallow end, all participants with moderate autism were not fully attentive when directed with the group. Instead, they were offered one to one or one to two instructions during water

aerobics, and they started following instructions then. They performed running in place, jumping jacks and hopping on one foot with assistance. Also, they performed noodle kicks and noodle jumps. They played catching and throwing balls as one to one with the trainers unlike their peers with mild autism. Children showed improvement in their fine and gross motor functioning (better performance when running and jumping in place). Moreover, they showed improvement in their motor coordination by displaying better abilities in aiming and catching balls. When the time was up, all participants with moderate autism did not want to leave as usual and were refusing to get out.

Children with **mild** and **moderate autism** in **group 2** (inclusive group) displayed similar social and emotional, language and communication and physical skills as their peers in group 1. Children with **mild autism** and their peers who were typically developed were excited and clearly happy as in previous sessions. Similar to their peers in group 1, participants knew the rules and knew where to go and where to stand by themselves without being directed. They showed improvement in their social and emotional skills by responding more to interactions from peers (e.g., answering questions, accept toy from peer), making comments about what he/she is playing to peers (e.g., am getting better at blowing bubbles) as well as showing better abilities identifying likes and dislikes (e.g., stating that they like the shallow end more than the deep, they like entering the pool slowly instead of jumping). In addition, to these skills, it was observed that children who were typically developed showed progress in their social skills by providing verbal encouragement to their peers with mild autism during phase 3 (water aerobics). Consequently, children with mild autism were trying hard to master the movements and determined to succeed. For example, children with mild autism were able to properly perform some aerobics moves compared to previous weeks such as jumping jacks, running in place and hopping forward, backward and sideways after being encouraged by their peers.

Furthermore, they showed improvement in their conversational skills by talking to each other and the trainers most of the time, asking questions about the activities “When are we using water noodles?”, “When are you going to teach us how to swim?” and responding more to questions from trainers and peers. During this session, they showed progress by playing more associatively with peers with mild autism and the typically developed ones by sharing the equipment used during the session (e.g. balls, noodles). Concerning their swimming skills, all of them mastered the introduction to water skills (e.g. touching chin, ears, mouth to water, pouring water on the head) as well as breathing skills (placing the head in water without consuming much water). They were still working on floating skills (learning positions and

rotating from one another supine, standing and prone position). Moreover, they were introduced to balance and control movements (allowing the instructor to move them through the water in the prone/supine position). During aerobics at the shallow end, children were very active and competitive and performed the same activities as their peers in the group. All of them showed improvement in their fine and gross motor functioning (better performance when running and jumping in place). Also, they showed improvement in their motor coordination by displaying better abilities in aiming and catching balls. When the time was up, they didn't want to leave and requested to stay longer in the pool.

Children with **moderate autism** were all comfortable in the water and entered the pool without assistance. Socially, they showed progress by being more attentive compared to previous weeks and following instructions during phase 2 (one to three instructions). They kept close proximity to trainers and peers while observing them performing the movements. In addition, they were comfortable playing near-peer unlike previous weeks. Concerning their emotional skills, they showed improvement by being calm and easy to handle demonstrating fewer refusals and attempts of disengagement. Children with moderate autism acquired a new skill which was identifying likes and dislikes as observed with their peers in group 1. Some of the in previous sessions used to hesitate before jumping or practicing some skills at the deep side. During this session, they showed no fears of the deep end of the pool, neither jumping. Furthermore, they showed interest in some games more than others. For example, they were attentive and showing interest during throwing and catching balls and shooting balls into hoops more than jumping and running in place. Concerning their swimming skills, they were at the same level as their peers in group 1. They mastered the introduction to water skills but still working on breathing and floating skills. They displayed the same behaviors as their peers in group 1 by being inattentive during water aerobics. Instead, they were offered one to one or one to two instructions during water aerobics, and they started following instructions then. Participants showed improvement in their fine and gross motor functioning (better performance when running and jumping in place). Moreover, they showed improvement in their motor coordination by displaying better abilities in aiming and catching balls. When the time was up, all participants with moderate autism did not want to leave as usual and were refusing to get out.

The following behaviours/skills were observed during week 7:

Jogging session

During the jogging session, children with **mild autism in group 1** (segregated group) showed progress in previously displayed skills and acquired new ones. Socially, they showed progress by being more interactive with the trainers and their peers. They were telling stories about school; home and their upcoming vacation and others were responding to their stories by asking and answering questions. They acquired new skills such as making comments about what he/she is playing to peers (e.g., “look at my jogging”, “I can jog faster than you”). In addition, a new skill was displayed which was organising play by suggesting a play plan (e.g., “Let’s pretend we are a train and follow each other”). Participants with mild autism also displayed new emotional skills. One of the skills was demonstrating affection toward peers (e.g., giving peers hugs to greet them instead of shaking hands). Also, they used appropriate attention-seeking behaviors from trainers and peers (e.g., calling name, tapping shoulder). The children were expressing how happy and proud they were of the number of laps they completed by counting the number of laps out loud and sharing it with their parents who were waiting outside. Participants with mild autism showed progress in their language and communication skills as well. In previous weeks, the ones who arrived first used to ask about their peers who did not arrive yet by name. During week 7, participants asked about their peers who did not arrive by name and also asked about the reason behind their delay or absence. They were more talkative as mentioned above initiating conversations about different topics such as school, home and travelling as well as asking and responding to questions from peers. Most of the children with mild autism were able to identify likes and dislikes (e.g., stated the kind of snacks they like most) as well as identify emotions in self and others (e.g., they can tell if one of their peers was tired).

Concerning their physical skills, they showed improvement in their motion planning and balancing. They were able to navigate directions from the start to the finish point with less verbal directions from the trainers. In addition, participants showed better ability in adjusting jogging speed (slower and faster) when needed. Moreover, they kept space between peer/trainer while exercising without directing them. In addition, they were able to control when to start and stop in the case facing an object or person without being directed. Their postural stability and fitness improved as well. Children kept their bodies in good form in an upright position and were able to carry out jogging without undue fatigue. Also, they showed improvement in their motor coordination by jogging properly (swinging their arms forward and backwards between waist and lower chest level while moving their legs) with occasional verbal directives and encouragements when they lost focus or stopped moving their hands. All

participants with mild autism completed 17 laps and were so happy with the number they achieved. They started sharing it with the trainers, assistants and their parents/caregivers (see table 6.1 for the overall progress of the number of laps achieved week by week by the two groups). It was observed week after week that using the exercise charts made the children focus on the number of laps they can achieve and increased their motivational levels.

Children with **moderate autism** showed social and emotional, language and communication and physical development as their peers with mild autism and acquired new skills. Socially, they showed progress by being more comfortable around team members and peers, keeping close proximity all the time during warming up, jogging and cooling down. They were still receiving one to one instruction with less verbal cueing, modeling and physical guidance. They acquired a new skill which was observing their peers and the trainers more and for longer periods of time while performing the movements. Children with moderate autism showed improvement by dealing calmly with the trainers and they were easy to handle unlike previous weeks. Emotionally, acquired a new skill which was demonstrating affection toward peers and the trainers by giving them hugs and high fives. Also, all of them stopped demonstrating aggressive behaviours toward self and others. Another skill was acquired which was identifying likes and dislikes. During placing the happy faces on the exercise chart, they chose the colour of the happy faces to place under their names as well as the kind of edible reinforcement they want to receive. Concerning their language and communication, participants were attentive most of the time and following directions with no attempts to disengage. They showed significant language improvement as the ones who had limited vocabulary, started saying more words and acquired new words and the ones who were nonverbal started saying few words (e.g., “no” “I want” “candy” “bye”). Regarding their non-conversational skills, they showed better eye contact and oriented body to speaker most of the time. They showed better improvement paying attention to the trainer’s nonverbal language and comprehend what is being communicated (e.g., if someone shakes their head for no and nodding means yes).

Physically, the children showed better postural stability and fitness levels than previous weeks by keeping the body in a stable and balanced position most of the time and were able to carry out jogging without undue fatigue asking for fewer breaks. They kept their bodies in a good form in a stable and balanced position with physical guidance. Their motion planning and balancing also improved as they were able to navigate directions from the start to the finish point with less verbal directions from the trainers. In addition, all of them showed better ability

in adjusting jogging speed (slower and faster) when directed. Also, they kept space between peer/trainer while exercising without directing them. Furthermore, they were able to control when to start and stop in case facing an object or person without being directed. Moreover, participants showed improvement in their motor coordination by jogging properly when physically guided (swinging their arms forward and backwards between waist and lower chest level while moving their legs) with occasional verbal directives and encouragements when they lost focus or stopped moving their hands. All the children with moderate autism completed 15 laps which were a significant improvement compared to previous weeks.

Children with **mild** and **moderate autism** in **group 2** (inclusive group) displayed similar social and emotional, language and communication and physical skills as their peers in group 1 showing improvements and acquired new skills as well. Children with **mild autism** and the typically developed ones showed progress in previously displayed skills and acquired new ones. Concerning their social skills, they showed progress by interacting more with the trainers and their peers. they were telling about the school and the leisure center and the activities provided there. Children with mild autism and the typically developed ones were asking and responding to questions. For example, a child said, “Do you live in this neighbourhood?”. In addition, they showed progress by suggesting jogging together like in the previous session and they were all happy to follow the idea. They all jogged as a group starting and finishing the laps together. Moreover, they acquired a new skill which was making comments about what he/she is playing to peers (e.g., “I will finish my first lap before you”). Emotionally, they showed progress by greeting each other with hugs and asking about each other by name. The children were expressing how happy and proud they were of the number of laps they completed by counting the number of laps out loud and sharing it with their parents who were waiting outside. Participants with mild autism showed progress in their language and communication skills as well. They were more talkative as mentioned above initiating conversations about different topics such as school, football and the leisure centre. Similar to their peers in group 1, participants with mild autism asked about their peers who did not arrive by name and also asked about the reason behind their delay or absence while the typically developed ones were counting the number of participants at the field. Concerning their physical skills, similar to their peers in group 1 they showed improvement in their motion planning and balancing by being able to navigate directions from the start to the finish point with less verbal directions from the trainers as they were all jogging together following their typically developed peer. In addition, jogging together and copying their typically developed peers as well as the trainers

made them show better ability in adjusting jogging speed (slower and faster) when needed. Moreover, they kept space between peer/trainer while exercising without directing them. In addition, they were able to control when to start and stop in case facing an object or person without being directed. All of them improved their postural stability and fitness by keeping their bodies in a good form in a stable and balanced position and were able to carry out jogging without undue fatigue. Also, they showed improvement in their motor coordination by jogging properly (swinging their arms forward and backwards between waist and lower chest level while moving their legs) with occasional verbal directives and encouragements when they lost focus or stopped moving their hands. All participants with mild autism and their typically developed peers completed 17 laps and were so happy with the number they achieved. They started sharing it with the trainers, assistants and their parents/caregivers.

In regard to children with **moderate autism**, they showed a huge difference by displaying similar social and emotional, language and communication and physical skills as their peers in group 1, unlike the previous weeks. They showed social progress by receiving less verbal cueing, modeling and physical guidance during one to one instruction. Also, they showed progress by being comfortable around team members and peers, keeping close proximity all the time during warming up, jogging and cooling down. They also showed progress by being calmer compared to previous weeks and easier to handle. A new skill was acquired which was observing peers as well as the trainers for some time while performing the movements. They showed a huge difference by acquiring new emotional skills such as demonstrating affection toward peers and the trainers by giving them hugs and high fives. Also, all of them stopped demonstrating aggressive behaviours toward self and others. In addition, all of them displayed an ability to identifying likes and dislikes as their peers in group 1. During placing the happy faces on the exercise chart, they chose the colour of the happy faces to place under their names as well as the kind of edible reinforcement they want to receive. Concerning their language and communication, they showed significant language improvement as the ones who had limited vocabulary, started saying more words and acquired new words and the ones who were nonverbal started saying few words (e.g., “no” “I want” “candy” “bye”). Regarding their non-conversational skills, participants were attentive most of the time and following directions with no attempts to disengage. Moreover, they showed better eye contact and oriented body to speaker most of the time. All of them showed better improvement paying attention to the trainer’s nonverbal language and comprehend what is being communicated when shaking their heads for no and nodding for yes). Physically, the children showed better postural stability and

fitness levels, motion planning and balancing and motor coordination than previous weeks like their peers in group 1. All the children with moderate autism completed 15 laps which were a significant improvement compared to previous weeks.

Mixed games

During the mixed games, session children with **mild autism in group 1** developed new social and emotional skills. In-play skills they were giving up and offering materials to their peers. For example, during collecting balls into the bucket participants used to share the balls if they carried more than one and give it to their peer who is trying to collect one. It was observed that children started offering and sharing materials after the trainers reinforced this behaviour. One of the participants with mild autism gave his peer an extra ball and one of the trainers encouraged him verbally by saying “That’s is very generous of you, am so proud of you for helping your peer”. Other children noticed and started doing the same. Also, they accepted losing at a game without becoming upset or angry (flexibility) as directed by the trainers who kept telling them “We are exercising to have fun, keep doing your best”. For example, one participant was very competitive and used to shout with anger if lost during a game. During this session, he showed improvement by not shouting and expressing his feelings by saying “I really wish to be first, I hate losing”. Some participants dealt with winning and losing appropriately (e.g., the child said, “Maybe next time” or by congratulating the winner.) as well as accepting making mistakes without becoming upset or angry. Also, they showed an improvement by accepting not being first at a game or activity by waiting for their turn to come without being directed. Children were clearly happy all the time, cheerful and encouraging each other. They showed improvement in their group skills by making the transition to the next activity by themselves when hearing the whistle and without verbal instructions (followed the group). It was observed that the trainers used to always refer to the poster board to remind the children of the order of the activities. It seemed to be an effective strategy as then participants started checking it themselves and moved through the circuit as directed.

Regarding their language and communication skills, participants developed a new skill which was interacting with their peers with moderate autism and they were enjoying it. They greeted them at the beginning of the session. During the activity circuit, children with mild autism were encouraging their peers with moderate autism as well as calling them by name. Furthermore, they kept close proximity to their peers with moderate autism unlike previous weeks, where they only observed them from distance. They initiated conversations with them and asked them questions like “How are you?”, “Which school do you go to?”. In general, participants with

mild autism were talkative with their peers and trainers. For example, one of the participants came wearing new sunglasses, watch and clothes. He went and showed all his peers and the trainers what he was wearing. Other participants were excited to check it out and were asking him “Where did you buy it from?”. Other participants got really excited and mentioned that they would bring their stuff next session to show it to their peers and the team members. Physically, they showed drastic improvement as they became more independent and mastered most of the activities. They showed improvement in their fitness level as it increased and all of them did not ask for a break in between the games and were able to carry on with the 8 games (the circuit) without undue fatigue. Their fine and gross motor functioning showed improvement (e.g., faster in collecting balls, faster in jumping on both legs, faster and more stable running). Their motor coordination also improved (e.g., kicking the ball in the right direction, throwing and catching the ball many times).

Children with **moderate autism** showed improvement in their social skills. They were able to maintain eye contact when a peer or a trainer is speaking to them. Also, they were more attentive to instructions and paying attention to peers around them, observing their moves and behaviors. During week 5 participants acquired new play skill which was parallel play near peers using the same materials. During this session, they showed improvement by playing associatively with peers by sharing materials (e.g., balls). They started responding to interaction from peers such as smiling back at them, shaking hands, accept their peers giving them the happy faces to place it at the exercise chart. They acquired some new group skills such as seeking assistance from adults and peers. For example, during catch the ball, some participants used to hold the trainer’s hand and put it on top of theirs is to help them catch the ball. Also, children with moderate autism developed their ability to accept not being first in a game and wait for their turn to come (self-regulation). Another skill was developed which was follow the group. Participants were able to make a smooth transition to the next activity when directed by the trainers. It was noticeable that participants became familiar with the environment/structure and an increase in their attention and independence while moving and performing the activities was observed. Children with moderate autism during this week were able to move through the activity areas smoothly and ready for the next activity. Consequently, they showed better abilities following the plan and making the transition to the next activity when directed. Moreover, the physical structure also fostered emotional security. During the first 4 weeks, participants with mild autism seemed overwhelmed and fearful. It was observed

during this week and after getting used to the structured environment and the trainers, children were calmer, more comfortable and off-task behaviours were reduced.

Emotionally, children with moderate autism developed their ability to identify their likes and dislikes by pointing at what they want and sometimes say a word or two (e.g., child says “Water”, “Juice”) (e.g., one child was pointing at the swimming pool meaning to say he wants to swim). They were always encouraged by the trainers to perform appropriate behaviors such as pointing to what they want or talking if they can by applying verbal directions, modeling the behavior and verbal and physical reinforcement. Using these strategies was effective as it made them acquire new social and emotional skills. They demonstrated affection toward peers and the trainers by giving them hugs and high fives. Also, they stopped demonstrating aggressive behaviours toward self and others. Regarding their physical skills, participants with moderate autism showed an improvement in their motion planning as their speed was relatively increased during racing and performing the activities and were able to control when to start and stop in case facing an object or person most of the time. Their fine and gross motor functioning improved as they were able to perform more activities without modification compared to previous weeks (e.g., fast walking in place, racing) and performed some with less assistance (e.g., collecting balls, hopping). Also, children showed better eye-hand coordination during ball games (e.g., throwing, catching, picking up balls). All of them showed progress in their fitness skills by taking fewer breaks compared to previous weeks and completed all 8 activities. They were clearly happy during placing the happy faces on the exercise chart and were provided with assistance by showing them their names and where to place it.

