Underestimation of body weight and its associated factors among trainee healthcare professionals: A cross-sectional study in Pakistan

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By

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Summary

Background:

Underestimation of body weight is one of the barriers to the prevention of overweight and obesity. The aim of this study was to estimate the prevalence of underestimation of body weight and its associated factors among trainee healthcare professionals (HCPs).

Methodology:

A cross-sectional analytical study was conducted in Karachi. Data were collected from the undergraduate students of medicine, dentistry, physiotherapy, pharmacy and nursing through self-administered questionnaires, followed by anthropometric measurements. Actual weight categories were defined using South Asian body mass index (BMI) cut-off points. Underestimation of body weight occurred if participants self-reported a lower weight category than their actual measured weight category. Logistic regression was used to determine the factors associated with underestimation of body weight.

Results:

A total of 2,114 students participated. The mean (±SD) age of participants was 20.6±2.4 years. Thirty percent of participants were overweight or obese, whereas 23% were underweight. Over seventy five percent of the participants did not know their BMI value. The overall prevalence of underestimation of body weight was 36.6%.

Men were more likely to underestimate their body weight than women [OR=3.11 (95%C.I: 2.30-4.21)]. Compared to normal weight individuals, overweight and obese individuals were more likely to underestimate weight [OR=9.45 (95%C.I: 7.28-12.25)]. Compared to self-measured weight, participants who obtained weight knowledge from others were more likely to underestimate their weight [OR=1.38 (95%C.I: 1.02-1.87)]. Participants who received weight-related comments from parents [OR=1.56 (95%C.I: 1.19-2.03)], and friends [OR=1.46 (95% C.I: 1.12-1.92)] were more likely to underestimate their weight. Similarly, an increase in the number of siblings also increased the likelihood of underestimation of body weight [OR=1.12 (95% C.I: 1.03-1.23)].

Conclusion:

High prevalence of underestimation of body weight suggests the need for a future curriculum that would educate trainee HCPs about healthy weight and accurate weight assessment methods to bring positive behavioural change.

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List of publications

List of the publication based on the thesis is as below:

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1. **Mahmood, S**., Relton, C., Croot, L., and Freeman, J. (2014) Do Healthcare Professionals Practice What They Preach in Reality? J *Obes Wt Loss Ther,* S3, e001.

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List of presentations

- **Oral presentation:** "*Underestimation of body weight among students of medicine and allied health sciences in public sector institutes of Karachi, Pakistan"* at IACSS 2013-International Academic Conference on Social Sciences, Istanbul, Turkey on 27-28th July 2013
- **Oral presentation: "***Weight stigmatization among students of medicine and allied health sciences in public sector institutes of Karachi, Pakistan: A ground reality from developing country"* at 2nd International Conference and Exhibition on Obesity & Weight Management, Las Vegas, NV, USA on December 02-04th December, 2013
- **Poster presentation:** *"Overweight and obesity among students of medicine and allied health sciences in public sector institutes of Karachi, Pakistan"* at 2nd International Conference and Exhibition on Obesity & Weight Management, Las Vegas, NV, USA on December 02-04th December, 2013

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Acronyms

AAFP	American Academy of Family Physicians
ACC	American College of Cardiology
ACS	American Cancer Society
AFR	African Region
AHA	American Heart Association
AIHW	Australian Institute of Health and Welfare
AMA	American Medical Association
AMR	American Region
ARMC	Academy of Royal Medical Colleges
BCO	Beliefs about the Causes of Obesity
BDS	Bachelor of Dental Surgery
BMI	Body Mass Index
BPCOP	Beliefs about the Personality Characteristics of Obese Persons
BRFSS	Behavioural Risk Factor Surveillance System
BSPT	Bachelor of Science Physiotherapy
CASP	Critical Appraisal Skills Programme
CDC	Centers for Disease Control and Prevention
CEE	Central and Eastern Europe
CHMS	Canadian Health Measures Survey
CI	Confidence Interval
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CLHNS	Cebu Longitudinal Health and Nutrition Survey
COP	College of Physiotherapy
CPD	Continuing Professional Development
CVDs	Cardiovascular Diseases
DCOP	Dow College of Pharmacy
DHS	Demographic and Health Surveys
DIKIOHS	Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences
DMC	Dow Medical College
DoH	Department of Health
DParm	Doctor of Pharmacy
DUHS	Dow University of Health Sciences
EASO	European Association for the Study of Obesity
EHIS	European Health Interview Survey

EMR	Eastern Mediterranean Region
ER	Emotional Response
ERC	Ethics Review Committee
EU	European Union
EUR	European Region
FGDs	Focus Group Discussions
GMC	General Medical Council
GNI	Gross National Income
GPs	General Physicians
HAPIEE	Health, Alcohol and Psychological factors in Eastern Europe
HCPs	Healthcare Professionals
HCWs	Healthcare Workers
HEC	Higher Education Commission
HIV	Human Immunodeficiency Virus
HSE	Health Survey for England
IDF	International Diabetes Federation
IG	Inspector General
IoN	Institute of Nursing
IOTF	International Obesity Task Force
IPMR	Institute of Physical Medicine and Rehabilitation
IRB	Institutional Review Board
JPMC	Jinnah Postgraduate Medical Centre
LMICs	Low and Middle Income Countries
MBBS	Bachelor of Medicine and Bachelor of Surgery
MECC	Making Every Contact Count
NCDs	Non-communicable Diseases
NHANES	National Health and Nutrition Examination Survey
NHLBI	National Heart, Lung, and Blood Institute
NHMRC	National Health and Medical Research Council
NHMS	National Health and Morbidity Survey
NHNS	National Health and Nutrition Survey
NHS	National Health Service
NHSP	National Health Survey of Pakistan
NICE	National Institute for Health and Care Excellence
NIH	National Institute of Health
NIHN	National Institute of Health and Nutrition
NIPS	National Institute of Population Studies