Participants in **group 2** (inclusive group) with **mild** and **moderate autism** displayed similar social and emotional, language and communication and physical skills as their peers in group 1. Children with **mild autism** and the typically developed ones acquired new play skills such as being flexible during the games by accepting losing at a game without becoming upset or angry, sharing materials with their peers and accepting making mistakes without becoming upset or angry. They showed improvement in their group skills by making the transition to the next activity by themselves when hearing the whistle and without verbal instructions (followed the group). In addition to these skills, it was observed that children with mild autism and their peers who were typically developed displayed a new social skill which was encouraging their peers with moderate autism while performing the activities. For example, participants with mild autism and the typically developed ones encouraged their peers by shouting their names and telling them to go faster and try harder. Also, participants with mild autism used to call

their peers with moderate autism by their names when playing in pairs (e.g., catch the ball) and direct them as the trainers did. Children with moderate autism in group 1 and 2 displayed significant improvement in their social and emotional, language and communication and physical skill which brought them closer to their autistic and non-autistic peers.

Emotionally, they were clearly happy all the time, cheerful and encouraging each other. Regarding their language and communication skills, participants developed a new skill which was interacting with their peers with moderate autism by greeting them at the beginning of the session, calling them by name and keeping close proximity to them unlike previous weeks where they only observed them from distance. Physically, they showed improvement in their motor coordination (e.g., kicking the ball in the right direction, throwing and catching the ball many times). They showed improvement in their fitness level as it increased, and they were able to carry on with the 8 games (the circuit) without asking for a break. Their fine and gross motor functioning showed improvement as well (e.g., faster in collecting balls, faster in jumping on both legs, faster and more stable running). During this session, they were more independent while performing the activities.

Children with **moderate autism** showed improvement in their social skills as well as acquired new skills as their peers in group 1. They were more attentive to instructions and responding to interactions from peers and trainers by maintaining eye contact, smiling back at them and shaking hands. During the games, they showed progress by paying attention to their peers around them and observing their moves and behaviors. In previous weeks, participants acquired new play skill which was parallel play near peers using the same materials. During this session, they showed improvement by playing associatively with peers by sharing materials (e.g., balls). They acquired some new group skills such as seeking assistance from the trainers while performing the movements. For example, during running and kicking the ball, some participants used to hold the trainer's hand and pull them to run with them and direct them. They also showed progress by following the group and making a smooth transition to the next activity unlike previous weeks.

Emotionally, similar to their peers with mild autism, children with moderate autism developed their ability to identify their likes and dislikes by pointing at what they want and sometimes say a word or two (e.g., child says "Water", "Juice") (e.g., one child was pointing at the swimming pool meaning to say he wants to swim). They stopped demonstrating aggressive behaviors toward self and others. Instead, participants demonstrated affection toward peers and trainers by giving them hugs and high fives. Regarding their physical skills, participants with

moderate autism showed an improvement in their fine and gross motor functioning as they were able to perform more activities without modification compared to previous weeks (e.g., fast walking in place, racing) and performed some with less assistance (e.g., collecting balls, hopping). Also, better eye-hand coordination was observed during ball games (e.g., throwing, catching, picking up balls). Their motion planning was improved as their speed was relatively increased during racing and performing the activities and were able to control when to start and stop in case facing an object or person most of the time. It was also observed that children showed progress in their fitness skills by taking fewer breaks compared to previous weeks and completed all 8 activities. They were clearly happy during placing the happy faces on the exercise chart and were provided with assistance by showing them their names and where to place it.

Aquatic session

During the aquatic session, children with **mild autism** in **group 1** (segregated group) were excited as usual and clearly happy. By week 7, they knew the rules and knew where to go and where to stand by themselves without being directed. It was observed that following the routine and moving phase by phase following the poster boards made the children understand what was expected and made the sessions go smooth and easy to handle. Consequently, sessions were organized, and the trainers provided an engaging learning environment. They were performing the warming up and cooling down movements with less verbal directions and modeling. Participants showed improvement in their social skills (play behaviors) by responding more to interactions from peers (e.g., answering questions, being attentive to their comments) as well as imitating their peers verbally and physically. For example, during phase 2 (one to three) if one participant asked the trainer a question, the others would ask the same question (e.g., Am I doing a good job?). During this session, they showed progress by playing more associatively with peers by sharing the equipment used during the session (e.g. balls, noodles, toys).

They showed improvement in their emotional skills by identifying more likes and dislikes compared to week 5 (e.g., stating that they like the shallow end more than the deep, they like entering the pool slowly instead of jumping, they like phase 2 and 3 more than warming up and cooling down). Children with mild autism showed improvement in their conversational skills as well. All of them were talking to each other and the trainers most of the time as well as to their peers in the other groups. Furthermore, they were asking more questions about the activities “When are we using the balls?”, “When are you going to teach us how to swim?”

“When is water aerobics?”. In addition, they were responding more to questions from trainers and peers. For example, children were asking each other if they like swimming or not and if they have pools at home so they can practice swimming. They were following instructions and were more attentive during phase 2 (one to three instruction) and 3 (water aerobics) compared to previous weeks.

Concerning their swimming skills, all of them mastered floating skills (learning positions and rotating from one another supine, standing and prone position). In addition, they showed progress in balance and control movements by being more independent and flexible compared to week 5 where they were hesitant and scared (allowing the instructor to move them through the water in the prone/supine position). During this session, children were introduced to stroke skills (leg kicks with instructor support or holding pool deck, moving arms with instructor support). During aerobics at the shallow end, they were very active and competitive. They performed running in place, jumping jacks and hopping on one foot showing progress as they needed much less assistance to balance while performing the movements compared to week 5. Also, participants performed noodle kicks and noodle jumps as well as racing as a team using noodles. They played catching and throwing balls between participants to keep it away from the trainer showing more confidence moving in the water. Children showed improvement in their fine and gross motor functioning (better performance when running, hopping, jumping in place). Moreover, they showed improvement in their motor coordination by displaying better abilities in aiming and catching balls compared to week 5. When the time was up, they didn't want to leave and asked the trainers if they can stay longer and help them training the other group (group 2).

Children with **moderate autism** were excited and clearly happy and entered the pool without assistance. Socially, they showed progress by keeping close proximity to trainers and peers most of the time, with fewer attempts to disengage. They were observing trainers and peers while performing the movements most of the time receiving less assistance, verbal directions and physical guidance. They were more attentive compared to previous weeks and following instructions during phase 2 (one to three instructions). During week 5 participants with moderate autism acquired new play skill which was parallel play near peers using the same materials. During this session, they showed improvement by playing associatively with peers by sharing materials (e.g., balls) and throwing it back to the trainer and peers. They started responding to interaction from peers as smiling back at them, shaking hands, accept their peers giving them water noodles and balls. Children with moderate autism acquired some group as

well. They sought assistance from adults and peers. For example, during phase 2 and while working on balance and control movement they allowed the instructor to move them through the water in the prone/supine position and if the instructor's hand went loose, they used to grab it and put it back on their bodies.

Emotionally, participants developed their ability to identify likes and dislike by pointing at what they want and sometimes say a word or two (e.g., saying "ball", "pool") (e.g., one child was pointing at his mother meaning to say he wants her to swim with him). They demonstrated affection toward peers and trainers by giving them hugs and high fives. Concerning their swimming skills, all of them mastered breathing skills (placing the head in water without consuming much water). They showed progress in floating skills by rotating from one another supine, standing and prone position with less assistance. In addition, children showed progress in balance and control movements (allowing the instructor to move them through the water in the prone/supine position) by being more independent and flexible compared to week 5 where they were hesitant and scared. During water aerobics at the shallow end, participants showed progress by being attentive at sometimes when directed with the group but still receiving one to one instruction when needed. They performed running in place, jumping jacks and hopping on one foot with less assistance. Also, they performed noodle kicks and noodle jumps. They played catching and throwing balls with their peers while being directed by the trainer. Participants showed better improvement in their fine and gross motor functioning (better performance when running and jumping in place) compared to week 5. Moreover, they showed improvement in their motor coordination by displaying better abilities in aiming and catching balls. When the time was up, they did not want to leave as usual. Yet, they did not resist and went out without assistance.

Children with **mild** and **moderate autism** in **group 2** (inclusive group) displayed similar social and emotional, language and communication and physical skills as their peers in group 1. During this session and similar to their peers in group 1, participants knew the rules and knew where to go and where to stand by themselves without being directed. They received less verbal directions and modeling during performing the warming up and cooling down movements. Participants showed improvement in their social skills (play behaviors) by responding more to interactions from peers, imitating their peers verbally and physically. In addition to these behaviors, it was observed that children with **mild autism** and their peers who were typically developed displayed a new social skill which was encouraging their peers with moderate autism during performing the movements as observed in the mixed games session. For

example, participants with mild autism imitated their peers who were typically developed when they encouraged their peers with moderate autism. They were calling their names and telling them to go faster and try harder. Also, participants with mild autism used to direct their peers with moderate autism as the trainers did during water aerobics (e.g., children used to say “Throw the ball to me, throw it high”). They showed improvement in their emotional skills by stating their likes and dislikes (e.g., stating that they like phase 2 and 3 more than warming up and cooling down, they like the shallow end more than the deep). During this session, they showed progress by playing more associatively with peers by sharing the equipment used during the session (e.g. balls, noodles, toys). Children with mild autism showed improvement in their conversational skills as well. They were talkative and asking questions about the activities “When are we using the balls?”, “Can we dive in?” “We want to race?”. They were following instructions during all the phases. It was observed that children with mild autism and their peers who were typically developed are interacting and talking all the time. Concerning their swimming skills, similar to their peers in group 1, all of them mastered floating skills. In addition, they showed progress in balance and control movements by being more independent and flexible compared to week 5 where they were hesitant and scared. During this session, children were introduced to stroke skills (leg kicks with instructor support or holding pool deck, moving arms with instructor support). During aerobics at the shallow end, they performed the same activities performed by their peers in group 1. Children showed improvement in their motor coordination showed and their fine and gross motor functioning. When the time was up, they did not want to leave and asked the trainers if they can stay longer and help them training the other group (group 2).

Children with **moderate autism** during this session showed improvement in their social skills. They displayed fewer attempts to disengage and kept close proximity to trainers and peers most of the time. They received less assistance, verbal directions and physical guidance while performing the movements. They were more attentive compared to previous weeks and following instructions during phase 2 (one to three instructions). During this session, they showed improvement by playing associatively with peers by sharing materials (e.g., balls) and throwing it back to the trainer and peers like their peers in group 1. They acquired a new skill which was responding to interaction from peers as smiling back at them, shaking hands, accept their peers giving them water noodles and balls. They also acquired some group skills such as seeking assistance from adults and peers. For example, during phase 2 and while working on balance and control movement they allowed the instructor to move them through the water in

the prone/supine position and if the instructor's hand went loose, they used to grab it and put it back on their bodies.

Emotionally, participants demonstrated affection toward peers and trainers by giving them hugs and high fives. Concerning their swimming skills, all of them mastered breathing skills (placing the head in water without consuming much water). They showed progress in balance and control movements (allowing the instructor to move them through the water in the prone/supine position) by being more independent and flexible. Children developed their floating skills by rotating from one another supine, standing and prone position with less assistance. In addition, children showed progress by being attentive at sometimes when directed with the group but still receiving one to one instruction when needed during water aerobics. During performing the movements (e.g., running, jumping in place) they showed improvement in their fine and gross motor functioning their motor coordination by displaying better abilities in aiming and catching balls. When the time was up, they did not want to leave as usual. Yet, they did not resist and went out without assistance.

Note:

Three swimming sessions were replaced with mixed games sessions due to unavailability of trainers from week 8 till week 10. This event was out of the control of the researcher. The trainers had other commitments in special centres and were not able to manage their times. The researcher tried to find other trainers to continue with the children, but swimming trainers who are specialised in training children with special needs and especially autism are few. Therefore, the researcher decided to replace the swimming sessions with mixed games sessions.

The following behaviours/skills were observed during week 10:

Jogging session

During the jogging session, children with **mild autism** in **group 1** (segregated group) showed improvement in their social and emotional, language and communication and physical skills. All of them were telling their parents to leave before reaching the field, unlike previous weeks where their parents used to leave them upon reaching the field. They were very happy and comfortable around their peers and team members. They needed less verbal instructions during warming up, jogging and cooling down where they were directed only once at some times. They did not receive any physical guidance. Socially, participants displayed more group skills such as giving assistance to peers (e.g., giving happy faces to their peers, giving their peers water to drink during break time), using appropriate attention-seeking behaviour with peers with mild and moderate autism as well as the trainers (e.g., calling name, tapping shoulder). In

addition, all of them made smooth transitions from warming up to jogging then to cooling down when directed once or just by hearing the whistle.

Their language and communication also improved. Children with mild autism were talkative using full sentences with their peers and the trainers unlike previous weeks, where some participants used to speak in incomplete sentences. Also, they initiated more conversations around specified topics (e.g., a participant says to peers, “Guess what I did yesterday?”), ask “Wh” questions for information (e.g., a child will ask “When are we starting?”, “Is it true that this is our last jogging session?”). One of the children got a new water bottle with him and started showing it to his peers during the break and the others started showing theirs to their peers too. All children were all using “please” and “thank you at appropriate times when given the happy faces or when choosing the colour of the happy face. Moreover, they were all able to answer subjective questions such as “what do you like to eat/drink?” or “what is your favourite colour?”.

Participants with mild autism showed drastic physical improvement. They showed improvement in their motion planning and balancing. They were able to navigate directions from the start to the finish point with much less verbal directions from the trainers compared to week 7. Also, all of them showed better ability in adjusting jogging speed (slower and faster) when needed. Moreover, they kept space between peer/trainer while exercising without directing them. In addition, children were able to control when to start and stop in case facing an object or person without being directed. Their postural stability and fitness level also improved by keeping their bodies in stable and balanced position all the time jogging with good posture and were steadier in terms of their gait. Furthermore, they carried out jogging without undue fatigue taking one break only. In addition, participants showed improvement in their motor coordination by jogging properly (swinging their arms forward and backwards between waist and lower chest level while moving their legs) with occasional verbal directives and encouragements when they lost focus or stopped moving their hands. Participants completed 17 laps and were so happy counting the happy faces together. They shared the number of laps achieved with the trainers, assistants and their parents/caregivers. They were not tired at all and they continued playing with each other (e.g., playing tag). Before leaving, children said goodbye to their peers and the team members thanked us for the activities we provided. They were all sad that the program is ending.

Children with **moderate autism** showed social and emotional, language and communication and physical development as their peers with mild autism and acquired new skills. They were

so comfortable and clearly happy. They received less verbal instructions, modeling and physical guidance. Socially, they showed improvement by keeping close proximity to trainers and peers all the time during warming up, jogging and cooling down. Participants showed improvement by receiving instructions as a group with one to one instruction when needed. They were observing their peers and the trainers most of the time during performing the movements. Moreover, all of them were dealing calmly with the trainers and they were easy to handle unlike previous weeks. Children showed progress by responding to interactions from peers (e.g., physically accept candy from a peer; answer questions by saying yes or no). In addition, they returned and initiated greetings with peers and team members by shaking hands and waving goodbye. Emotionally, children demonstrated affection toward peers and trainers by giving them hugs and high fives. Also, they stopped demonstrating aggressive behaviours toward self and others. Furthermore, all of them displayed an ability to identify likes and dislikes by choosing the colour of the happy faces to place under their names. They showed improvement in their language and communication by answering questions with “Yes and No”. A new skill was acquired which was answering simple social questions (e.g., name), as well as subjective questions such as “what do you like to eat/drink?”. Another new skill that was observed was using “please” and “thank you” at appropriate times. Participants with moderate autism were attentive most of the time and following directions with no attempts to disengage. Regarding their non-conversational skills, they showed better eye contact and oriented body to the speaker all the time.

Physically, participants showed better postural stability and fitness levels than previous weeks by keeping the body in a stable and balanced position being steadier on grounds most of the time with less physical guidance. Also, children were able to carry out jogging without undue fatigue taking two breaks only. Their motion planning and balancing also improved as they were able to navigate directions from the start to the finish point with less verbal directions from the trainers compared to week 7. Participants showed better ability in adjusting jogging speed (slower and faster) when directed. Furthermore, they kept space between peer/trainer while exercising without directing them. In addition, they were able to control when to start and stop in case facing an object or person without being directed. Additionally, they showed improvement in their motor coordination by jogging properly with less physical guidance (swinging their arms forward and backwards between waist and lower chest level while moving their legs) with occasional verbal directives and encouragements when they lost focus or stopped moving their hands. All children with moderate autism finished 15 laps. They were

clearly happy placing the happy faces on their own (see table 6.1 for the overall progress of the number of laps achieved week by week by the two groups). They were not tired at all and continued playing around their peers (running around them and touching them) even when the time was up. Before leaving, they waved goodbye to their peers and team members, hugged the trainers and the researcher and they did not want to leave.

Participants with **mild** and **moderate** autism in **group 2** (inclusive group) displayed similar social and emotional, language and communication and physical skills like the ones displayed by their peers in group 1. In specific to children with **mild autism** and the typically developed ones, they showed improvement in their social skills by being happy and comfortable around their peers and trainers. They were fully independent of reaching the field, leaving their parents behind them at the gate of the leisure centre. During warming up, jogging and cooling down, they were directed much less compared to the beginning of the program. Participants were talking to each other, encouraging each other during warming up, jogging and cooling down. They were giving assistance to peers and reminding each other to breathe. All of them were using appropriate attention-seeking behaviour with peers with moderate autism, typically developed as well as the trainers (e.g., calling name, tapping shoulder). In addition, all of them made smooth transitions from warming up to jogging then to cooling down when directed once or just by hearing the whistle.

Their language and communication also improved. They initiated more conversations around specified topics (e.g., a participant says to peers, “Guess what I did yesterday?”), ask “Wh” questions for information (e.g., a child will ask “When are we starting?”, “Is it true that this is our last jogging session?”). They were confident while talking to their peers and the trainers using full sentences with their peers and the trainers unlike previous weeks where some participants used to speak in incomplete sentences. Moreover, they were all able to answer subjective questions such as “what do you like to eat/drink?” or “what is your favourite colour?”. Participants with mild autism and their typically developing peers showed drastic physical improvement similar to their peers in group 1. They displayed the same physical improvement by showing better motion planning and balancing, postural stability and fitness level and motor coordination. Participants completed 17 laps and were so happy counting the happy faces together. They shared the number of laps achieved with the trainers, assistants and their parents/caregivers. They were not tired at all and they continued playing with each other (e.g., racing). Before leaving, children said goodbye to their peers and the team members thanked us for the activities we provided. They were all sad that the program is ending.

Children with **moderate autism** showed significant improvement compared to the beginning of the program. Socially, they were engaged, easy to handle, comfortable and clearly happy. They received less verbal instructions, modeling and physical guidance during the session. They kept close proximity to trainers and peers all the time during warming up, jogging and cooling down and remained with the group. Similar to their peers in group1, participants showed improvement by receiving instructions as a group with one to one instruction when needed. They improved their observation skills by observing their peers and the trainers most of the time during performing the movements. In addition, their interactions with their peers relatively increased (e.g., physically accept candy from a peer; answer questions by saying yes or no, shaking hands and waving goodbye). Emotionally, participants stopped demonstrating aggressive behaviours toward self and others and demonstrated affection toward peers and the trainers by giving them hugs and high fives.

They showed improvement in their language and communication by answering questions with “Yes and No”. A new skill was acquired which was answering simple social questions (e.g., name), as well as subjective questions such as “what do you like to eat/drink?”. Another new skill that was observed was using “please” and “thank you” at appropriate times. Regarding their non-conversational skills, they showed better eye contact and oriented body to the speaker all the time which was an improvement compared to the beginning of the program. Children with moderate autism improved their physical skills by showing better postural stability and fitness levels than previous weeks by keeping the body in an upright position being steadier on grounds most of the time with less physical guidance. Also, children were able to carry out jogging taking two breaks only. Their motion planning and balancing also improved like their peers in group 1 by being able to navigate directions from the start to the finish point with less verbal directions from the trainers compared to week 7 as well as showing better ability in adjusting jogging speed (slower and faster) when directed. Furthermore, they kept space between peer/trainer while exercising without directing them and were able to control when to start and stop in case facing an object or person without being directed. Additionally, they showed improvement in their motor coordination by jogging properly with less physical guidance (swinging their arms forward and backwards between waist and lower chest level while moving their legs) with occasional verbal directives and encouragements when they lost focus or stopped moving their hands. All children with moderate autism finished 15 laps. They were clearly happy placing the happy faces on their own. They were not tired at all and continued playing around their peers (running around them and touching them) even when the

time was up. Before leaving, they waved goodbye to their peers and team members, hugged the trainers and the researcher.

Mixed games sessions

During mixed games sessions, children with **mild autism** in **group 1** (segregated group) displayed the same positive social and emotional, language and communication and physical skills that were observed in previous weeks. During this session, interestingly, their parents left them at the gate as requested by their children and were told to pick them up when they finish unlike the beginning of the program where parents used to hand them in and get into the field with them and toward the middle of the program they had to sit outside and watch them. Remarkably, participants were told the instructions only once during warming up and cooling down as well as for each activity, and they continued the rest on their own with no physical guidance neither modeling. Children were all clearly happy and very comfortable around their peers and team members. Socially, they displayed more group skills such as giving assistance to peers (e.g., getting the balls when it gets kicked or thrown far away, giving their peers water to drink during break time). In addition, all of them made smooth transitions from warming up to the activity circuit then to cooling down just by hearing the whistle. They were also choosing teams and asking their friends to stay with them. Children were taking turns during the activities without being directed. During the activities, they were very cheerful and encouraging each other without being directed as well as using appropriate attention-seeking behaviors with their peers with mild and moderate autism as well as the trainers (e.g., calling name).

Their language and communication improved by being more talkative using full sentences with their peers and trainers. Also, participants initiated more conversations around specified topics (e.g., a participant says to peers, “Guess where I am going for the weekend?”), ask “Wh” questions for information (e.g., all were asking the researcher and the team members “Are we going to see you again?”, “Is it true that this is our last mixed games session?”). Most of them got toys and were telling each other that they can play with them after the session is over. They were all using “please” and “thank you” at appropriate times when given the happy faces or when choosing the colour of the happy face. Moreover, children were all able to answer subjective questions such as “what do you like to eat/drink?” or “what is your favourite colour?”. Concerning their non-conversational skills, they were all able to orient body to their peers and trainers all the time when speaking to them. Also, they maintained eye contact all the time during instructions and even broke time.

Physically, participants showed drastic improvement as they became independent and mastered most of the activities. They showed improvement in their fine and gross motor functioning when picking up and holding balls, holding a racket, catching and throwing balls as well as hopping and running. Also, they showed improvement in their motor coordination when throwing a ball into a wall and being able to catch it or aim right and throw it to peer. Most of them were able to run and kick the ball continuously unlike previous weeks where they used to miss the ball and stop to direct themselves. They displayed better skills in motion planning and balancing. For example, children were better in navigating able to navigate directions during running and kicking the ball at the same time. In addition, they were able to adjust speed (slower and faster) during racing. Their fitness level relatively increased as they were all able to carry on with the 8 activities without taking a break showing no signs of discomfort. Also, they became faster in running, hopping and jumping. When the time was up, all participants were so excited about placing and counting the happy faces on the exercise charts. They wanted to play more and started asking the team members to continue playing with them. All the participants and the team members continued playing (e.g., racing, football).

Children with **moderate autism** displayed similar positive social and emotional, language and communication and physical skills like the ones displayed in the previous jogging session as well as previous sessions in week 5 and 7. Participants were so comfortable and clearly happy. They received less verbal instructions, modeling and physical guidance and no more edible reinforcement during the session. They received edible reinforcement after the session was over for completing the circuit. Socially, children kept close proximity to trainers and peers all the time during warming up, activity circuit and cooling down when directed only once to stay close to the trainer. They received instructions as a group with one to one instruction when needed. They were observing their peers and the trainers most of the time during performing the movements. All of them were dealing calmly with the trainers and following instructions, unlike previous weeks (1,3, and 5). They showed progress in games where they played as pairs by responding to their peers, sharing the materials, trying again when directed by the trainers and their peers and maintaining eye contact with the peer. Children also showed progress by remaining with the group during warming up, activity circuit and cooling down unlike the beginning of the program where they used to disengage and stay away. In addition, they showed progress by responding to interactions from peers while waiting for their turn to come and at the end of the session (e.g., physically accept candy from a peer at the end of the session;

answer questions by saying yes or no). In addition, they returned and initiated greetings with peers and team members by shaking hands and waving hi and goodbye.

Emotionally, participants demonstrated more affection toward peers and the trainers by giving them hugs, high fives and smiling back at them. Also, they stopped demonstrating aggressive behaviours toward self and others. They identified likes and dislikes by choosing the kind of edible reinforcement they received at the end of the session. Children with moderate autism showed improvement in their language and communication by answering questions with “Yes and No” as well as nodding their heads for yes and shaking it for no. In addition, they answered simple social questions (e.g., name), as well as subjective questions such as “what do you like to eat/drink?”. All of them used “please” and “thank you” at appropriate times. Moreover, they were attentive most of the time and following directions with no attempts to disengage. Regarding their non-conversational skills, they showed better eye contact and oriented body to the speaker all the time.

In terms of their physical skills, participants were able to perform most of the activities with less assistance. Some activities were modified like shooting hoops (one of the team members used to adjust the hoop by lowering it down for it not to be too high for the participants to aim). They showed better postural stability and fitness levels than previous weeks by keeping the body in stable and balanced position during activities like fast walking in place, catch the ball, kicking the ball, as well as being steadier on grounds during racing. In addition, they were able to carry out the 8 activities (the whole circuit) without undue fatigue taking one break only. Their motion planning and balancing also improved as they showed better ability in adjusting their speed (slower and faster) when directed during racing, running and kicking the ball unlike previous weeks where they needed physical guidance to do so. Also, during warming up, activity circuit and cooling down participants with moderate autism kept space between peer/trainer while exercising without directing them. In addition, they were able to control when to start and stop in case facing an object or person without being directed as observed in the jogging session. Furthermore, they showed improvement in their motor coordination by showing better abilities during throwing a ball into a wall and catching it once or twice, unlike previous weeks, where they failed to catch it back. Also, they were able to run and kick the ball with less assistance in directing them and controlling the ball most of the time unlike previous weeks where they were not in possession of the ball most of the time. Another example of improving their motor coordination was during bouncing the ball game. In previous weeks, participants with moderate autism used to bounce the ball with assistance by placing the

trainer’s hand on top of theirs and directing it to control the ball. During this session, children were able to control the ball for some time without assistance. Participants completed the activity circuit and were clearly happy when placing the happy faces on the chart. They were not tired at all as observed in the jogging session and continued playing around their peers (running around them and touching them). Before leaving, they waved goodbye to their peers and team members and hugged the team members.

Children in **group 2** (inclusive group) with **mild** and **moderate** autism displayed similar improvements in their social and emotional, language and communication and physical skills as the ones displayed by their peers in group 1. In addition to these skills and in specific to children with mild autism and the typically developed children, it was observed that they displayed better physical skills. Their fitness level was higher compared to their peers in group 1 especially during racing (they were much faster). Also, they were faster in performing the activities which made them practice more attempts in each activity.

Table 6.1 The increase in jogging laps from week to week for each group

| Group 1 (segregated) | Number of laps | Group 2 (inclusive) | Number of laps |
|-----------------------------|-----------------------|----------------------------|-----------------------|
| Week 1 | | Week 1 | |
| Mild autism | 3 laps | Mild autism | 4 laps |
| Moderate autism | 2 laps | Moderate autism | 4 laps |
| Week 3 | | Week 3 | |
| Mild autism | 10 laps | Mild autism | 10 laps |
| Moderate autism | 6-10 laps | Moderate autism | 6-8 laps |
| Week 5 | | Week 5 | |
| Mild autism | 15-17 laps | Mild autism | 12-14 laps |
| Moderate autism | 8-10 laps | Moderate autism | 8 laps |
| Week 7 | | Week 7 | |
| Mild autism | 17 laps | Mild autism | 17 laps |
| Moderate autism | 15 laps | Moderate autism | 15 laps |
| Week 10 | | Week 10 | |
| Mild autism | 17 laps | Mild autism | 17 laps |
| Moderate autism | 15 laps | Moderate autism | 15 laps |

The table above shows the increase in the number of laps from week 1 until week 10 for each group specifying the difference in the number of laps accomplished by children with mild autism versus moderate autism.

Table 6.2 Main study findings

The following table illustrates the main study findings by stating the main variables examined, the findings in regard to each supported by raw data.

| Variable | Findings | Example of raw data |
|-------------------------------|--|---|
| <p>Motor abilities</p> | <p>(M ABC-2):</p> <p>All children in both groups (inclusive & segregated) showed progress in their motor skills.</p> <p>Participants with ASD in the inclusive group showed better scores post the intervention compared to the segregated group.</p> <p>Participants in group 1 (segregated group) showed better improvement when compared with group 2 (inclusive).</p> <p>Interviews:</p> <p>All children improved their motor abilities by increasing their fitness level, motor functioning and muscle tone.</p> <p>An increase in motor competence transferred to other settings (home).</p> <p>Observations:</p> <p>All participants showed a significant increase in their motor abilities.</p> | <p>Participants with ASD in group 2 scored 33.4 and 42.6 (TTS), pre-and post-intervention compared to 39.5 and 48.5 (TTS) scored by the segregated group.</p> <p>Group 1 had an average increase of 22.7% were group 2 had a 16.5% increase.</p> <p>“At first my son was running and sometimes walking, but with time I have seen the change. He learned how to jog properly with good posture, and I was surprised when he started doing up to 7 laps with no breaks in between.” (MG)</p> <p>“He had a poor ability to throw, catch and kick a ball, but with time and practice his coordination improved and it was amazing seeing him run while kicking the ball all around the field.” (AB)</p> <p>“Our children increased their physical abilities also at home when practising similar activities”</p> <p>Fine and gross motor development was noticeable. Their ability to pick up, hold and throw balls became better as</p> |

| | | |
|-----------------------------|---|---|
| | | <p>well as in hopping, jumping and running.</p> <p>Motor coordination development was evident as throwing and catching enhanced as well as running while kicking a ball.</p> <p>Motion planning and balancing was improved as they started being able to adjust their speed (slower and faster), keep space between trainer/peers while exercising and able to control when to start and stop in case of facing an object or a person.</p> <p>Their fitness level also improved as they were able to carry out tasks without undue fatigue and without asking for breaks.</p> |
| Cognitive skills | <p>Interviews:</p> <p>All parents noticed a decrease in hyper activity levels.</p> <p>All children displayed longer attention span and followed more instructions.</p> <p>Observations:</p> <p>Participants were less hyper active and had longer attention, higher engagement level and paying attention most of the time.</p> | <p>“It positively impacted my son’s attention span, perception, performance and engagement level in many tasks. His ability to understand and follow instructions enhanced too. He can perform the same problems that he could not two weeks ago. This was surprising and made us determined to find a program for him to participate at all year long.” (SL)</p> <p>During the sessions, participants were more focused, following more instructions during warming up, cooling down and the activity whether it is jogging, mixed games and swimming.</p> |
| Psychological health | <p>Interviews:</p> <p>All parents noticed that their children are happy with less stress and aggressive behaviors.</p> | <p>“Exercising and especially swimming made AM very happy unlike before exercising where he was always sad because no one understands him! Maybe just getting into the water itself and the way the senses work there, and then the endorphins, made him more relaxed and less angry.” (AM) “My son stopped biting himself and others a few weeks after starting exercising. He used to bite himself and others whenever feeling stressed, anxious or overwhelmed. An obvious benefit of exercising was reducing his aggressive</p> |

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| | <p>Observations:</p> <p>It was observed that participants seemed happier and less stressed.</p> | <p>behaviour toward self and others.” (MA)</p> <p>All children with ASD in both groups seemed relaxed and happy with smiles on their faces after a few weeks from starting the program.</p> |
| <p>Social and emotional skills</p> | <p>Interviews</p> <p>Parents noticed that their children displayed less non-social behaviors and an ability to learn and show more positive social behaviors</p> <p>Observations</p> <p>Participants with ASD demonstrated progress in their social and emotional interaction behaviors during all sessions.</p> | <p>“I loved seeing my child initiating conversation and following other’s lead in playing group games. After the sessions, most of the children were not ready to leave, and my son was one of them.” (MG)</p> <p>“My child became friends with his cousins and siblings. While the program was running, he used to tell them to come and play sport with him and used to say, “it is so much fun, am sure the trainer will allow you.” (AM)</p> <p>The largest growth observed was in four key areas: play behaviors, understanding emotions, self-regulation and group behaviors.</p> |
| <p>Language and communication skills</p> | <p>Interviews</p> <p>All parents noticed that their children displayed more talking and acquired new vocabulary, and for those who were nonverbal, they started saying a few new words.</p> <p>Parents also indicated that their children improved their eye contact and understood nonverbal language (head nodding and pointing).</p> <p>Observations</p> <p>It was observed that participants had a significant increase in their vocabulary and the frequency of language use. Non-verbal skills were developed too.</p> | <p>“My child had limited vocabulary, but toward the end of the program, she began saying “I want” “candy” “bye” and “yes, no” and it is thrilling. These are some of the words that were used by the trainers during the sessions when dealing with her.” (JA)</p> <p>“Our son is nonverbal but his eye contact drastically improved, he started pointing at what he wanted and started understanding facial expressions. He is more attentive and engaged compared to before.” (NB)</p> <p>In the middle and toward the end of the study, it was observed that participants were frequently speaking, using new and more vocabulary, initiating conversations about different topics and responding to questions asked by peers and trainers. Also, they maintained appropriate eye contact, oriented body to speaker and</p> |