NMC	Nursing and Midwifery Council
NZHS	New Zealand Health Survey
OE	Outcome Expectations
OECD	Organisation for Economic Co-operation and Development
OPD	Outpatient Department
OR	Odds ratio
PB	Perceived Barriers
PCP	Pharmacy Council of Pakistan
PGR	Postgraduate Research
PhD	Doctor of Philosophy
PHIAC	Public Health Interventions Advisory Committee
PHSC	Population Health Survey of Canada
PI	Principal Investigator
PMDC	Pakistan Medical and Dental Council
PNC	Pakistan Nursing Council
PNDS	Pakistan Nutrition Dietetic Society
PPTA	Pakistan Physical Therapy Association
PRI	Professional Role Identity
PRL	Population Research Laboratory
PS	Perceived Severity
QALYs	Quality Adjusted Life Years
RCP	Royal College of Physicians
RCTs	Randomized Controlled Trials
SA	South Asian
ScHARR	School of Health and Related Research
SD	Standard Deviation
SE	Self-efficacy
SEAR	South East Asian Region
SES	Socio-economic Status
SLAN	Surveys of Lifestyle and Nutrition
SMC	Sindh Medical College
SPSS	Statistical Package for Social Sciences
STROBE	STrengthening the Reporting of OBservational studies in Epidemiology
TOS	The Obesity Society
TTM	Transtheoretical Model
UAE	United Arab Emirates

UK	United Kingdom
UoK	University of Karachi
US	United States
USPSTF	United States Preventive Services Task Force
VC	Vice Chancellor
WC	Waist Circumference
WHO	World Health Organization
WPR	Western Pacific Region

Glossary of terms

Body mass index	A simple index of weight-for -height and calculated with the help of formula: BMI (kg/m^2) = weight in kilograms/height in metres^2
Developing countries	Countries with gross national income per capita US$ 12, 745 or less based on calculation using the World Bank atlas method 2013.
Developed countries	Countries with gross national income per capita US$ 12, 746 or more based on calculation using the World Bank atlas method 2013.
Healthcare professionals	Healthcare professionals refer to doctors, dentists, pharmacists, physiotherapists and nurses
Overweight or obesity based on the South Asian criterion	BMI $\geq$ 23 kg/m^2
Overweight or obesity based on the WHO criterion	BMI $\geq$ 25 kg/m^2
Trainee healthcare professionals	Trainee healthcare professionals refer to undergraduate students of medicine, dentistry, pharmacy, physiotherapy and nursing.
Underestimation of body weight	Underestimation of body weight occurs if individuals self-reported a lower weight category than actual measured weight category.

Chapter 1: Introduction

Obesity is an epidemic of the 21st century (Kaidar-Person et al., 2011). Underestimation of body weight is one of the main barriers to the prevention of overweight and obesity (Bhanji et al., 2011; Kuchler & Variyam, 2003). This thesis is concerned with estimating the prevalence of underestimation of body weight among trainee[1] healthcare professionals (HCPs) in Pakistan. This thesis also aims to identify the factors associated with underestimation of body weight among trainee HCPs.

This introductory chapter starts by defining obesity and describing various body mass index classification cut-off points and outlining the importance of combining body mass index and waist circumference data to assess the health risks of individuals for chronic diseases. Then, it highlights the burden of obesity and its association with chronic diseases, and reviews the available guidance for the prevention of obesity and the role of HCPs. It is followed by presenting the evidence for whether HCPs' personal weight and health behaviour influence their professional practice and patients and whether HCPs really practise what they advocate. Thereafter, the issue of underestimation of body weight among overweight and obese HCPs is highlighted. This chapter also highlights the significance of selecting trainee HCPs for the current study, the study setting, the aims and objectives, research questions and the target audience for this thesis.

1.1 The problem: Global burden of obesity and chronic disease

1.1.1 What is obesity?

The term 'obesity' refers to the excessive accumulation of body fat that places individuals at greater risk of chronic diseases (British Nutrition Foundation, 2004). Clinicians and researchers working in the field of obesity use various measures to assess the degree of fatness. The most commonly used measure is the 'body mass index' (BMI) which is a simple index of weight-for-height and is calculated with the help of the formula: BMI (kg/m^2) = weight in kilograms/ height in metres^2 (National Institute of Health, 1998). BMI generally correlates well with the level of adiposity, although it can misclassify total body fat content, especially among athletes and the shortest and tallest individuals (Ranasinghe et al., 2013). However, easy techniques and the need for less sophisticated apparatus have made it a common weight classification tool for epidemiological studies.

[1] Trainee HCPs in this thesis refers to undergraduate students of medicine, dentistry, pharmacy, physiotherapy and nursing.