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| | | maintained proximity to peers and trainers. |
| Impact of mixed games sessions | Observations and interviews revealed that participating in mixed games sessions improved children’s social and emotional, physical, language and communication, and cognitive skills. | <p>“My child is nonverbal, and he keeps his distance (proximity) when dealing with strangers, but with children in his group and during the group play he kept close proximity and was trying to perform the activities as his peers were showing him. He had a smile on his face at all times, and he did not want to leave the field. He used to stay close to other children even after the sessions were over.” (AS)</p> <p>“What I like most is that my child kept practising the same games at home and used to engage us with him and there were skills that he never performed before and acquired pretty fast.” (MK).</p> <p>It was noticed that participants were fully engaged, interacted, learned from their peers and trainers through play. Social engagement was noticed as they kept close proximity to peers and trainers, displayed more eye contact, initiated conversations, followed other’s lead and engaged more in group games and even after the sessions were over.</p> <p>Fine and gross motor development was noticeable. Participant’s ability to pick up, hold and throw balls became better as well as in hopping, jumping and running. Also, motor coordination development was evident as throwing and catching enhanced as well as running and kicking. Their fitness level also improved as they were able to carry out tasks without undue fatigue and without asking for breaks.</p> <p>It was noticed that participants were talking about the games and the materials and even suggesting games that were not in the activity circuit. More conversations and interaction took place during the games compared the jogging and swimming sessions.</p> |
| Inclusion | Observations and interviews revealed that participants in the inclusive group improved and mastered advanced social interaction and | “Being around children with similar and higher abilities, similar goals, similar schedules and experiences |

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| | <p>engagement skills more than the segregated group.</p> <p>Observations and interviews found that Being included influenced the development of language and communication skills in children with autism during exercising, after exercising and at home with their families.</p> | <p>enabled AB to focus and enjoy exercise while being supported by his group who understood him.” (AB2)</p> <p>“The exercise group was like an extended family.” (AH)</p> <p>It was observed that being included, supported and paired with non-autistic children, especially during mixed games and water aerobics influenced participants with ASD to remain engaged and do their best. Participants really enjoyed socialising during group games, they stayed active and really enjoyed talking to their peers.</p> <p>Children communicated during the sessions with non-autistic children and became friends after a few weeks from starting the program. Toward the end of the program, participants seemed happy when seeing their peers and wanted to spend more time together after the sessions were over. It encouraged participants to talk more and share and express ideas and feelings. It also helped them acquire new vocabulary.</p> |
| <p>Engaging elements applied to exercise setting</p> | <p>Interviews and observations revealed that pedagogy (i.e. teaching strategies) had a positive impact as it facilitated participant’s engagement in the program and made them able to develop the skills necessary to exercise and show progress with time.</p> | <p>Parents stated that “it was rewarding and effective” as they saw their children paying more attention, following instruction with a smile on their faces after receiving different kinds of reinforcement accompanied by modelling and verbal instructions.</p> <p>It was noticed that using tangible, verbal reinforcement, as well as reinforcement boards and exercise charts, was very effective as it encouraged participants to complete the tasks and kept them focused.</p> <p>Parents mentioned that they saw their children very happy when placing the stickers and made the parents even happier seeing them placing it without assistance after the fourth week from starting the program.</p> <p>The researcher observed the participants following the routine and choosing the color of the happy faces</p> |

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| | <p>Physical structure contributed to the success of the program.</p> <p>The type of exercise (variety of activities) was engaging to the participants and influenced the development of their dysfunction areas.</p> | <p>and telling the trainers that they don't need help placing it.</p> <p>“Short verbal instructions followed by modelling made each exercise/game clearer to the participants to follow.” (MG)</p> <p>“What I loved about the sessions is the consistency of the setting and the materials used, and that made SL very comfortable. It was like a second home to him.” (SL)</p> <p>It was observed that the physical setting helped the children get used to the activities and get more familiar with the environment and that increased their engagement, independence and progress.</p> <p>Children were able to associate materials and clearly marked areas with the activities required and remember what is required. It was observed that the children paid more attention to the materials and were always close to the activity area and it eliminated overwhelming feelings and off-task behaviors; this was also noticed by parents.</p> <p>During swimming, it was noticed that the water was reinforcing and encouraging, it was a fun environment for the children to learn social, motor and language skills naturally without pressure though it was structured.</p> <p>Parents mentioned that their children were never exposed to such intense exercise (jogging & mixed games) and thought that their children are not able to perform such movements. But after a few weeks, they started showing progress, and toward the end, the change was remarkable in their physical, social and language skills.</p> |
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Chapter 7: Discussion

This chapter discusses the impact that the exercise program had on children with autism in relation to the aims of the research study. Initially, each aim is discussed in relation to the results found from each research method (MABC-2, interviews, observations) and in relation to previous research in the area. Overall, the benefits of a variety of exercise activities, inclusion and a structured pedagogy are discussed, and the interacting relationship between the aims are explored. How being engaged in a variety of exercise activities with structured teaching procedures in an included or segregated setting is discussed and the influence on skill development in children with autism.

This study aimed to examine the impact of a variety of exercise activities on the functioning of children with ASD when included with non-autistic children versus segregation. In addition, the influence of teaching procedures, physical structure and organisation of setting on improving participant's performance in the exercise sessions were also examined. The study also aimed to investigate the impact of mixed games sessions compared to individual exercise such as jogging on the physical, cognitive, social and emotional, language and communication skills and behaviors of children with ASD. Results revealed that engaging in a variety of exercise activities improved children's physical, cognitive, social and emotional, language and communication skills and their psychological health in both groups. Children in the inclusion group had a slightly higher improvement in their motor, language and communication and social skills. The results also revealed that participating in mixed games sessions provided an opportunity to naturally communicate, acquire and develop social and language skills and promoted positive social integration and interactions. Overall participating in exercise seemed to positively impact the overall functioning of children with ASD whether included or segregated. This is one of the first studies to use a mixed-method research design (qualitative and quantitative approach) to provide additional and robust data on the impact of a variety of exercise activities on children with ASD. Also, it is one of the first to provide clear guidelines of how exercise can be implemented to ensure the engagement and development of children with ASD. The results will now be discussed in relation to the aims.

First aim: the first aim of the study was to investigate the impact of inclusive exercise compared to segregated exercise on the physical, cognitive, social and emotional, language and communication skills and the psychological health of children with autism. Within that, the following was considered:

- Physical/movement skills development
- Cognitive skills and psychological health development
- Social and emotional skills development
- Language and communication skills development

Physical/movement skills development

The Movement ABC-2 enabled motor competence before and after being engaged in the exercise program to be tested and comparisons were made within and between groups. The current study showed that a motor delay is present in most children with mild and moderate autism to a significant degree when performing the MABC-2. This finding is consistent with the findings of previous research comparing the motor abilities of children with ASD (Baranek et al., 2005; Provost et al., 2007; Staples and Reid, 2010). However, and in line with the first aim, the results from the MABC-2 post the intervention revealed and indicates that motor competence can be enhanced when engaged in exercise whether included with non-autistic children or segregated (only with autistic children). The results of this study indicate that exercise has a positive impact on the overall functioning of children with autism and their physical skills in particular. These findings are consistent with previous research that examined the effects and the benefits of exercise on ASDs and reported progress in children's motor functioning skills (Magnusson et al., 2012; Pan et al., 2011; Sorensen and Zarrett, 2014; Sowa and Meulenbroek, 2012). The results also indicate that all autistic children in both groups showed progress as well as the typically developed children in group 2 (inclusive group). However, the results also show that the inclusive group had better scores post the intervention with children with and without autism scoring 62.1 (TTS) on an average. Being taught in an inclusive manner appeared to facilitate the development of motor skills. It may be that the typically developing children had a positive impact on the autistic children as found by the test scores. The typically developed children used to model the activities and ask the autistic ones to copy them. Also, they used to support them and cheer them regardless of the outcome. As a result, the autistic children used to imitate them and clearly learnt from them. Our results are compatible with other studies that suggested that including children with autism with non-autistic children is beneficial especially when they tutor them, and that improves their motor functioning and increases their scores on motor skills tests (Houston-Wilson et al., 1997; Houston-Wilson and Lieberman, 2003; Schleien et al., 1988; Ward and Lee, 2005; Zhang and Griffin, 2007).

Another possible explanation of this outcome may lie in the large variation level of performance within the group and in between both groups. As mentioned before, participants included in the program were identified with (mild, mild to moderate and moderate) autism and typically developing children. The performance of children with mild autism was more variable than the ones with moderate autism, and both are more variable than those who are typically developed of the same age. Research has noted that heterogeneity of the spectrum among individuals and within groups of individuals with ASD can be a possible explanation for the variation between results (Masi et al., 2017; Toal et al., 2010). It was mentioned that ASD is heterogenous in nature, the severity of the impairment and the symptoms differ across individuals. This rationale has been used to explain the difference in results among studies examining different areas in ASDs as executive functioning (Geurts et al., 2014), emotional disturbance (Matson and Nebel-Schwalm, 2007) and motor impairments (Ming et al., 2007).

Regarding the improvement of both groups, the results indicate that participants in group 1 (segregated group) showed better improvement when compared with group 2 (inclusive). As mentioned in the results chapter (CH 6), the improvement is the percentage change of the TTS post to pre-intervention. Group 1 had an average increase of 22.7% were group 2 had a 16.5% increase. We suggest that this result is due to the variation of abilities between groups. As mentioned above in the previous paragraph, each group included mixed abilities and different ranges of autism. According to literature, individuals with autism share common characteristics but the severity and the combination of symptoms vary per individual and age group (Nicholson et al., 2011). In this case, participants with mild autism in the segregated group shared common characteristics with participants with mild autism in the inclusive group. However, they were displaying better motor skills during testing (pre and post the program) and during the practice sessions. Since they had better motor skills and with practice, they developed these skills and acquired new ones; therefore, they showed better improvement compared to their peers in the inclusive group.

Another possible explanation behind this outcome may be the number of participants in the group. The segregated group included 8 autistic children, and it appears to facilitate the improvement of motor skills more than having a larger number in a group. It could be that having only 8 allowed the participants to have more practice attempts especially during the mixed games sessions that included similar tasks/activities to the ones in the MABC-2. As a result, they became more familiar with the tasks with practice and repetition were each individual had more practice attempts during the 4 minutes duration of each activity and had

better improvement compared to their peers in group 2 (n=13 autistic n=7, non-autistic=6). In specific to children with autism in both groups, the current study showed that exercise had a positive impact on their motor skills. Their TTS increased more in the inclusive group 27.4% compared to the segregated group 22.7%. The inclusive group had a slightly higher improvement by 4.7% compared to the segregated group. It was suggested earlier that being included when engaged in exercise appear to facilitate the development of motor skills. Nevertheless, since the improvement is slight, it is also suggested that exercise had a greater impact on developing participant's motor skills when compared to inclusion. These results are consistent with previous research that examined the impact of general physical education on children with autism and reported that participants gained higher scores on the motor test (Pan et al., 2011). The results of the test's components also support our suggestion. It was found that all children with autism had a delay on all three domains of motor competence, manual dexterity, ball skills and balance before their participation in the program. These findings are consistent with previous findings examining the degree of motor impairment in children with ASD and their motor performance on the motor assessment battery (Green et al., 2009; Liu and Breslin, 2013). In the present study and after participating in the Exercise program, most children showed improvement in all three domains. They were able to perform most of the tasks even the ones that they could not perform and improved in performing the ones they poorly performed before the intervention.

The current data is compatible with the Ecological theory of motor learning. According to the theory, when an individual tries to perform a motor action biological and physical conditions change; subsequently established neural patterns and signals change especially in the area of the brain that controls voluntary motor movement to complete the action (Lennon and Stokes, 2008; Turvey et al., 1982; Umphred and Lazaro, 2012). Exercise activates the cortex and leads to changes in neuronal metabolic activity. Participants improved their smoothness and accuracy of their motor movements during testing. When they were tested before the intervention, their movements during manual dexterity, ball skills and balance were slow, inefficient and inconsistent. They took time to understand what is required and try to perform it. Their movement post the intervention changed to the better were it was smoother, more consistent and efficient. It could be due to the weeks of practicing similar activities/skills in a structured work place offering structured teaching procedures that allowed them to perceive and identify the skills and then perform it.

Other measures that were used to support the MABC-2 in regard to the development of physical abilities are the interviews and the observations; both reported positive results. According to parents, all children increased their fitness level, motor functioning and muscle tone. Children were able to exercise for longer; they improved their fine and gross motor functioning (their arms and legs became stronger), maintained posture and performed activities that they could not perform before. As the researcher's observation, all participants showed a significant increase in their physical skills as the observed increase was in their fine and gross motor functioning, motor coordination, motion planning and balancing and postural stability and fitness. The observed increase in their physical abilities after engaging in exercise is consistent with previous studies that examined the impact of exercise on the physical abilities of children with ASD and reported positive result including improvement in the overall physical functioning of their participants (Bass et al., 2009; Huettig and Darden-Melton, 2004; Pan, 2010; Pitetti et al., 2007; Wuang et al., 2010; Yilmaz et al., 2004). In addition, the current results are compatible with previous research that found that aerobic activities have been found to improve muscular strength, functional ability, fitness level in children with ASD (Elliott Jr et al., 1994; Powers et al., 1992; Yilmaz et al., 2004). We suggest that engaging children with ASD in a high-intensity exercise program improve all their physical abilities. The children with mild and moderate autism underwent a qualitative change in the skills they displayed from week 3 until the end of the program. Fine and gross motor development was noticeable. Their ability to pick up, hold and throw balls became better as well as in hopping, jumping and running. Also, motor coordination development was evident as throwing and catching enhanced as well as running while kicking a ball. In addition, the children demonstrated improvement in motion planning and balancing as they started being able to adjust their speed (slower and faster), keep space between trainer/peers while exercising and able to control when to start and stop in case of facing an object or a person. Their fitness level also improved as they were able to carry out tasks without undue fatigue and without asking for breaks. These improvements in physical functioning are promising as they suggest that the variety of exercise activities does have an impact on children with autism and can change their physical abilities to the better. These results are compatible with previous findings examining the impact of multi-sport camp on improving motor skills of girls with autism (Guest et al., 2017). Results indicated that the camp had a positive impact and improved motor skills, physical self-perception and social skills.

In addition to the benefits shown during the sessions, their motor competence transferred to other settings. As parents reported that their children showed an increase in their physical abilities also at home when practising similar activities. These findings are encouraging as it indicates that exercise had beneficial effects beyond the program sessions. The improvement in physical skills may be accounted for the type of exercise, teaching strategies and the structured content and physical setting. Some tasks were modified depending on the child's ability and once learned and able to do the modified movement, the participant was instructed to move to the original intense movement. With repetition and after mastering the activities, children were better able to use their bodies and function. The children were consistently reinforced for exercising and for trying to perform the movements. At first, they were not confident enough that they can jog, swim or play sports games. But with time, with the right type of exercise and teaching procedures, they got motivated in exercise which in turn led to positive effects and consequences in their physical abilities as coordination, balancing and motor functioning. These findings are consistent with the self-determination theory (SDT) (Deci and Ryan, 1985; Hagger and Chatzisarantis, 2007). This theory suggests, to get motivated in exercise there is a sequential psychological process that starts with competence (feeling of efficacious to the activity, autonomy (e.g. having a choice)) and relatedness (e.g. socially attached or related), and this process of motivation leads to positive consequences. In this case, participants were thriving for an activity different than the structured class-based activities received in schools and special centres and that made them engage. In addition, they were given a choice to participate by their parents, and they were offered a variety of activities that also gave them choices and kept them motivated. After time and after being engaged with other children, they felt related, and they had a sense of community and became attached to the team members. This sequential motivation process made them determined to succeed, put greater effort, enjoy the sessions and benefit physically and in all other areas as observed.

Cognitive skills and psychological health development

The results from the interviews in accordance to the first aim and in line with the observations also revealed that exercise enhanced several skills in addition to physical as social and emotional, language and communication, psychological and cognitive skills and decreased the repetitive stereotypical behaviors. These findings are consistent with previous findings that examined the impact of exercise on children with ASD and reported an enhancement in their motor, social and communication abilities (Pan and Frey, 2006; Pan et al., 2011). All parents reported positive results in many developmental areas and noticed a significant change in their

children's abilities. According to research, regular and repetitive exercise can assist children with ASD to improve their dysfunction in many domains based on the feedback to the vestibular system and its impact on their brain processing (Morin, 2009).

Meanwhile, most of the parents were concerned about the hyper-activity level, and all noticed that it lessened with time after being engaged in the program. They all related by saying that being less hyper-active helped their children function better in terms of having a longer attention span and following more instructions. Being less hyper-active improved their cognitive skills by showing better visual and auditory perception, performance and engagement level in many tasks. The researcher observed the same improvement during the sessions. All children with mild autism in both groups seemed less hyper active and had longer attention span after a few weeks from starting the program. They were more focused, following more instructions during warming up, cooling down and the activity whether it is jogging, mixed games and swimming. Off task behaviors decreased and non was displayed after week 5. Participants showed higher engagement level and were paying attention most of the time during observing the trainers when modeling the skills and giving directions. As a result, they showed better performance in all three activities. It took a few weeks more for children with moderate autism to show similar pleasant skills. These results are consistent with previous research that provided evidence on the positive effects of exercise on cognitive functioning among typically developing children and children with ASD (Anderson-Hanley et al., 2011; Kern et al., 1982; Nicholson et al., 2011; Reid et al., 1988; Rosenthal-Malek and Mitchell, 1997; Tomporowski, 2003; Tomporowski et al., 2011). For example, the study of Anderson et al. examined the impact of increased physical activity on cognitive outcomes and reported positive results (Anderson-Hanley et al., 2011). It reported an increase in the executive functioning abilities specifically the memory span where participants were able to remember a long list of items and repeat it in the correct order; DSF digit span forward and DSB digit span backwards. The present findings are also compatible with other studies that examined increasing PA and its effect on attention, academic performance and compliance (Kern et al., 1982; Reid et al., 1988; Rosenthal-Malek and Mitchell, 1997). For example, the study of Reid et al. (1988) conducted a physical activity program to examine its impact on decreasing off-task behaviors and increasing on-task behaviors and other appropriate behaviors in adolescents with autism. Three boys participated in the program and showed a decrease in off-task behaviors and an increase in on-task behaviors (Reid et al., 1988).

Another area that was developed is the children's psychological health. Parents mentioned that before the exercise program, their children were sad, and some reported that they were neither happy nor sad. Also, they get easily stressed and display aggressive behaviour when putting in new situations. After participation in the program, all parents noticed that their children are happy with less stress and aggressive behaviors. Parents noticed more smiles on their children's faces, and they were relaxed and calm especially after the sessions. The researcher observed the same behaviors during the sessions. All children with mild autism in both groups seemed relaxed and happy after a few weeks from starting the program, and it took a few weeks more for children with moderate autism to show similar pleasant behaviors. The current data is compatible with previous findings that suggest that exercise releases a natural substance called endorphin and increased endorphin in the nervous system have great power on enhancing the sense of well-being, and it results in better psychological health (Association, 2007; Diseases, 1991; Health and Services, 2000; Strong et al., 2005). In addition, another research points out that exercise releases serotonin in the central nervous system and high levels of serotonin are associated with better mental health and feelings of wellbeing (Association, 2007; Diseases, 1991; Health and Services, 2000). Improving psychological health in typically developing children by exercising was discussed earlier in chapter 2 under the benefits of exercise for children. It was reported that exercise decreases psychological stress such as anxiety, tension and depression levels and anger are promoted by exercise (Sothorn et al., 1999). Specifically, 30 minutes and more intense exercise has a positive impact on psychological health. Studies reported that active children have less anxiety and depression levels as well as better mood/outlook and sleep quality (Fletcher et al., 1996; Janssen, 2007; Janssen and LeBlanc, 2010; Sothorn et al., 1999). It was reported that most children feel calm and happy after exercising (Association, 2007; Diseases, 1991; Health and Services, 2000; Strong et al., 2005). In the present study, the results discussed concerning typically developing children extended to the children with autism who participated in the exercise program and this is compatible with existing research that suggests the health benefits of exercise that are well documented to all people of all ages can extend to the autistic population and positively impact their overall functioning and general health (Health and Services, 2000; Longmuir and Bar-Or, 2000; Micacchi et al., 2006).

Social and emotional skills development

Social and emotional skills were also developed. Interacting with peers and trainers while performing physical movements had unexpected social lessons. Group work and group games

allowed the children to interact with everybody, support their peers, spend more time with their peers, make new friends and follow other's lead. Most parents reported that their children also displayed the same social behaviors at home. More specifically, children with mild and moderate autism demonstrated progress in their social and emotional interaction behaviors evidencing the largest growth in four key areas, play behaviors, understanding emotions, self-regulation and group behaviors. In specific to children with mild autism and their social and emotional abilities, although these children did not display positive social skills at the beginning of the program, they underwent a qualitative change in the skills they displayed toward the middle and the end of the program starting with week 3 and forward. Non-social behaviors became fewer, and an ability to learn and show more positive social behaviors were noticed. Moreover, the children improved their emotional skills. A qualitative change was evident in their emotional skills during the program. In the end, these children demonstrated improvement in their ability to express their needs, ideas and feelings to their peers and the team of trainers and volunteers. Noting that the team had a huge role in modelling and reinforcing pleasant emotional behaviours. Children with moderate autism demonstrated development in their social and emotional abilities (e.g., keep close proximity to trainer and peers, follow directions, respond when another child is present). Although these children did not display positive social skills at the beginning of the program until week 4 they were still not following directions and were inattentive at sometimes. Starting with week 5 after they got used to the environment, team and program content, they underwent a qualitative change in the skills they displayed till the end of the program. Unpleasant social behaviors became fewer and the ability to learn social skills was noticed. Moreover, they improved their emotional skills during the sessions. These children demonstrated improvement in their ability to express their needs and likes and dislikes to their trainers and peers and stopped demonstrating aggressive behaviors toward self and others. These findings are consistent with previous findings that examined the relationship between exercise and social development in children with ASD and reported a development in social skills and an increase in social engagement and interaction during and after exercise sessions (Movahedi et al., 2013; Pan, 2009, 2010, 2011). These findings highlight that exercise can develop social and emotional abilities in children with autism as suggested by previous research (Bauminger, 2002; Pan, 2010, 2011; Yilmaz et al., 2004) and extend by suggesting that social and emotional abilities can be taught and improved as an outcome of constant training providing suitable teaching procedures during therapeutic interventions.

Participant's social and emotional improvement exceeded the learned areas, and it was transferred into other settings and the child's social competence with others. The children showed improvement in their social and emotional abilities specifically at play behaviors, understanding emotions, self-regulation and group skills behaviors. In the social domain at week 5 and toward the end, children displayed positive social behaviors at the sessions and displayed the same behaviors at home with their families. In their emotional abilities, they displayed new emotions, and more emotions in the field that did not show at the beginning of the program and the same emotions were displayed at home. This suggests that the children became more aware of their own feelings in different settings. Children were only directed to express their emotions during exercising in the field, and they were not instructed to express it in other situations/settings. Their increased ability to express their emotions and display positive emotional behaviors in the field and at home may indicate an improvement in the recognition and awareness of their own emotions after being engaged in exercise that stimulated their brains and developed this area. Also including their families or sharing their skills with their family members implies that perhaps they increased their awareness and acknowledgement of people's roles in their emotional world. In terms of social interaction, children showed progress in their play behaviors and group skills. Trainers noticed an improvement in children's overall social behaviors specifically in their play and group skills (e.g. initiate play ideas and activities with peers, follow others lead, take turns, remain with the group). Another indication of children's social development is the increase in their interaction after the sessions were over. These results are consistent with previous research results that suggest that exercising with a group encourages positive social and emotional interactions and builds confidence to transfer it to other settings (Buchanan et al., 2017; Burke et al., 2017).

The study of (McElroy, 2002) suggested that individuals with ASD create their social identity through dealing with others. Thus, they have social difficulties, yet they understand themselves through social involvement. Therefore, being included when engaged in exercise activity can positively impact and improve their social experiences, relationships and personalities as the current findings and previous research showed (Sowa and Meulenbroek, 2012) that the difficulty with social interactions experienced by children with autism can hinder social development, functioning and interaction. In this study, most parents reported that their children are placed in special centres and receive one to one sessions and aren't exposed much to be socially included and spend time with peers and develop meaningful relationships at the centre. However, this program provided opportunities to build friendships and promote

integration and social connections and enhanced experiences of having a sense of community. These results are consistent with (Aggerholm and Moltke Martiny, 2017; Goodwin et al., 2011; Goodwin and Staples, 2005). According to research, exercise enhances social acceptance in children with special needs by facilitating and modelling opportunities for positive social integration and interactions (Eime et al., 2013). This positive social inclusion could relate to their need of receiving alternative therapeutic interventions unlike what is offered in the special centres (structured behavioral interventions) and possibly enhances the feeling of relatedness and normality. These findings can shed light on and provide evidence that participating in exercise when included with non-autistic children allow for meaningful social interactions and improving social skills.

Being included, supported and paired with non-autistic children, especially during mixed games and water aerobics influenced children with ASD to remain engaged and do their best. Also, the relationship with the instructors was very powerful and made them achieve their goals and acquire new skills. Children really enjoyed socialising during group games, they stayed active and really enjoyed talking to their peers (will be discussed further in the section below in specific to the second aim). Being included provided an opportunity to socialise and learn through play, and that allowed the children to naturally develop their skills and their social skills in specific. These findings are consistent with previous findings that suggest that social influences impact the individual with ASD (Buchanan et al., 2017). It is also consistent with previous research that suggested that inclusion provides children with ASD with a chance to learn how to initiate social interaction, express and understand emotions and play with others (Eldar et al., 2010; Harrower and Dunlap, 2001a). The study compared students with ASD in an included setting to their peers with ASD in a segregated setting reporting that students who were fully included developed, improved and mastered advanced social interaction and engagement skills more than the segregated group.

In the present study, some children with mild autism had outgoing personalities. So, playing with non-autistic children played a role in the activities by directing, cheering them and talking to them contributed to their continued engagement and enhanced social skills. These findings correspond closely to those of (Brookman et al., 2003; Buchanan et al., 2017; Fennick and Royle, 2003; Moon, 1994; Schleien et al., 1987; Schleien et al., 1988; Schleien et al., 1990; Taliaferro and Hammond, 2016; Webster, 2016) who reported that social interaction with friends and peers facilitated the participation of children with autism in exercise and had a

positive impact on their social skills. The positive change in children's behaviour is due to the inclusion/cooperative group structure, the use of effective teaching strategies such as training peers to deal with special friends and to being included in exercise which is a face to face learning experience that facilitates cooperative learning and social integration. These studies concluded that they support being included during exercise and playing with partners. The findings also correspond closely to studies that revealed that children with ASD who are fully included display high levels of social interaction and engagement and receive and give social support (Farlow, 1996; Fryxell and Kennedy, 1995; Harrower and Dunlap, 2001b; Hauck et al., 1995; Lord and Hopkins, 1986; Zanolli et al., 1996).

Language and communication skills development

In terms of language and communication development, all parents noticed an impact on this area. Their children displayed more talking and acquired new vocabulary, and for those who were nonverbal, they started saying a few new words. It was also indicated that they improved their eye contact, being fully engaged and understood nonverbal language (head nodding and pointing). Progress in their language and communication skills was notable during the program. During the course of this study and during the observations, positive effects were noticed on children's language abilities. Significant increase in vocabulary was noticed in children with mild autism also the frequency of language use. At first, for the first three weeks, their conversational skills were limited. Also, they used to initiate conversations about specific topics (e.g. "what we are going to do today?") and ask questions for information like when what and who. They used to talk to peers and trainers, but it was limited in the amount of vocabulary and the length of their sentences. In the middle and toward the end of the study, children were frequently speaking, using new and more vocabulary, initiating conversations about different topics (e.g., says to peer, "Guess what I did yesterday? "Guess where am going for summer vacation?"), asking about peers and team members by name and responding to questions asked by peers and trainers. In regard to nonverbal conversational skills, it was limited at first. They did not maintain appropriate eye contact and did not pay attention to a person's nonverbal language. At the middle and toward the end of the study, they maintained appropriate eye contact, oriented body to the speaker, maintained proximity to peers and trainers, paid attention and understood a person's nonverbal language. Previous studies have reported a positive correlation between exercise and an increase in language and communication skills in children with autism (Rogers et al., 2010; Yilmaz et al., 2004).

In specific to children with moderate autism and as mentioned before, they were displaying unpleasant behaviors as refusing to get in and being inattentive and aggressive. As it was a new environment, it took them longer to get used to the program compared to their peers. Thus, they showed a positive change in their language and communication abilities starting at week 5 and until the end of the program. All of them were nonverbal and used to communicate by sounds and pointing to what they want except for two who had limited number of vocabularies. Their nonverbal conversational skills were limited, they maintained very short eye contact or almost none, maintained far proximity to peers and trainers and did not understand nonverbal language. After week 5 and forward, children were able to maintain longer eye contact, maintain appropriate proximity, pay attention to nonverbal language and acquire new vocabulary. It is important to note that most children stopped after school one to one private sessions so that they could attend the program sessions. So, they were not receiving SLP (speech and language pathology) services outside the context of the study. Therefore, it is possible to refer to the progress in children's language skills to participate in the program; several reasons can provide an explanation for why those changes might occur related to the study. It should be noted that the trainers who were following the teaching procedures were highly concentrating on the children's overall behaviours and not only on their physical performance and were responsive to their behaviours during exercising on land and in the pool, including reinforcing pleasant behaviours, modelling pleasant behaviours, responding to child initiations and questions and motivating them to initiate conversations and ask questions. Moreover, at the time of the sessions and after the sessions were over may have given time for the children to communicate and socialise. Furthermore, exercising on land and in the pool may have been engaging and motivating to be communicative.

Being included influenced the development of language and communication skills in children with autism during exercising, after exercising and at home with their families. Parents whose children were in the inclusive group noticed that their children communicated during the sessions with non-autistic children and became friends after a few weeks from starting the program. Toward the end of the program, their children seemed happy when seeing their peers and wanted to spend more time together after the sessions were over. Talking to other children and the trainers encouraged children to talk more and share and express ideas and feelings. It also helped them acquire new vocabulary. Parents reported that their children displayed the same skills at home. Exercise and inclusion encouraged them to talk, listen and learn from others, and this experience may not have existed otherwise. This study extends previous

research on the benefits of exercise for children with autism. It suggests that including children with autism with non-autistic children during exercise should be considered when trying to enhance ASD symptoms. Being included with non-autistic children mainly influenced the development of social skills in children with autism and enhanced their language skills.

Second aim: the second aim of the study was to investigate the impact of mixed games sessions compared to individual exercise as jogging on the social and emotional, physical, language and communication and cognitive skills and behaviors of children with ASD. Within that, the following was considered:

- Social gains
- Physical gains
- Language, communication and cognitive gains

Socials gains

The observations and the interviews revealed that participating in mixed games sessions improved children's social and emotional, physical, language and communication, and cognitive skills. All parents in both groups reported that their children displayed more pleasant social behaviors, acquired and learned new social skills during the mixed games sessions. They noticed that their children communicated with their peers and even more with their partners during the games that needed playing in pairs compared to the jogging and swimming sessions. They also noticed that at the beginning, their children found it difficult to wait for their turns, learn from their peers and support their peers. A few weeks later and toward the end of the program, their children seemed happy while waiting for their turns, paying attention to their peers and supporting them. These findings are consistent with previous findings that investigated parent's perceptions of the engagement of their children with autism in physical activity (Buchanan et al., 2017). The study suggests that interacting with other children while playing, positively impact children with autism and facilitate their participation in physical activity. Being engaged in mixed games and group play influenced children with autism to fully engage, learn from their peers and trainers and develop their social skills. Being paired and engaged in group games provided an opportunity to interact, socialise and learn through play and that allowed participants to develop their social skills naturally. The children displayed social engagement a few weeks after starting the program, they kept close proximity to peers and trainers, displayed more eye contact, initiated conversations, followed other's lead

and engaged more in group games and even after the sessions were over. These findings contradict the results of a meta-analysis examining a number of studies that investigated the impact of individual versus group exercise on children with autism (Sowa and Meulenbroek, 2012). The meta-analysis revealed that the effects of individual interventions on the social and motor domains were greater than group interventions. Noting that the studies analysis was not clear about the social interaction between the participants with ASD and their peers and team members.

In the current study, the interaction between participants and team members and other participants was clearly described during individual and group exercise, and that allowed positive effects of the three activity sessions and the group mixed games in specific on social, motor and language deficits to be determined revealing greater effects compared to individual interventions. Exercising with a group is suggested to make exercise sessions more enjoyable and encourage participants to stay active as well as increases their motivational levels and social engagement (Cannella-Malone et al., 2011; Todd and Reid, 2006). The current study also suggests that the intensity of exercise positively impacted social functioning. This finding is compatible with previous research. Studies reported that the more intense the exercise the maximum benefits were achieved for social functioning (Bahrami et al., 2016; Movahedi et al., 2013). Both studies reported significant effect size on social functioning and communication.

Physical gains

Their physical development was notable as they showed significant improvement in their fine and gross motor functioning, motor coordination, motion planning and balancing, postural stability and fitness. The activities chosen (please refer to table 5.2) were suggested to help participants improve their flexibility, eye-hand coordination, balance, fitness level and learn how to perform new activities/skills (i.e. hula hoops jump, racing, throwing and catching ball...etc.) (Cannella-Malone et al., 2011; Todd and Reid, 2006). Fine and gross motor development was noticeable. The activities proven to be effective as participant's ability to pick up, hold and throw balls became better as well as in hopping, jumping and running. Also, motor coordination development was evident as throwing and catching enhanced as well as running and kicking. Their fitness level also improved as they were able to carry out tasks without undue fatigue and without asking for breaks. These improvements in physical functioning are promising as they suggest that the variety of activities during the mixed games sessions does have an impact on children with autism and can change their physical abilities to the better. Activity sessions and mixed games sessions in specific were a fun environment for

the children to learn social, language and physical skills without pressure though it was structured. During the sessions, participants used to observe each other and keep an eye on their partners, and that influenced the children to copy each other and facilitated their physical improvement. When played with pairs, children were engaged with their partners and focused on mastering the skill and they used to encourage each other by saying “You can do it”. Doing so made them more determined to practice the movements and succeed with time.