1.1.2 BMI classification cut-off points

The World Health Organisation (WHO) proposed an international[1] set of BMI cut-off points to categorise individuals into different weight categories based on morbidity and mortality data from the White Caucasian population (WHO, 1998). These BMI cut-off points are age-independent and the same for both sexes. However, the proposed BMI cut-off points may not correspond to the same degree of fatness in all ethnic groups particularly in the South Asian population. Consequently, the WHO advised lower BMI[2] cut-off points for public health action for the Asian population based on their risk factors and morbidities identified by local population based data (Deurenberg-Yap et al., 1999; Ko et al., 1999). This was further supported by large population based studies from India (n= 10,025) and Pakistan (n=8972) indicating that the South Asian population are at greater risk of chronic diseases and co-morbidities at a much lower level than the White population (Jafar et al., 2006; Snehalatha et al., 2003). More recently, a cohort population based study from London also concluded that British South Asians had equivalent diabetes incidence rates at substantially lower BMI cut-off points (BMI 25.2) than the conventional European BMI (BMI ≥ 30.0) cut-off points (Tillin et al., 2015). The WHO expert consultation (WHO, 2004) concluded that the percentage of Asian people with a high risk of cardiovascular disease and type 2 diabetes is at the lower end of the BMI cut-off point than the existing WHO cut-off point for overweight (≥25 kg/m^2). However, the cut-off point for observed risk varies between 22 kg/m^2 and 25 kg/m^2 in different Asian populations and for high risk, it varies between 26 kg/m^2 and 31 kg/m^2. Further evidence is still required to define clear BMI cut-off points for minority groups, ideally through prospective studies with objective anthropometric measurements. The consultation, therefore, recommended that the current[1] WHO BMI cut-off points should be retained as the international classification but advised countries and regional organisations to identify the public health action points that are most useful for the situation at local or country level.

As a response to the WHO call, more than 100 medical experts from across India belonging to the field of medicine, diabetes, metabolism, cardiology and other allied health sciences met at a consensus meeting held in New Delhi on November 2008. Based on available evidence from across the country (Bhansali et al., 2006; Misra et al., 2003; Misra & Vikram, 2004; Raji et al., 2001; Singh et al., 2004; Singh & Garg, 2008; Snehalatha et al., 2003; Vikram et al., 2003), the consensus committee proposed the optimum BMI[3] cut-off points for the Asian population (Misra et al., 2009) which are different than the earlier suggested BMI cut-off points by the WHO for the White[1] and Asian population[2] (WHO, 2004). Table 1.1 summarises these described BMI cut-off points for Europids (White) and Asian populations.

Table 1.1: Classification of weight by BMI in adults

BMI categories	[1]White populations	[2]Asian populations	[3]Asian populations
Underweight	< 18.5	< 18.5	< 18.5
Normal weight	18.5 – 24.99	18.5 – 22.99	18.5 – 22.99
Overweight	25.0 – 29.99	23.0 – 27.49	23.0 – 24.99
Obese I	30.0 – 34.99	27.5 – 32.49	25.0 – 27.49
Obese II	35.0 – 39.99	32.5 – 37.49	27.5 – 29.99
Obese III	≥ 40.0	≥ 37.5	≥ 30
	WHO, 1998	WHO, 2004	Misra et al. 2009

The South Asian BMI[3] cut-off points proposed by Misra et al. (2009) are based on the local population data (Bhansali et al., 2006; Misra et al., 2003; Misra & Vikram, 2004; Raji et al., 2001; Singh et al., 2004; Singh & Garg, 2008; Snehalatha et al., 2003; Vikram et al., 2003) and later published studies from Pakistan have also used these BMI[3] cut-off points (Bhanji et al., 2011; Mahmood et al., 2013; Mozaffer et al., 2009; Shaikh et al., 2011). Thus, in the current thesis overweight and obesity results are reported by using these South Asian BMI[3] cut-off points as well as those used for the White population[1] to compare the findings with local and international studies respectively. The BMI[3] cut-off point (≥ 23.0) for defining the overweight or obese category by Misra et al. (2009) is the same as that defined by the WHO BMI[2] cut-off points (≥ 23.0) for overweight or obesity in the South Asian population so the prevalence of overweight or obesity will remain the same. Similarly, in the literature review, evidence regarding overweight and obesity are presented with the types of BMI cut-off points used wherever information was available.

1.1.3 The combination of BMI and waist circumference data

The WHO (2008) also recommended the combination of BMI and waist circumference (WC) data to assess the health risks of individuals of chronic diseases related to weight status based on available evidence (Ardern et al., 2003; Janiszewski et al., 2007; Meisinger et al., 2006). WC is a simple and easily obtainable anthropometric parameter, which can be assessed in an outpatient clinic setting. Table 1.2 summarises the BMI and WC cut-off points for the risk assessment of chronic diseases among overweight and obese individuals.