Language, communication and cognitive gains

Participants displayed language development a few weeks after starting the program. Parents and the researcher noticed that the children started talking to their friends even before the sessions started, they were talking about the games and the materials and even suggesting games that were not in the activity circuit. More conversations and interaction took place during the games compared to the first weeks when the program started and to the jogging sessions. Participants were following the trainer’s lead and the words used by them, and as the program moved on, participants started using their own words and way in speaking with others and cheering and encouraging others. The parents and the researcher also noticed cognitive development. After a few weeks, participants had a longer attention span, were more focused and attentive to instructions and following instructions. They also showed better visual and auditory perception as their performance was getting better every session and their engagement level was increasing. The kind of sport could be one of the reasons behind the development in these areas. Studies suggest that mixed games which are classified under aerobics improve social skills as well as language and sensory skills (Bass et al., 2009; Nicholson et al., 2011; Pan, 2011). Studies suggest that moderate to intense aerobic exercise stimulates the brain and gives better and stronger therapeutic results (Nicholson et al., 2011). In this program, the mixed games sessions involved many tasks/activities with moderate to high intensity that tackled different body muscles (e.g. racing, hopping, shooting a hoop, kicking, throwing, catching...etc.). Another reason behind the improvement could be the ongoing interaction between peers and trainers while performing the movements that had an unexpected social and language & communication lesson.

Third aim: the third aim of the study was determining the influence of elements applied to exercise setting on improving participant’s performance in following instructions, engagement level, motor performance, and being independent. Taken collectively, the results from the

interviews and the observations evidenced that factors or elements applied to exercise sessions and setting played a marked role in the participant's engagement level and the development of their abilities. All parents with no exception mentioned positive elements that were applied to the program's sessions such as pedagogy, physical structure and organisation of setting and type of exercise offered.

Pedagogy

A number of research studies described elements that facilitate ASDs participation in exercise and influence the development of their dysfunction areas (Firman et al., 2002; Lang et al., 2010; Micacchi et al., 2006; Schultheis et al., 2000; Srinivasan et al., 2014; Todd and Reid, 2006). One of these elements described and was applied to our program was pedagogy. Direct instruction and verbal cueing, modeling and physical guidance, reinforcement, exercise charts and self-monitoring boards were applied. Following these teaching procedures that were highly recommended by previous research for successful exercise-based programs for children with ASD, facilitated participant's engagement in the program and made them able to develop the skills necessary to exercise and show progress with time. Also, it made exercising effective and rewarding. All parents discussed the positive impact pedagogy had on their children since it was well chosen, age-appropriate and consistent. According to parents and regarding reinforcement as a teaching procedure applied to exercise programs in previous experiences, they mentioned that the kind of reinforcement applied was not enough neither consistent. Also, they noted that it was not chosen according to their children's preference neither age-appropriate. Parents also mentioned that programs included so many unwritten rules, long verbal instructions and very fast modelling which was a "disaster" and overwhelming for the children. In this study and during the sessions, different kinds of reinforcement were offered (combination) depending on the child's needs and preference continuously and consistently. Parents stated that "it was rewarding and effective" as they saw their children paying more attention, following instruction with a smile on their faces after receiving the reinforcement accompanied by modelling and verbal instructions. It was also noticeable during observations. Using edible (with participants with moderate autism only), tangible, verbal reinforcement, as well as reinforcement boards and exercise charts, was very effective as it encouraged participants to complete the tasks, provided a clear plan and kept them focused. Parents emphasised that the boards stimulated their cognition and made them think of what, where and when. These results are consistent with (Sherrill, 1998) that argues that using exercise boards encourages cognition and enhances children's understanding of concepts such as "what",

“when” and “where”. Also, placing stickers and happy faces on the boards ensured adherence to exercise and was reinforcing independence. Parents mentioned that they saw their children very happy when placing the stickers and made the parents even happier seeing them placing it without assistance after the fourth week from starting the program. The researcher observed the participants following the routine and choosing the color of the happy face and telling the trainers that they don’t need help placing it. These findings are consistent with previous research that suggests that exercise charts and reinforcement boards keep children organised, self-motivated and increase independence (Schopler et al., 1995; Schultheis et al., 2000).

Direct and short verbal instructions consistent with modeling and physical guidance all were very effective strategies that facilitated the natural behavioural acquisition and acquiring new skills that participants were never exposed to. Direct verbal instructions and encouragements are commonly used with children with autism especially during exercise for them to perform their maximum (Bickers, 1993; Cannella-Malone et al., 2011). In the sessions, since ASDs learn best through observation, we combined verbal cueing with modeling and physical guidance to ensure encouragement and performing the right movement that led to mastering the assigned skills. The current results suggest that pedagogy and development of abilities interact in a reciprocal relation. The researcher during the observations and parents of children in both groups noticed the impact that the carefully designed and chosen pedagogy had on their children compared to their previous experiences. It could be suggested that providing a comprehensive pedagogy that fits the children’s needs and the program made the program successful and for an exercise program to be successful a well-chosen pedagogy should be considered. Not to forget that pedagogy and other elements worked hand in hand for the program to succeed (will be discussed further in the sections below). An example of the reciprocal relationships among the pedagogy and the development of the individuals is the direct instruction consistent with modeling, physical guidance and reinforcement. The individuals received instructions, while the team of professionals were trained to teach them motor and fitness skills. While the program provided an activity, the development would not occur without implementing the right teaching procedures. Another explanation of the relation is providing the exercise program that offers a pedagogy fitting the children’s symptoms. Without such support and services, the children would not have been able to exercise effectively and develop their dysfunction areas. Parents reported that their children were fully engaged because of the content of the program and all the other elements that worked hand in hand.

Physical structure

Another element that contributed to the success of the program is the physical structure. All parents mentioned their admiration to the well-organized setting including (physical boundaries, e.g. boards and coloured tapes and specified materials/activity circuit) that provided structure and routine to the sessions. The current findings are compatible with previous research that suggests modifying the structure of the environment in exercise setting for individuals with ASD should be a major focus to accommodate their symptoms and ensure effectiveness (Schopler et al., 1995; Schultheis et al., 2000) and TEACCH program (Treatment and Education of Autistic and Related Communications-Handicapped children). Research also suggests that establishing physical structure using boundaries and materials can foster independence, increases emotional security and increases on-task behaviors for many children that will result in mastering the tasks and benefiting from the exercise (Schultheis et al., 2000; Srinivasan et al., 2014). According to parents and to the observations, it was noticed that the physical setting helped the children get used to the activities and get more familiar with the environment and that increased their engagement, independence and progress. Many children with ASD get overwhelmed by large and empty spaces, and that increases off-task behaviors as stereotypic ones (Schulte's et al., 2000). To avoid that and to accommodate their symptoms, consistent, limited in space depending on the activity and well-demarcated structure based on the principle of (TEACCH) was provided.

In the sessions, colored tapes were used to mark activity areas, start and finish points and to warm up and to cool down areas. Exercise charts and marked areas with materials for each activity (during mixed games sessions) was applied. It was noticed during the observations that the children became more independent after becoming familiar with the environment, physical structure and the materials. Children were able to associate materials and clearly marked areas with the activities required and remember what is required. Consequently, they started to successfully follow the assigned activities with less verbal instructions compared to the beginning of the program. In addition to independence, after a few weeks, our children with moderate autism became more secure (emotionally) and not overwhelmed anymore. It appears to be because of physical structure. It was found that the children paid more attention to the materials and were always close to the activity area and it eliminated overwhelming feelings and off-task behaviors; this was also noticed by parents. Consequently, the children gave their maximum time on task that allowed them to master the tasks and develop their skills. These results are consistent with previous research that examined the impact of the physical structure

and other elements on physical fitness and motor abilities in children with autism (Schultheis et al., 2000). The study of Schultheis et al. reported that using physical boundaries was very effective and helpful for their students and that allowed their students to develop the skills necessary to exercise and play games.

Type of exercise

Another element that was mentioned by parents that played a role in the development of their children was the type of exercise. Some parents mentioned that the exercise programs that were offered to their children only included simple movements/skills that focused on occupational therapy and rarely offered a sport like swimming or jogging. In regard to the current program, parents noted that the type of activity was carefully chosen for children with autism and that the variety of activities was engaging to their children and influenced the development of their dysfunction areas. Swimming, jogging and aerobics were recommended for children with autism to be implemented in a structured manner as proven to be effective and beneficial sports for this population as discussed in chapter 3 (Attwood, 1997; Cole and Becker, 2004; Pan, 2011; Powers et al., 1992; Sowa and Meulenbroek, 2012; Yilmaz et al., 2004). This program combined and conducted a variety of activities (jogging, swimming, and mixed games) to tackle all body muscles and to provide a new and engaging learning environment for children with ASD to ensure the development of skills and improvement. In regard to swimming, parents noticed that their children were very happy and excited in the pool, communicating with their peers and the trainers freely and following instructions. Noting that instructions were told only once and only receiving verbal and physical reinforcement, unlike the other sessions where trainers had to repeat the instructions more than once and they were receiving different kinds of reinforcement. Parents also noted that their children received less verbal instructions and in time became more independent and improved their balance, muscle tone and motor coordination. According to research, pools are an appropriate setting for educational intervention as the water enhances motor competence, muscle tone, balance and motor coordination and allows efficient movement opposing to a land setting that stresses specific body parts (Adamowycz, 2008; Pan, 2010, 2011). Research also suggests that pools offer an open door for social and language interaction (Bachrach et al., 1978; Pan, 2010).

The current findings are consistent with these findings, and it is also suggested that the water was reinforcing and encouraging by itself and less rigid compared to the land setting. It was a fun environment for the children to learn social, motor and language skills naturally without pressure though it was structured. In regard to jogging and mixed games that are classified

under aerobics, studies reported that it improves social interaction, language and communication, sensory skills and decrease stereotypical behaviors (Bass et al., 2009; Nicholson et al., 2011; Pan, 2011; Sowa and Meulenbroek, 2012). The reason behind the improvement is the intensity of the aerobics movements that stimulate the brain and gives better and stronger therapeutic results (Morin, 2009; Nicholson et al., 2011). The current results are compatible with previous research as noticed by parents and the researcher's observations that jogging and mixed games sessions tackled and focused on all body muscles as children progressed in terms of their motor abilities such as balance, posture and physical fitness. Parents mentioned that their children were never exposed to such intense exercise and thought that their children are not able to perform such movements. But after a few weeks, they started showing progress, and toward the end, the change was remarkable in their physical, social and language skills. Consequently, their kids learned new skills and developed previously acquired ones. It could be suggested that the variety of activities had a positive impact on the children as discussed and as previously mentioned in sections discussing the benefits of exercise in relation to the first aim according to parents, observations and the results of the MABC-2. Different aspects discussed above were included to the type of exercise to be effective and develop participant's dysfunction areas.

Conclusion

This study examined the impact of the exercise-based program designed to enhance the overall functioning of children with ASD when included with non-autistic children. The program adopted a comprehensive design focusing on the type of exercise, pedagogy and physical structure that emphasise ASDs dysfunction areas. In addition, the intervention followed a structured procedure in delivering each sport in every session, and that played a remarkable role in the enhancement of children's social and emotional, language and communication, cognitive, physical and psychological abilities. Validated qualitative and quantitative measures were used to examine and describe this impact and fulfil the aims of the study; the MABC-2, semi-structured interviews and observations. Overall findings from the current study revealed that engagement in exercise as swimming, jogging and mixed games enhanced the overall functioning of children with ASD. All children in both groups inclusive and segregated improved their physical, cognitive, social and emotional, language and communication skills and their psychological health. However, children in the inclusion group had slightly higher improvement in their motor, language and communication and social skills. Being included appear to facilitate the development of these skills, and it is due to the impact typically

developing children had on the autistic children. Typically developed children used to display positive behaviors such as modelling, talking to their peers, supporting their peers, playing with them even after the sessions were over. As a result, children with autism remained engaged, enjoyed the sessions and learned from their peers. Since the improvement in the inclusion group is slight compared to the segregated group in accordance to the results of the research methods and that both groups showed improvements, it is suggested that a variety of exercise activities seemed to positively impact the overall functioning of children with ASD whether included or segregated. The results also revealed that being engaged in mixed games sessions provided a natural environment for the children to communicate, acquire and develop social, physical, cognitive and language skills and promote positive social integration and interaction. Being engaged in mixed games and group play influenced the children to fully engage, learn from their peers and trainers and develop their overall skills as it was a fun environment to learn new skills without pressure during the ongoing exercising and the ongoing interaction between peers and trainers and peers themselves.

Moreover, findings also revealed that for an exercise program to be successful and beneficial, positive elements as pedagogy, physical structure and organisation of setting and the type of exercise should be applied. Following specific teaching procedures that suit ASDs facilitated their participation and engagement in the program and developed their skills. The physical structure also contributed to the success of the program as it fostered independence, emotional security and lessen off-task behaviours. As for the type of exercise, the variety of activities was a new learning environment that was engaging to the children and influenced the development of their dysfunction areas. The sessions provided a fun environment for the children to learn new skills naturally though it was structured. The findings from observing the children are compatible with the interviews and the MABC-2 findings; it suggests that exercise can develop many skills in children with autism, but findings from observations highlight and suggest that social and emotional, language and communication and physical abilities can be taught and improved as an outcome of constant training providing suitable teaching procedures during exercise. In addition, participants transferred the learned areas to other settings, which means that exercise had a beneficial effect beyond the program sessions where the children showed improvement in these abilities after the sessions were over and at home too.

Chapter 8: Conclusion

Conclusion

The current study provides additional data on the impact of exercise and especially a variety of exercise activities as a means of improving ASDs dysfunction areas. It also provides clear guidelines of how exercise can be implemented by trained staff following structured procedures to ensure engagement and improvement (see table 8.1 below). Currently, exercise is rarely considered for children with autism in Saudi Arabia; this data provides support for its use during school/special centres day or as an afterschool activity if available and suitable for the child and the family. This data also supports inclusion during exercising and its impact on the social and emotional, motor and language and communication skills of children with autism. Understanding and implementing exercise programs may have benefited this population who need innovative strategies for enhancing their life experience. This study extends previous findings on the benefits of exercise for children with autism (Anderson-Hanley et al., 2011), (Reid et al., 1988), (Pan and Frey, 2006; Pan et al., 2011), (Allison et al., 1991) (Bahrami et al., 2012) (Sorensen and Zarrett, 2014) and suggests that exercise would be more beneficial and engaging when implementing positive elements as effective teaching strategies, effective kind of sport, organized physical structure of the exercise setting and inclusion.

Implications for practice

Therapeutic interventions as exercise are recommended for children with ASD. Years ago, there was a lack of evidence supporting the use of exercise for improving ASD's dysfunction areas, but now, there is a large, high-quality evidence supporting the positive impact exercise has on the overall functioning of children with ASD (Anderson-Hanley et al., 2011), (Reid et al., 1988), (Pan and Frey, 2006; Pan et al., 2011), (Allison et al., 1991) (Bahrami et al., 2012) (Sorensen and Zarrett, 2014). Current interventions for children with autism mainly focus on their social abilities and managing their behaviors (Srinivasan et al., 2014). Such interventions include picture exchange communication system (PECS), applied behaviour analysis (ABA) and treatment and education of autistic and related communication disabled children (TEACHH). These approaches are mainly sedentary and implemented in highly structured and confined environments. Therefore, this study recommends professionals in the field to promote interventions based on exercise and inclusion by spreading awareness about the importance of exercise, inclusion and inclusive physical education to this population. Spreading awareness

targeting parents, caregivers, schools and private centers to change their perception about the overall benefits and importance of exercise and inclusion as they play an important role in defining the exercise profile of their children. Awareness campaigns should focus on inclusive exercise-based interventions that aim to enhance impairments related to autism in the social, behavioral, language, motor, cognitive and psychological domains. Being physically active with children with autism and non-autistic children will provide great opportunities for socialising with peers, communicating, practising movements and improving motor skills.

It is acknowledged that ASD is a complex disorder and holistic interventions that address impairments in all domains are necessary. Therefore, it is suggested to include an exercise plan within the intervention plan of care for children with autism that promotes the diet and healthy lifestyle, behavior management and exercise than only focusing on programs that concentrate on a single component such as behavior management or exercise. Professionals in schools and private centers should provide an effective treatment plan of care (holistic) that includes exercise given its positive effects that involves collaborative teaming among special educators, parents and caregivers, physical education teachers, physical therapists to ensure long term improvements. Since children with autism spend most of their day in school or private centers, it makes more sense to implement exercise at a school level by including them in physical education with skilled professionals that can modify the instructions when necessary based on the unique needs displayed by their students with ASD to ensure participation and ongoing improvements. For those who attend at private centers, it is suggested to add a number of exercise sessions to their weekly schedules as it would be more valuable in developing their dysfunction areas. Center/school-based programs may be more effective and valuable in developing a healthy lifestyle practice and long-term habit in these children. Location and time management were reported as barriers for parents of children with autism to participate in exercise as an afterschool activity. Therefore, providing exercise programs in schools and centers is more convenient for parents and it can ensure children's participation and make parents lives easier. Working with individuals with autism is challenging considering their symptoms. Therefore, to be able to develop a holistic approach it is suggested to use the right type of exercise/activity recommended for this population (i.e. jogging, cycling, swimming). Participating in the right type of exercise can make children's engagement more successful and more motivated to learn. The physical educator must determine the motor skills that the child with autism is capable of to be able to choose the right type of sport/exercise. This study also suggests applying specific engaging teaching strategies that are tailored to children with autism

when designing exercise-based programs and during implementation to facilitate and maintain their engagement and adherence to exercise (see table 8.1 below). In addition, when planning a holistic approach, it is important to consider modifying the structure of the environment to accommodate the symptoms of children with autism. This study emphasizes on the need for structured physical setting and structured materials (e.g. time tables, picture symbols, clear boundaries outlining activity areas) to enable participants to understand the environment, predict the events to come and reduce behavioral problems.

Findings from this study regarding the need of holistic interventions that include exercise for children with ASD and the necessity of ongoing collaboration among professionals and parents and the importance of specific teaching procedures suitable for children with ASD raise the questions of are the curriculums of adaptive physical education available for the physical education teachers to implement? If it is unavailable, can professionals develop a curriculum or modify the curriculum available that is used with the typically developed to suit the students involved with ASD or will the students with ASD continue to be denied access to physical education? If it is available, are physical education teachers receiving the necessary training to help inclusive adaptive physical education? If training programs for physical education teachers are not preparing them to serve in this domain, will inclusive physical education be delivered in a suitable way or will the students with ASD continue to be denied access to physical education? It is suggested to apply legal mandates that require mainstream schools and private centres to provide adapted physical education curriculums and provide access to the physical exercise curriculum and actively involve children with special needs and children with autism in it and demonstrate progress. Great attention must be paid to what the children need and why exercise is overlooked. Professionals in charge should request for mandates to be applied to schools and private centres. Although access to physical education can be the first and most essential step, a well-defined understanding of the age-level curriculum and the content of physical education is required before conducting it. Once schools, centres and physical education teachers have this knowledge, they must discover the most suitable ways to support these children by collaborating, making accommodations and teaching. The goal of inclusive physical education is to provide children with special needs with the most effective learning environment and not bringing them physically together.

Table 8.1. A list of key pedagogical factors that are important for good practice transition

| Pedagogical Factors | Specific Recommendations |
|---------------------------------------|---|
| Instructions and reinforcement | <p>Use visual supports</p> <ul style="list-style-type: none"> ▪ Use schedules/boards that contain pictures, drawings, written information/steps on it to provide structure to the setting. It helps children understand the sequence of the session and anticipate change (Fittipaldi-Wert and Mowling, 2009; Morrison et al., 2002; Simpson and Myles, 1990). ▪ Activities must be predictable in a specific order. Put clear expectations of the activity session. <p>Reinforcement</p> <ul style="list-style-type: none"> ▪ Provide external reinforcement such as verbal cueing “good job”, edible, tangible (e.g., stickers) and gestural (e.g., clapping, tap on the shoulder, high fives) (Firman et al., 2002; Hughes et al., 2002; Srinivasan et al., 2014; Utley and Astill, 2001). ▪ Use reinforcement boards and exercise charts to place stickers or happy faces on it upon completing the task to motivate the children and increase their engagement level (Todd and Reid, 2006). <p>Direct instructions</p> <ul style="list-style-type: none"> ▪ Use clear, direct, precise and concrete verbal instructions (Lang et al., 2010, p. 574; Srinivasan et al., 2014; Utley and Astill, 2001). Avoid long verbal instructions. <p>Modelling and physical guidance</p> <ul style="list-style-type: none"> ▪ Demonstrate each activity and provide manual guidance as required (Allison et al., 1991; Bandura, 1969; Celiberti et al., 1997; Shipley-Benamou et al., 2002). |
| Exercise considerations | <ul style="list-style-type: none"> ▪ Individualise instructions to meet each student’s need based on the student’s abilities (Zhang, 2006; Zhang and Griffin, 2007). ▪ Task modification. Instructors can modify the presentation of the task to suit the child’s needs (Pope et al., 2012; Todd and Reid, 2006). Instructors can modify the activities and relate them to the student’s interest when experiencing low motivational levels. Modify equipment by using a lighter weight or smaller size equipment and gradually move to heavier or bigger. Workouts can be modified to low impact and gradually move to high impact. ▪ Establish a routine. Have sequenced and consistent activities and program components (e.g. environment, materials, professionals). It helps the children get comfortable during the sessions and remember the sequence of the events from session to session and from week to week (Lang et al., 2010; Prupas et al., 2006). Ensure consistency with the task organisation and instructional routine. Conduct sessions in the same physical space. ▪ Manage challenging behaviors. Use effective strategies to eliminate these behaviors, such as positive reinforcement and behavior management (Collier and Reid, 2003). Connect the child’s interest/challenging behavior to exercise to gain similar physical stimulation via the exercise movement to that obtained via the stereotypic behaviors (Lang et al., 2010; Zhang and Griffin, 2007). ▪ Target age appropriate activities. Determine the physical abilities/motor skills |

| | |
|-------------------------------------|---|
| | that the child with autism is capable of to be able to choose an age-appropriate sport (Block, 2007; Lang et al., 2010; Zhang and Griffin, 2007). |
| Structure of the environment | <ul style="list-style-type: none"> ▪ Use physical boundaries (i.e. room dividers/partitions, colored tapes, flags) (Schopler et al., 1995; Schultheis et al., 2000). ▪ The environment should be consistent from session to session as well as the equipment used (Prupas et al., 2006). Using equipment in a structured manner is an effective way to increase a student’s participation in physical activity. ▪ Conduct sessions in the same physical space (Srinivasan et al., 2014). |

Strengths and limitations of the present research

One strength of this study is that it implemented a variety of exercise activities. To the best of our knowledge, this study is one of few that implemented more than one sport/activity for children with ASD. Most of previous studies applied one type of exercise (e.g. swimming, walking, jogging) (Bass et al., 2009; Cannella-Malone et al., 2011; Pan, 2010, 2011; Pitetti et al., 2007; Todd et al., 2010). The variety of activities in the present study provided maximum learning experiences and changed children’s behaviors and abilities to the better. Another strength of this intervention is the inclusion factor. Few previous studies have examined the impact of inclusion during exercise on children with ASD (Fennick and Royle, 2003; Howells et al., 2019; Prupas et al., 2006). In the present study, aged-matched typically developing children dealt naturally with autistic children and made the sessions flow go smoothly following the directions of the trainers. Being supported and paired with non-autistic children influenced ASDs engagement and performance. Also using highly structured procedures including teaching strategies and the physical setting was a major strength of this study. Only a few studies used such strategies and reported very promising results (Schopler et al., 1995; Schultheis et al., 2000). Using such procedures facilitated children’s engagement and positively affected their abilities. Last, prior to this study, no known attempts had been made using the MABC-2 to measure and compare motor development of children with ASD before and after being engaged in exercise with their peers who are typically developed when included versus segregated. Previous studies only examined the difference in motor development by children with ASD and their peers who are typically developed (Green et al., 2009; Liu and Breslin, 2013; Whyatt and Craig, 2012). Using the battery enabled us to test their motor competence before and after being engaged in the exercise program and compare the difference within each group and between the two groups and determine if there was any progress or change.

Although the study had positive outcomes, there are several limitations that should be

discussed. One potential limitation is the limited number of participants in the study. Though the number of this population is large in the city where the program was conducted, a small number initiated the willingness to participate; this was mainly due to the timing of the sessions that were offered as an after-school activity. Some parents found it difficult to manage their times and commit for 3 days a week, and all shared that it is best for them if it was offered during the school day. Another limitation is that the small sample size and ASD severity can limit generalisation across studies/settings. It is known that ASD individuals are heterogeneous in their nature, they share common symptoms, but the severity and the combination of symptoms vary per individual and age group (Nicholson et al., 2011). In this study, children displayed a variation in their symptoms and their performances. In future studies, it is best to implement the program and provide modifications when needed for it to be appropriate for their study sample size and the severity of participants. Another limitation is access to large sports facilities to implement this intervention. The variety of exercise activities require a large contained facility that might be hard to find across the city due to the limited number of such facilities that contain a sports field and a swimming pool suitable for individuals with special needs. Also, it is almost unavailable in all schools, and if available, conflicts in schedules can occur. For instance, some schools use their sports facility as the school's event space. Hence, it would be occupied during school hours.

Ideas for future research

To expand the clinical efficacy and confidence in the results and findings regarding the use of inclusive exercise-based programs for improving the overall functioning of children with autism, future research can examine the applicability of the current findings to other disorders under the spectrum and other age groups as well. Further experimental studies are needed to examine and determine the impact of the exercise program on children with severe autism since participants included in this study were with mild and moderate autism only. This could potentially emphasise on the need for exercise programs for individuals under the spectrum regardless of the severity. Future research can be conducted using a larger sample size. Larger sample size can provide more data for professionals in the field to work with, keeping in mind that a larger sample size requires larger finance, time commitment and a larger number of professionals involved. Moreover, future research can examine the impact of differentiation of instruction on children's performance. It can involve adjusting the content like adding some games to the mixed games session targeting different skills that the children show deficiency at and modify it to meet their needs. Differentiation of instruction can also involve adjusting

the processes of the exercise to better understand the content and extend participants expectations and abilities. For example, different strategies can be considered to facilitate children's learning like peer tutoring and grouping. During jogging, mixed games and aquatic, different approaches to grouping can be used such as friendship groups, randomly selected groups and/or ability groups. The benefits of the different grouping systems can be examined. Also, adjusting presentation that involves using different teaching styles considering learning styles that can positively impact the children's learning experience. lastly, future research can examine assessing the student's performance employing different strategies such as interviewing the students if possible depending on the severity of autism and their age. Further, longitudinal studies should be conducted to assess its robustness over time and examine the long-term effect of the program on children with ASD. This could potentially emphasise the need for developing exercise programs that run all year long to develop a healthy lifestyle practice and long-term habit in this population. While conducting this study, the children displayed interest in exercising with their parents. Therefore, there is a need for studies to study the involvement of parents during exercising and examine their impact on their children.

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Appendices

Appendix 1

Semi-structured interview questions for parents/guardians of a child

The questions below are intended to be a guide during interviewing parents/guardians of a child with autism who will be participating in the study (engaged in the exercise program).

Introduction

Hello, I am _____. I would like to talk to you about your child's previous experience in exercise /sports, your expectations of the program, your concerns, the program's impact on your child's quality of life and your recommendations.

Section 1. Parent's views and previous experience of their child during exercise programs.

Note: Section 1 is conducted prior that start of the program.

Q 1. Has your child ever been engaged in sports/ exercise programs?

- If yes, what kind of sport/activity?

Q 2. Did your child enjoy it?

- If no, tell me why?
- If yes, tell me why?
- How did your child show his/her signs of enjoyment? (list examples)

Q 3. Were you satisfied with the program?

- If no, tell me why?
- If yes, tell me why?

Q 4. What do you find most challenging about engaging your child in exercise?

Q 5. Did it influence your child's quality of life?

- If yes, please specify?
- Did it enhance certain skills? (i.e. social, cognitive, physical, language skills)

Q 6. What barriers did your child face when participated in sports/ exercise?

- If there was any, please explain!

Q 7. What are you expecting from our program?

Q 8. Do you have any concerns?

- If yes, (please list).

Section 2. Parent's views and opinions of the program and its impact on their children.

Note: section 2 is conducted during the 10 weeks' program on week 5.

Q 1. What do you like most and least about the jogging sessions?

Q 2. What do you like most and least about the swimming sessions?

Q 3. What do you like most and least about the mixed games sessions?

Q 4. What progress have you seen in your child since the beginning of the program?

- Has it improved certain skills?
- If yes, please explain?

Section 3. The overall impact of the program on the child's skills and parent's recommendations.

Note: Section 3 is conducted post the program on weeks 11 & 12.

Q 1. Did the program have an overall impact on your child's skills/abilities?

Q 2. Did your child have a favourite session?

- If yes, specify and tell me why?
- If no, specify and tell me why?

Q 3. Do you have any recommendations to help us improve the quality of the program?

Q 4. Would you recommend the program to other families/children?

- If no, please explain why?
- If yes, please explain why?

Appendix 2

Observation sheet record

Date ____/____/____

The group observed & Session:

Observer:

Behaviours/skills observed:

Social & emotional, language & communication and physical skills

Section 1: Social skills/development:

1.1 Play Behaviors ex: Maintain proximity to peers within 1 foot, observe peers in play, parallel play near peers using the same or similar materials (e.g., playing with ball next to peer who is also playing with a ball), imitate peer (physical or verbal), take turns during simple games (e.g., rolling ball back and forth), play associatively with other children (sharing), respond to interactions from peers (e.g., physically accept toy from a peer; answer questions), return and initiate greetings with peers, take turns during structured games/activities (e.g. shooting hoops), make comments about what he/she is playing to peers, organize play by suggesting play plan, follow another peers play ideas.

| Skill Area | Observation/notes |
|--------------------|-------------------|
| 1.1 Play Behaviors | |
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Section 2: Emotional skills/ development:

2.1 understanding emotions ex: Identify likes and dislikes, identify emotions in self, identify emotions in others, justify an emotion once identified/labelled (e.g., if a girl is crying the child can say she is crying because she fell down and she is hurt), demonstrate affection toward peers (e.g., gives peers hugs), demonstrate aggressive behaviour toward others, demonstrate aggressive behaviour toward self, demonstrate intense fears.

2.2 Self-regulation ex: Allow others to comfort him/her if upset or agitated, self-regulate when energy level is high (e.g., Counts to 10 or runs around the playground to release energy), use acceptable ways to express anger or frustration (e.g., states being upset or asks to take a break), request a "break", Accept not being first at a game or activity, accept losing at a game without becoming upset/angry.

2.3 Flexibility ex: Accept making mistakes without becoming upset/angry, accept the consequences of his/her behaviours without becoming upset/angry, accept unexpected changes, accept changes in routine.

| Skill Area | Observation/notes |
|----------------------------|-------------------|
| 2.1 Understanding Emotions | |
| | |
| | |
| | |
| 2.2 Self-Regulation | |
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|-----------------|--|
| 2.3 Flexibility | |
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Section 3: Group Skills

3.1 Seeking assistance ex: Seek assistance from adults, seek assistance from peers, give assistance to peers.

3.2 Participate in group ex: Respond/participate when one other child is present, respond/participate when more than one other child is present, use appropriate attention-seeking behaviours (e.g., calling name, tapping shoulder).

3.3 Follow group ex: Remain with the group, follow the group routine, follow directions, make the transition to the next activity when directed.

| Skill Area | Observation/notes |
|--------------------------|-------------------|
| 3.1 Seeking Assistance | |
| | |
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| 3.2 Participate in Group | |
| | |
| | |
| | |
| 3.3 Follow Group | |
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Section 4: language and communications skills:

4.1 Conversational Skills ex: Initiate a conversation around specified topics (e.g., says to peers, “Guess what I did yesterday?”), ask “Wh” questions for information (e.g., child will ask “When are we starting?” or “Who is that girl?”), respond to “Wh” questions, ask questions to gain more information, introduce him/herself to someone new.

4.2 Nonverbal Conversational Skills ex: Orient body to speaker, maintain appropriate eye contact, maintain appropriate proximity to conversation partner (e.g., does not stand too close or touch other person), pay attention to a person’s nonverbal language and understand what is being communicated (e.g., if someone shakes their head that means no and nodding your head means yes).

4.3 Questions ex: Answer Yes/No questions, answer simple social questions (e.g., name, age, hair colour, address), answer subjective questions such as “what do you like to eat/drink?” or “what is your favourite colour/video?”), ask questions to gain more information, use “please” and “thank you” at appropriate times.

| Skill Area | Observation/notes |
|---|-------------------|
| 4.1 Conversational Skills .. | |
| | |
| | |
| 4.2 Nonverbal Conversational Skills .. | |
| | |
| | |
| 4.3 Questions | |
| | |
| | |

Section 5: physical skills:

5.1 Fine and gross motor functioning ex: picking up objects, holding objects, throwing, catching, running, jumping, hopping

5.2 Motor coordination ex: throwing a ball into a wall and catching it or to peer, running and kicking a ball, aiming.

5.3 Motion planning and balancing ex: able to navigate directions, able to adjust speed (slower and faster) depending on the activity, able to keep space between peer/trainer while exercising, able to control when to start and stop in case facing an object or person.