Table 1.2: The combination of BMI and waist circumference data to assess the risk of chronic diseases

Weight status	BMI cut-off points	Disease risk (relative to normal weight and waist circumference)	
		Waist circumference	
		Men < 102cm Women < 88cm	Men ≥ 102cm Women ≥ 88cm
Underweight	< 18.5		
Normal weight	18.5 – 24.99		
Overweight	25.0 – 29.99	Increased	High
Obese I	30.0 – 34.99	High	Very high
Obese II	35.0 – 39.99	Very high	Very high
Obese III	≥ 40.0	Extremely high	Extremely high

National Heart, Lung and Blood Institute (NHLBI) Obesity Education Initiative, 2000

However, the recommended cut-off points of WC (men ≥ 102cm and women ≥ 88cm) for overweight and obesity are not applicable to all populations especially the South Asians. The available evidence based on local data shows that the Asian population has a higher morbidity and mortality rate at a lower cut-off point of WC than the White Caucasians (Misra et al., 2006; Mohan et al., 2007; Vikram et al., 2003). Table 1.3 shows the International Diabetes Federation's (IDF) guidance on waist circumference thresholds for different ethnic groups (Alberti et al., 2007). The given lower cut-off points of WC (men ≥ 90cm and women ≥ 80cm) for the South Asian population are also recommended by the WHO (2008), and the National Institute for Health and Care Excellence (NICE) (NICE, 2013). Similarly, the consensus committee from India who proposed a lower BMI cut-off point for the South Asian population also agreed on the given cut-off points of WC (Misra et al., 2009). Thus, in the current thesis additional information regarding overweight or obesity and the associated risk of diseases is provided by using the recommended (men ≥ 90cm and women ≥ 80cm) cut-off points of WC for the South Asian population.

Table 1.3: International Diabetes Federation guidance on waist circumference thresholds as a measure of central obesity

Ethnic group	Waist circumference (cm)	
	Men	Women
Europid	> 94	> 80
South Asian, Chinese and Japanese	> 90	> 80

Alberti et al. 2007

1.1.4 Epidemic of obesity and chronic diseases

Previously, obesity was thought to be a problem solely of developed countries, but rates have tripled over the last two decades even in the developing parts of the world (Jafar et al., 2008). Obesity has multiple adverse health consequences. Metabolically, it increases insulin resistance, as well as cardiovascular disease (CVD) risk factors such as dyslipidaemia, hypertension, left ventricular hypertrophy and early progression of atherosclerosis (Berenson et al., 1998; Davis et al., 2001; Flegal et al., 2002; Hossain et al., 2007; Kaidar-Person et al., 2011; Malloy & Kane, 2012; Niu et al., 2013; Rosenson et al., 2002).

Consequently, obesity increases the risk of chronic diseases, e.g. diabetes, stroke, osteoarthritis and many types of cancers in later life, which contribute towards premature morbidity and mortality (Jafar et al., 2006; Kaidar-Person et al., 2011; Kenchaiah et al., 2002; Kushi et al., 2005; Malloy & Kane, 2012; Mokdad et al., 2003; Niu et al., 2013). A strong positive association of BMI with overall and cause-specific mortality is also revealed by the Prospective Studies Collaboration who assessed the long-term prospective follow-up of large numbers of people (n= 894, 576) from 57 different follow-up studies (Whitlock et al., 2009). According to the WHO (2013), overweight and obesity cause approximately 2.8 million deaths per year worldwide. Furthermore, Wang and colleagues (2011) estimated that the combined annual medical costs for the treatment of preventable chronic diseases will increase by 48 to 66 billion $ in the US and by 1.9 to 2 billion £ in the UK by 2030. Thus, obesity has persistently been identified as a public health problem (Jafar et al., 2008; Kaidar-Person et al., 2011; Welborn, 2013).

The American Medical Association (AMA), the largest association of physicians who previously considered obesity a major public health issue, has officially recognised obesity as a disease now. Dr Patrice Harris, a senior member of the AMA, has stated,

> *"Recognizing obesity as a disease will help change the way the medical community tackles this complex issue that affects approximately one in three Americans"* (American Medical Association, 2013).

1.2 Prevention of obesity and the role of healthcare professionals

Healthcare professionals[2] (HCPs) provide an important point of contact where the issue of obesity can be raised. They are a source of health information trusted by their patients (Khoo et al., 2008). It is one of the responsibilities of HCPs to provide enough information to their patient in terms of healthy diet and lifestyle in order to prevent obesity from occurring in the first place (Davis et al., 2006). It is also crucial for HCPs to ensure the early detection and

[2] HCPs in this thesis refers to doctors, dentists, pharmacists, physiotherapists and nurses.

management of obesity. When a patient consults their physician, the physician should take the opportunity to measure their body weight and provide advice and support accordingly (NICE, 2014).

1.2.1 Guidance for the prevention of obesity

Many of the developed countries, such as the US, the EU, the UK and Australia (where obesity is a major problem), have emphasised training and educating HCPs to bring change in their behaviour and the organisation of care to prevent obesity among the general population (Jensen et al., 2014; Moyer, 2012; National Health and Medical Research Council (NHMRC), 2013; NICE, 2014; Royal College of Physicians (RCP), 2013; Tsigos et al., 2008). The following sections provide a review of their guidance for the prevention and management of overweight and obesity.

The United States Preventive Services Task Force (USPSTF) recommended that primary care clinicians should screen all adults for obesity (by objective measurements of height and weight) and those with a BMI ≥ 30 kg/m2 should be offered or referred to intensive, multicomponent behavioural interventions (Moyer, 2012). Overweight individuals (BMI 25.0–29.9 kg/m^2) are not referred to in this guidance, who also carry an increased risk of chronic diseases (compared to normal weight) as revealed by a systematic review (Guh et al., 2009) and are more likely to develop obesity in future (James, 2008). Similarly, the proposed BMI cut-off points for obesity (BMI ≥ 30 kg/m^2) may not correspond to the same degree of fatness in all ethnic groups especially the South Asian and other ethnic minority groups who develop a similar risk of chronic disease at a much lower BMI (Jafar et al., 2006; Misra et al., 2009; Snehalatha et al., 2003; Tillin et al., 2015). The USPSTF also did not mention the timing of screening and whether adults should be objectively measured on each visit or once a year. In this case, it might be relying on the primary care clinicians' estimation of who is overweight or obese and who needs to be screened and when they need to be screened. The consideration and involvement of other healthcare professionals such as dentists, nurses, pharmacists, and physiotherapists for obesity screening would be more effective.

More recently (Jensen et al., 2014) the American College of Cardiology (ACC), the American Heart Association (AHA) and the Obesity Society (TOS) have developed guidelines for the management of overweight and obesity in adults. These guidelines considered overweight individuals along with obese ones and advised weight assessment at least once a year for those in the normal weight category and more frequently in those in the overweight or obese weight category. Although the committee recommended the combined use of BMI and WC data for risk assessment, a lower BMI and WC cut-off points for the South Asian and other ethnic minority groups were not considered. The responsibility of overweight and obesity screening was given to primary care clinicians only.

The working group of the European Obesity Management Task Force of the European Association for the Study of Obesity (EASO) also developed clinical practice guidelines for obesity management in order to establish a basis for a more uniform approach across Europe (Tsigos et al., 2008). A simple algorithm (a clinical care pathway) for the assessment and stepwise management of overweight and obese individuals was provided. Physicians were given a greater responsibility for the screening of obesity and treatment with evidence-based interventions, keeping focused on realistic goals and lifelong management. The combined use of BMI and WC data was recommended for risk assessment. A lower WC cut-off point for the South Asian and other ethnic minority groups was advised based on the IDF's consensus for central obesity (Alberti et al., 2007). However lower BMI cut-off points for the South Asian and other ethnic minority groups were not considered. It is also not explicitly mentioned if every patient needs assessment for overweight and obesity and how frequently this screening or follow-up is needed, which means again relying on HCPs' estimation of who is overweight or obese and who needs to be screened and when they need to be screened. Yet again, the responsibility of overweight and obesity screening was given to general physicians only.

Similarly, NICE (2014) reviewed the guidelines and provided advice on the care of adults and children who are overweight or obese. Contrary to the other guidance (Jensen et al., 2014; Moyer, 2012; Tsigos et al., 2008), NICE (2014) recommended the use of ethnic specific BMI and WC cut-off points for the identification, assessment and management of obesity. General practitioners were advised to use their clinical judgement to decide when to measure a person's height and weight. Opportunities include registration with general practice, consultation for related conditions (such as cardiovascular disease, diabetes) and other routine health checks. Although the burden of overweight and obesity in the UK is similar to the US, NICE did not suggest screening everyone for obesity at least once a year as recommended in earlier guidelines from the US (Jensen et al., 2014; Moyer, 2012). Relying on the general practitioners' clinical judgment for weight assessment means many of the overweight and obese individuals may go undiagnosed as earlier studies reported that physicians underestimate the weight of their patients (Chaimovitz et al., 2008; Moorhead et al., 2013; O'Brien et al., 2004).

Along with managing the issue of obesity among the general population, NICE also gave recommendations for preventing obesity among health service employees in order to have a healthier workforce leading by example. However, the findings of 'the first national audit of implementation of NICE guidance for the workplace in NHS trusts in England' were not reassuring (RCP, 2011). According to the report, obesity guidance was given least priority as only 15% of the trusts had a policy or plan to prevent obesity among their staff. Healthy choices were provided in 60% of restaurants and 31% of shops. Similarly, weight management programmes were provided by 31% of the trusts. Williams and Jones (2012) also highlighted this gap and stated that currently weight management support for health service employees with an obesity problem was not adequate and there is an urgent need to encourage healthy eating and physical activity amongst NHS staff.

Similarly, the Royal College of Physicians (RCP) in the UK has emphasised the importance of tackling the issue of obesity and highlighted a need for more focused obesity management training and education for physicians (RCP, 2013). According to their report education in obesity and nutrition are inadequately represented in the current medical undergraduate curriculum. Thus, special emphasis has been given to the undergraduate, postgraduate and continuing professional development (CPD) of physicians in terms of obesity management. A need for local and national leadership on obesity, and a multidisciplinary team approach, specifically regarding the role of general practitioners, were also identified.

The National Health and Medical Research Council (NHMRC) of Australia also reviewed the available evidence and designed clinical practice guidelines tailored according to local needs for the prevention of overweight and obesity among the Australian population (NHMRC, 2013). The important role of primary healthcare professionals (such as general practitioners, practice nurses, aboriginal health workers) as well as allied health professionals (such as physiotherapists, dieticians, psychologists, occupational therapists, diabetes educators, mental health nurses) was acknowledged. Emphasis was also given on the involvement of the multidisciplinary team in effective patient management. The proposed clinical guidance is staged according to the 5As approach: Ask and Assess (for height, weight, lifestyle behaviours, co-morbidities and other factors related to health risk), Advise (regarding the benefits of a healthy lifestyle and weight management), Assist (in developing a weight management programme according to individual needs), Arrange (regular follow-up, or referral as required). Similar to NICE (2014), this guidance also advised the use of ethnic-specific BMI and WC cut-off points for screening and risk assessment of chronic diseases. Additionally, current guidance clearly stated that all patients should be assessed for weight at every health visit (NHMRC, 2013). This level of information is missing in other guidance.