5.4 Postural stability and fitness ex: able to keep the body in a stable and balanced position, able to carry out tasks without undue fatigue.

| Skill Area | Observation/notes | | | | | |
|--|---|--|--|--|--|--|
| 5.1 Fine and gross motor functioning . . | <table border="1"> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> </table> | | | | | |
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| 5.2 Motor coordination | <table border="1"> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> </table> | | | | | |
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| 5.3 Motion planning and balancing ex | <table border="1"> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> </table> | | | | | |
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| 5.4 Postural stability and fitness | <table border="1"> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> </table> | | | | | |
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Done by: Mayan Omair

PhD research project

Appendix 3

University of Leeds



Information Sheet for Research Participants

Physical activity for children with ASD

Purpose of the study

We are undertaking a study which involves collaboration between you as a parent, your child and the University of Leeds. We are studying the impact of physical activity (sports) on children with autism when included with non-autistic children. This research requires the involvement of children aged 7-10 and we would like you to consider allowing your child to take part in this study.

What the study involves

If you agree, your child will be engaged in a physical activity program that includes (swimming, jogging and mixed sport games sessions) three times a week, for 10 weeks long. Sessions will be held in the afternoons as after school activity. The researcher will observe the children during the sessions to record their interaction, behaviours and progress throughout the program. Parents will be interviewed a number of times to collect information about their expectations of the program and its impact on their children after a period of time. Children's motor functioning would be assessed twice pre and post the program to determine their motor abilities levels and compare progress if there was any.

Personal information will not be released to or viewed by, anyone other than the researchers named below. All results will be coded so that they are anonymous, i.e. they will not include your name, your child's name or any other identifying information.

Participation is voluntary, and you can withdraw consent at any time, even once the data have been collected.

What we hope to achieve

By conducting this research, we hope to learn more about the impact of physical activity on the physical, cognitive, social & emotional, language & communication skills and behaviours of children with autism and whether ASDs will do better segregated or included. We plan to use the information to design suitable physical activity programs for children with autism.

What will I gain?

By taking part in this study you will be adding to our understanding of physical activity and its impact on children with autism and helping this population to live a healthy life style. You will also get a person profile of your child's progress and skills which will help you plan your child's physical activities.

Researchers

Mrs. Mayan Omair

Dr. Andrea Utley – Senior Lecturer University of Leeds

Dr. Sarah Astill – Lecturer University of Leeds

We hope you will take part – your participation is really appreciated.

Consent Form

I _____ (full name in block capitals) have read the information sheet and give consent for my participation in this study. I understand that I may withdraw my consent and discontinue participation at any time. I understand that the data collected as part of this study will be treated confidentially, and that published results of this project will maintain that confidentiality. In signing this consent letter, I am not waving my legal claims, rights, or remedies.

I have reviewed and understand the Information for Research Participants Information Sheet and have asked any questions I may have to the researcher taking my consent: (circle yes or no)

YES NO

I consent to participate in the above study: (circle yes or no)

YES NO

I consent to be interviewed as a parent/guardian: (circle yes or no)

YES NO

I consent on behalf of my child to be observed during the physical activity sessions: (circle yes or no)

YES NO

If yes, I consent to the use of my data being presented to students or other health professionals for the purpose of:

Education in the University of Leeds: (circle yes or no) **YES** **NO**

Education in any other university: (circle yes or no) **YES** **NO**

National and international conferences: (circle yes or no) **YES** **NO**

Signature _____ Date _____

Name of Researcher taking consent: _____

Appendix 4

THE UNIVERSITY OF LEEDS



Parental Consent Form for motor test administration

I the Parent/Guardian of give permission for the administration of a motor functioning test (supervised by the researcher) to (child's name)

.....

Name:

Signed:

Date:

Appendix 5

THE UNIVERSITY OF LEEDS



Physical activity program for ASDs

Subject Consent Form

| | |
|--|---------|
| I have had the opportunity to ask questions and discuss the research study | Yes/ No |
| I am satisfied with the answers to my questions | Yes/ No |
| I have received enough information about the study | Yes/ No |
| I have spoken to Mrs | Yes/ No |
| I understand that I am free to withdraw from this study at any time | Yes/ No |
| I agree to take part in this study. | Yes/ No |

Signed.....

Name..... Date.....

Signature of person taking consent.....

Name..... Date.....

Appendix 6

Standard score equivalents of raw scores on each test item

B

NORMATIVE DATA

Age 7:0 to 7:11

| Standard Score | Placing Pegs Pref hand | Placing Pegs Non-pref hand | Threading Lace | Drawing Trail 2 | Catching with Two Hands | Throwing Beanbag onto Mat | One-Board Balance Best leg | One-Board Balance Other leg | Walking Heel-to-Toe Forwards | Hopping on Mats Best leg | Hopping on Mats Other leg | Standard Score |
|----------------|------------------------|----------------------------|----------------|-----------------|-------------------------|---------------------------|----------------------------|-----------------------------|------------------------------|--------------------------|---------------------------|----------------|
| 19 | - | - | - | - | - | - | - | - | - | - | - | 19 |
| 18 | - | - | - | - | - | - | - | - | - | - | - | 18 |
| 17 | - | <20 | - | - | 10 | 10 | - | - | - | - | - | 17 |
| 16 | <21 | 21 | <20 | - | - | - | - | 30 | - | - | - | 16 |
| 15 | 22-23 | 22-26 | 21 | - | 9 | 9 | - | 23-29 | - | - | - | 15 |
| 14 | 24-25 | 27 | 22 | - | - | - | 28-30 | 20-22 | - | - | - | 14 |
| 13 | 26 | 28-30 | 23-24 | - | - | - | - | 16-19 | - | - | 5 | 13 |
| 12 | 27-28 | 31-32 | 25-26 | 0 | - | 8 | 25-27 | 12-15 | 15 | - | - | 12 |
| 11 | 29 | 33-34 | 27-29 | - | 8 | 7 | 20-24 | 8-11 | - | 5 | - | 11 |
| 10 | 30 | 35-36 | 30 | 1 | 6-7 | - | 16-19 | 6-7 | 14 | - | - | 10 |
| 9 | 31-32 | 37-38 | 31-32 | - | 5 | 5-6 | 11-15 | 5 | - | - | 4 | 9 |
| 8 | 33-35 | 39-41 | 33-34 | 2 | 4 | - | 8-10 | 4 | 13 | - | - | 8 |
| 7 | 36 | 42-47 | 35-36 | - | 2-3 | 4 | 6-7 | 3 | - | - | - | 7 |
| 6 | 37-42 | 48-51 | 37-40 | - | 1 | - | 5 | - | 11-12 | - | 3 | 6 |
| 5 | 43-47 | - | 41-48 | 3 | 0 | 2-3 | 4 | 2 | 10 | - | 2 | 5 |
| 4 | 48+ | 52+ | - | - | - | - | 2-3 | 0-1 | 8-9 | 4 | 1 | 4 |
| 3 | - | - | 49+ | 4 | - | 0-1 | 0-1 | - | 2-7 | 2-3 | 0 | 3 |
| 2 | - | - | - | 5 | - | - | - | - | 0-1 | - | - | 2 |
| 1 | - | - | - | 6+ | - | - | - | - | - | 0-1 | - | 1 |

Age 8:0 to 8:11

| Standard Score | Placing Pegs Pref hand | Placing Pegs Non-pref hand | Threading Lace | Drawing Trail 2 | Catching with Two Hands | Throwing Beanbag onto Mat | One-Board Balance Best leg | One-Board Balance Other leg | Walking Heel-to-Toe Forwards | Hopping on Mats Best leg | Hopping on Mats Other leg | Standard Score |
|----------------|------------------------|----------------------------|----------------|-----------------|-------------------------|---------------------------|----------------------------|-----------------------------|------------------------------|--------------------------|---------------------------|----------------|
| 19 | - | - | - | - | - | - | - | - | - | - | - | 19 |
| 18 | - | - | - | - | - | - | - | - | - | - | - | 18 |
| 17 | - | - | - | - | - | 10 | - | - | - | - | - | 17 |
| 16 | <19 | <21 | - | - | - | - | - | - | - | - | - | 16 |
| 15 | 20 | 22-23 | <17 | - | 10 | - | - | 27-30 | - | - | - | 15 |
| 14 | 21 | 24-25 | 18 | - | - | 9 | - | 25-26 | - | - | - | 14 |
| 13 | 22 | 26 | 19-20 | - | - | - | 29-30 | 19-24 | - | - | - | 13 |
| 12 | 23-24 | 27 | 21-24 | 0 | 9 | - | 26-28 | 15-18 | - | - | 5 | 12 |
| 11 | 25-26 | 28-29 | 25 | - | - | 7-8 | 22-25 | 9-14 | 15 | 5 | - | 11 |
| 10 | 27 | 30-32 | 26 | - | 8 | - | 19-21 | 7-8 | - | - | - | 10 |
| 9 | 28 | 33 | 27-28 | - | 7 | - | 13-18 | 6 | - | - | - | 9 |
| 8 | 29 | 34-35 | 29-31 | - | 6 | 6 | 11-12 | 5 | - | - | - | 8 |
| 7 | 30-32 | 36-39 | 32-33 | - | 4-5 | - | 9-10 | 4 | 13-14 | - | - | 7 |
| 6 | 33-34 | 40-43 | 34-35 | 1 | 3 | 5 | 7-8 | - | 11-12 | - | 4 | 6 |
| 5 | 35 | 44 | 36-41 | 2 | 1-2 | 4 | 6 | 3 | 10 | - | 3 | 5 |
| 4 | 36 | 45+ | 42-45 | 3 | 0 | 3 | 4-5 | 2 | 8-9 | 4 | 2 | 4 |
| 3 | 37+ | - | 46+ | - | - | 0-2 | 0-3 | 0-1 | 2-7 | 2-3 | 1 | 3 |
| 2 | - | - | - | - | - | - | - | - | 0-1 | - | 0 | 2 |
| 1 | - | - | - | 4+ | - | - | - | - | - | 0-1 | - | 1 |

Age 9:0 to 9:11

| Standard Score | Placing Pegs Pref hand | Placing Pegs Non-pref hand | Threading Lace | Drawing Trail 2 | Catching with Two Hands | Throwing Beanbag onto Mat | One-Board Balance Best leg | One-Board Balance Other leg | Walking Heel-to-Toe Forwards | Hopping on Mats Best leg | Hopping on Mats Other leg | Standard Score |
|----------------|------------------------|----------------------------|----------------|-----------------|-------------------------|---------------------------|----------------------------|-----------------------------|------------------------------|--------------------------|---------------------------|----------------|
| 19 | - | - | - | - | - | - | - | - | - | - | - | 19 |
| 18 | - | - | - | - | - | - | - | - | - | - | - | 18 |
| 17 | - | - | - | - | - | - | - | - | - | - | - | 17 |
| 16 | <19 | <21 | - | - | - | - | - | - | - | - | - | 16 |
| 15 | 20 | 22-23 | <16 | - | 10 | - | - | - | - | - | - | 15 |
| 14 | 21 | 24-25 | 17 | - | - | 10 | - | - | - | - | - | 14 |
| 13 | 22 | 26 | 18-19 | - | - | - | 30 | 25-30 | - | - | - | 13 |
| 12 | 23-24 | 27 | 20 | - | 9 | 9 | 29 | 17-24 | - | - | 5 | 12 |
| 11 | 25 | 28-29 | 21 | 0 | - | 7-8 | 26-28 | 10-16 | 15 | 5 | - | 11 |
| 10 | 26 | 30 | 22-24 | - | 6-8 | - | 23-25 | 8-9 | - | - | - | 10 |
| 9 | 27 | 31-32 | 25-26 | - | 2-5 | - | 19-22 | 6-7 | - | - | - | 9 |
| 8 | 28 | 33-34 | 27 | - | 1 | 6 | 15-18 | 5 | - | - | - | 8 |
| 7 | 29-30 | 35-36 | 28-29 | - | - | - | 10-14 | 4 | 14 | - | - | 7 |
| 6 | 31-34 | 37-40 | 30-32 | 1 | - | 5 | 8-9 | - | - | - | 4 | 6 |
| 5 | 35 | 41-44 | 33 | - | 0 | 4 | 6-7 | 3 | - | - | 3 | 5 |
| 4 | 36 | 45+ | 34-36 | 2 | - | 3 | 4-5 | 2 | 13 | - | 2 | 4 |
| 3 | 37+ | - | 37-44 | 3 | - | 0-2 | 0-3 | 0-1 | 11-12 | 4 | 1 | 3 |
| 2 | - | - | 45+ | - | - | - | - | - | 8-10 | 2-3 | 0 | 2 |
| 1 | - | - | - | 4+ | - | - | - | - | 0-7 | 0-1 | - | 1 |

B
NORMATIVE DATA

Age 10:0 to 10:11

| Standard Score | Placing Pegs Pref hand | Placing Pegs Non-pref hand | Threading Lace | Drawing Trail 2 | Catching with Two Hands | Throwing Beanbag onto Mat | One-Board Balance Best leg | One-Board Balance Other leg | Walking Heel-to-Toe Forwards | Hopping on Mats Best leg | Hopping on Mats Other leg | Standard Score |
|----------------|------------------------|----------------------------|----------------|-----------------|-------------------------|---------------------------|----------------------------|-----------------------------|------------------------------|--------------------------|---------------------------|----------------|
| 19 | - | - | - | - | - | - | - | - | - | - | - | 19 |
| 18 | - | - | - | - | - | - | - | - | - | - | - | 18 |
| 17 | - | - | - | - | - | - | - | - | - | - | - | 17 |
| 16 | <18 | <20 | - | - | - | - | - | - | - | - | - | 16 |
| 15 | 19 | 21-22 | <15 | - | - | - | - | - | - | - | - | 15 |
| 14 | 20-21 | 23 | 16 | - | 10 | 10 | - | - | - | - | - | 14 |
| 13 | 22 | 24 | 17-18 | - | - | - | 30 | 25-30 | - | - | - | 13 |
| 12 | 23 | 25-26 | 19 | - | 9 | 9 | - | 24 | - | - | 5 | 12 |
| 11 | 24 | 27 | 20-21 | 0 | - | 8 | - | 17-23 | 15 | 5 | - | 11 |
| 10 | 25 | 28 | 22 | - | - | - | 27-29 | 10-16 | - | - | - | 10 |
| 9 | 26 | 29 | 23 | - | 7-8 | - | 19-26 | 7-9 | - | - | - | 9 |
| 8 | 27-28 | 30 | 24 | - | 5-6 | 7 | 16-18 | 6 | - | - | - | 8 |
| 7 | 29 | 31-33 | 25-27 | - | 3-4 | 6 | 14-15 | 5 | - | - | - | 7 |
| 6 | 30 | 34-38 | 28-32 | 1 | 1-2 | - | 10-13 | 4 | - | - | 4 | 6 |
| 5 | 31-32 | 39-40 | 33 | - | 0 | 4-5 | 6-9 | - | - | - | 3 | 5 |
| 4 | 33 | 41+ | 34-36 | 2 | - | 3 | 4-5 | 3 | 14 | - | 2 | 4 |
| 3 | 34+ | - | 37-44 | 3 | - | 0-2 | 0-3 | 0-2 | 11-13 | - | 1 | 3 |
| 2 | - | - | 45+ | - | - | - | - | - | 8-10 | - | 0 | 2 |
| 1 | - | - | - | 4+ | - | - | - | - | 0-7 | 0-4 | - | 1 |

Appendix 7

Standard score and percentile equivalents for Total Test Score

Table 3a: Standard score and percentile equivalents for Total Test Score

| Standard Score | Total Score | Percentile |
|----------------|-------------|------------|
| 19 | 108+ | 99.9 |
| 18 | 105-107 | 99.5 |
| 17 | 102-104 | 99 |
| 16 | 99-101 | 98 |
| 15 | 96-98 | 95 |
| 14 | 93-95 | 91 |
| 13 | 90-92 | 84 |
| 12 | 86-89 | 75 |
| 11 | 82-85 | 63 |
| 10 | 78-81 | 50 |
| 9 | 73-77 | 37 / |
| 8 | 68-72 | 25 |
| 7 | 63-67 | 16 |
| 6 | 57-62 | 9 |
| 5 | 50-56 | 5 |
| 4 | 44-49 | 2 |
| 3 | 38-43 | 1 |
| 2 | 30-37 | 0.5 |
| 1 | <29 | 0.1 |

Movement ABC-2 Test 'Traffic Light' System

Some users might find a simple 'Traffic Light' system useful when explaining a child's Test score to parents, teachers or learning support staff. This system is based on percentiles only. The definition of each zone is as follows:

Table 3b: Traffic Light system for Total Test Score

| Child's score | Total Test Score | Percentile range | Description |
|-------------------|-----------------------------|---|--|
| Red zone | up to and including 56 | at or below the 5th percentile | denotes a significant movement difficulty |
| Amber zone | between 57 and 67 inclusive | between the 5th and 15th percentile inclusive | suggests the child is 'at risk' of having a movement difficulty; monitoring required |
| Green zone | any score above 67 | above the 15th percentile | no movement difficulty detected |

Note: as there is no direct correspondence between the 15th percentile and a standard score, in this instance the 16th percentile point has been taken as the upper end of the 'amber' range, equivalent to a standard score of 7.

In the Movement ABC-2 Test, **poor** performance is represented by **low** standard scores. In contrast, in the Movement ABC-2 Checklist, **high** scores represent **poor** performance. In this case, the red zone represents scores at or above the 95th percentile, the amber zone between the 85th and the 94th percentile inclusive, and the green zone any score below the 85th percentile. (See page 96 for the equivalent table for the Checklist).