Similarly Asian Indian-specific guidelines for defining and managing overweight and obesity were developed based on the local population data (Misra et al., 2009). The guidelines clearly stated the use of lower BMI and WC cut-off points for the Indian population than those used for the European population. However, they do not provide information regarding who needs to be screened, when to be screened and who should screen. There is a need to review these guidelines and incorporate the required level of information. In this regard, the guidelines given by NHMRC (2013) from Australia can be a good starting point which can be tailored according to local need.

It is worth mentioning that the existing guidance for the management of overweight and obesity has some areas which need attention to enhance the usefulness of these guidelines. For example, the existing guidelines do not mention explicitly who needs to be screened and when to be screened (Misra et al., 2009; Moyer, 2012; Tsigos et al., 2008) and places greater responsibility on the healthcare professionals to decide about the screening of obesity among patients. Therefore, the accurate estimation of patients' body weight is important for HCPs to correctly follow the guidelines. In doing so, the guidance does not take into consideration the underlying fact that HCPs may fail to correctly estimate the weight of their patients (Chaimovitz et al., 2008; Moorhead et al., 2013; O'Brien et al., 2004). In almost all cases the responsibility for overweight and obesity screening was given to primary care physicians or general practitioners except in one case (NHMRC, 2013) where other allied healthcare professionals (such as physiotherapists, dieticians, psychologists, occupational therapists, diabetes educators, mental health nurses) were also considered. The application of ethnic-specific BMI and WC cut-off points was also lacking in the existing guidelines (Moyer et al., 2012; Tsigos et al., 2008). Although a recent European survey (EASO, 2015) highlighted the important issue of the underestimation of body weight among the general population and stated that 75% of the obese individuals described themselves as simply 'overweight' and 33% of overweight individuals thought their weight was 'normal', none of the existing guidelines has a component to address the issue of the underestimation of body weight. More importantly, these guidelines do not specifically target obesity among HCPs who themselves might be overweight or obese.

It is also important to mention that the effectiveness of these clinical guidelines in the management of overweight and obesity is yet to be explored. The available evidence based on systematic review and meta-analysis conducted by Flodgren et al. (2010) could not draw any firm conclusion regarding the effectiveness of interventions in changing the behaviour of health professionals and the organisation of care to promote weight reduction in overweight and obese adults. The review included 246 HCPs and 1,324 overweight or obese patients from six randomised control trials. According to Flodgren and colleagues (2010), most of the studies had methodological or reporting weaknesses, indicating a risk of bias, and thus the evaluated interventions would need further investigation.

1.2.2 What does ‘role model’ mean?

Perhaps more importantly, it has been argued that HCPs have a duty to serve as role models for the general population, especially in matters of health (Appel, 2009). The term ‘role model’ has been defined in various ways. According to the Oxford English Dictionary, it means,

“A person looked to by others as an example in a particular role” (Oxford English Dictionary, 2007, p. 2601).

Similarly, Robert K. Merton, one of the greatest sociologists of the 20th century, defined the role model as,

> *“A person who serves as an example, or whose behaviour is emulated by others”* (Merton, 2004).

Merton (2004) stated that individuals in any society compare themselves to reference groups of people (role models) who occupy the social role for which the individual aims and these role models help in shaping society and that for which it stands. The HCP’s role in any society in terms of health can be viewed in the context of Merton’s definition of a role model. HCPs are not only a symbol of social and wealth status but are also highly respected and influential community leaders, especially in the developing countries (American Cancer Society, 2003).

1.2.3 Why should HCPs be role models?

Professional organisations say that HCPs should be role models for their patients. The American Academy of Family Physicians (AAFP), in their report on ‘Practical advice for family physicians to help overweight patients’, emphasised the importance of empathy in the healthcare setting and sharing their experience about modifying health behaviours with patients, stating that:

> *“The most important thing a family physician can do is to serve as a role model for his/her patients by eating healthy foods, being physically active, and maintaining a healthy weight or trying to achieve a healthier weight”* (American Academy of Family Physicians, 2003).

Professional statutory bodies in the UK, such as the General Medical Council (GMC) and the Nursing and Midwifery Council (NMC), also recognise the responsibility of HCPs to act as role models. The GMC and NMC, in a joint statement on professional values, emphasised that senior consultants and senior nurse managers need to set an example as positive role models for junior staff and patients (NMC, 2012). Similarly, the WHO's new code of conduct states,

> *"Health professionals shall lead by example. They should act as role-models for their patients, by ceasing to smoke, and by ensuring their workplaces and public facilities are smoke and tobacco-free"* (WHO, 2004).

Smith and Leggat (2007), in their international review of tobacco smoking in the medical profession, explained the reason behind this expectation and argued that,

> *"Doctors incur a certain responsibility as exemplars for patients with regard to healthy behaviour, as well as the public image they inadvertently portray outside of the work environment. Having any physicians who smoke may increase public scepticism, with people inclined to ask why should they stop smoking when their doctor continues to do so? Continued tobacco usage by health care workers undermines the message to smokers that quitting is important, and as early as 1976 it was suggested that physicians could best persuade patients to quit if they themselves did not smoke"* (Smith & Leggat, 2007).

As trusted source of health information, HCPs have many opportunities to model healthy behaviours as they come into contact with a large proportion of the population over their health-related issues (Tulloch et al., 2006). National surveys from the US and Canada show that 80-94% of people visit HCPs every year and among these a quarter visit four to nine times (Canadian Institutes for Health Information, 2003; Lucas et al., 2004). This high rate of visits places additional responsibility on HCPs to be role models. More importantly, empathy is an effective tool in healthcare and HCPs who can share their own experience about modifying health behaviours have much to offer in the way of advice and encouragement for patients who are trying to make similar changes (American Academy of Family Physicians, 2003). The National Health Service (NHS) in the UK is the largest publically funded health service, dealing with over a million patients every 36 hours (NHS, 2014). It realised the importance of proactive prevention and addressing the wider determinants of health and introduced the concept of "Making Every Contact Count (MECC)" in the healthcare setting. The aims of this concept were to improve lifestyles and reduce health inequalities. In a report entitled 'The NHS's role in the public's health' it is stated that

> *"Every healthcare professional should "make every contact count": use every contact with an individual to maintain or improve their mental and*

> *physical health and wellbeing where possible, in particular targeting the four main lifestyle risk factors: diet, physical activity, alcohol and tobacco – whatever their specialty or the purpose of the contact"* (The NHS Future Forum, 2014).

Thus, HCPs should be role models for their patients and they have many opportunities.

1.2.4 Do HCPs' personal weight and health behaviour influence their professional practice and patients?

A number of studies on physical exercise and cigarette smoking provide evidence that healthcare professionals' own health and health behaviours are likely to influence their attitude and professional practices. Research showed that HCPs with less physical activity were less likely to have positive attitudes towards promoting physical activity among their patients than HCPs who were physically active and fit (Al-Doghether et al., 2007; Frank et al., 2003; Rogers et al., 2006). A recent systematic review by Fiea and colleagues (2012) also concluded that a higher physical activity level among physicians and nurses was associated with higher physical activity-promoting practices and that health professionals with positive attitudes toward physical activity were more likely to promote physical activity in their patients. Similar findings have been reported with respect to cigarette smoking. It was found that HCPs who smoke have less favourable attitudes towards their patients' smoking cessation, feel less confidence in helping their patients to quit smoking and have less intention to counsel their patients as compared with non-smoking HCPs (Gonzajlez et al., 2009; Gunes et al., 2005; Hall et al., 2005; Parna et al., 2005; Pretti et al., 2006; Willaing & Ladelund, 2004; Yan et al., 2008).

Similarly, Zhu and colleagues (2011) conducted a systematic review and found some evidence for a relationship between a healthcare professional's own weight status (not as currently suggested "health behaviour") and their attitudes and beliefs towards the weight management of patients (which might in turn influence their practice). According to this review (Zhu et al., 2011) normal weight HCPs had higher self-efficacy (SE)[3] scores, stronger professional role identity (PRI)[4], more positive outcome expectations (OE)[5] of weight

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[3] Personal perception of one's confidence or capability to carry out weight management.

[4] An individual's perception of "self" in relation to their professional role in the management of obesity and overweight people (e.g. being role models by maintaining a normal weight).

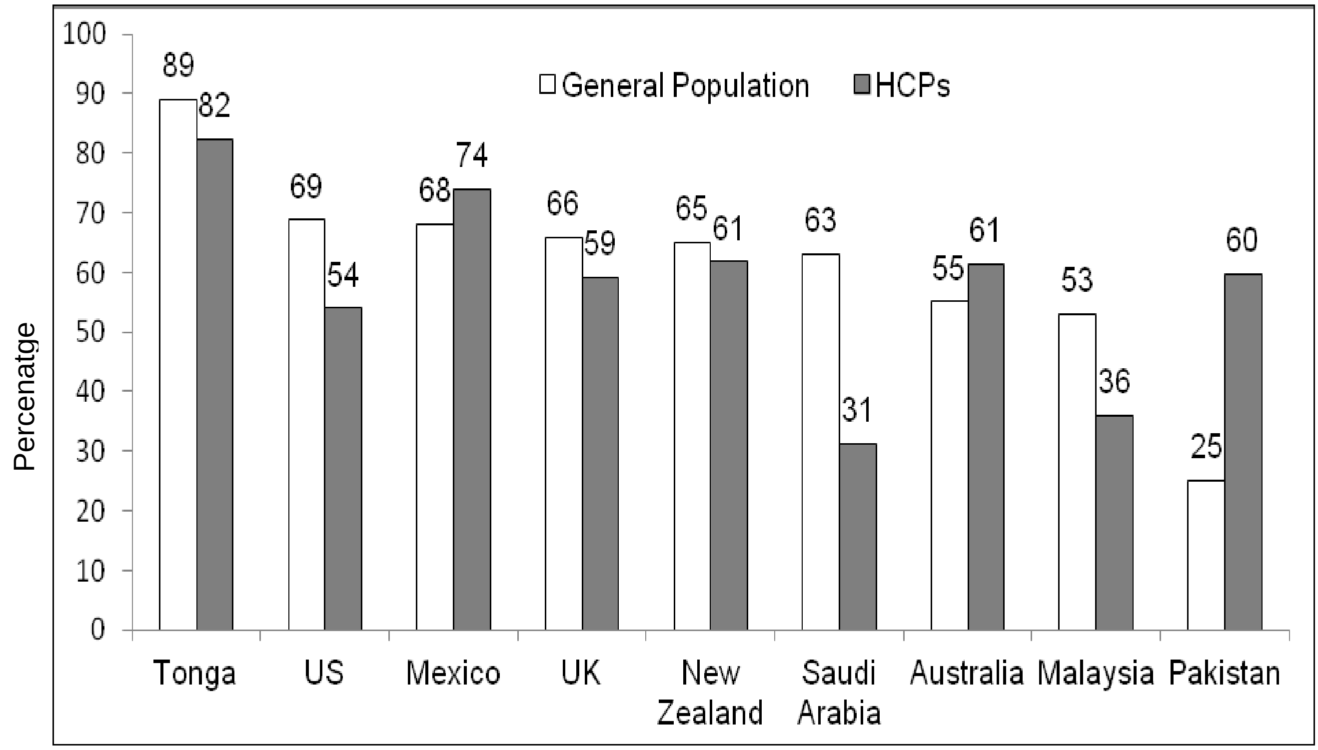
[5] Personal judgment that a particular behaviour related to weight management will produce a certain consequence, including positive (e.g. anticipated weight loss with restriction of diet) and negative (e.g. weight loss is impossible for most obese patients) components.

management, and less perceived barriers (PB)[6] to weight management of their patients than overweight or obese HCPs.

1.2.5 Do HCPs really practice what they advocate?

Evidence suggests that HCPs are gaining weight like the general population (Bogossiana et al., 2012; Boo et al., 2010; Ibrahim et al., 2014; Jimenez-Cruz et al., 2006; Kirk et al., 2008; Mahmood et al., 2010; Miller et al., 2008). Based on the available data from various countries, a comparison of overweight and obesity among the general population and HCPs is shown in Graph 1.1 which is described in detail in chapter 2.

Graph 1.1: Overweight and obesity among the general population & HCPs



n: GP	1022†	22847†	1200†	8291†††	14100†	5000†	9748†	4428†	8972†
n: HCPs	34†	760††	138††	991††	719††	214†	2859††	240†	117†
BMI	≥25	≥25	≥25	≥25	≥25	≥25	≥25	≥25	≥23

† measured data †† self-reported data ††† measured and sel-reported

It is evident that in the cases of Tonga, the UK and New Zealand the prevalence of overweight and obesity among HCPs (Bogossiana et al., 2012; Kirk et al., 2008) is nearly the same as that of the general population (Duarti et al., 2003; Health Survey of England, 2013; Ministry of Health, 2013). In some of the cases (Mexico, Australia and Pakistan) the

[6] Beliefs about the material and psychological costs of practising weight management.

magnitude of overweight and obesity among HCPs (Bogossiana et al., 2012; Jimenez-Cruz et al., 2006; Mahmood et al., 2010) is reported to be even higher than the general population (Australian Bureau of Statistics, 2010; Jafar et al., 2006; Salas et al., 2014).

The Behavioural Risk Factor Surveillance System (BRFSS) - which is the world's largest, ongoing telephone health survey system conducted by the Centers for Disease Control and Prevention (CDC) - also revealed that healthcare workers (HCWs) may not always be able to model healthy behaviours for their patients (Helfand & Mukamal, 2013). In this survey, information was collected from 260,558 participants including 21,380 HCWs. According to Helfand and Mukamal (2013), HCWs were as likely as the other participants to be overweight or obese (RR, 0.99; 95% CI, 0.96 - 1.01).

Underestimation of body weight is one of the important potential reasons HCPs do not "practise what they preach" which is an under-researched area. A few studies have highlighted the issue of underestimation of body weight among qualified physicians, paediatricians and nurses (Jimenez-Cruz & Bacardi-Gascon, 2006; Kirk et al., 2008; Perrin et al., 2005; Zhu et al., 2013). However, nothing is yet known about other healthcare professionals such as dentists, physiotherapists and pharmacists who are also major HCP groups and provide the widest healthcare services. More importantly, we still do not know whether trainee HCPs also underestimate their body weight.

1.3 Why trainee HCPs?

The focus of this thesis is on trainee HCPs which refers to the undergraduate students of medicine, dentistry, pharmacy, physiotherapy and nursing. The main reasons for choosing trainee HCPs in the current study are threefold:

- Although studies have highlighted the increasing magnitude of overweight and obesity among trainee HCPs (Chaudhry et al., 2012; Mahmood et al., 2010 & 2013; Minhas et al., 2010; Mozaffer et al., 2009; Nighat et al., 2009), no study has been conducted to date on the topic of underestimation of body weight among trainee HCPs. Thus, we still do not know whether trainee HCPs also underestimate their weight. If they do, it is not known how much nor what factors are associated with underestimation of weight. Having this information will help inform the design of interventions to improve weight estimation skills while HCPs are undergoing training.
- Compared to trained and qualified HCPs, students are more open and receptive to education and to the understanding of new professional

responsibilities and the trainee period is an excellent opportunity for educators to educate and train them accordingly (American Cancer Society, 2003).

- Trainee HCPs are the HCPs of the future and will be in direct contact with the general population in terms of health. Teaching trainee HCPs about healthy weight will help them to maintain a healthy weight and to minimise their risk of chronic disease. Additionally, this would help HCPs to improve the impact of their advice and make them better role models for their patients.

The major HCP groups who have the widest healthcare coverage in Pakistan are doctors, nurses, dentists, pharmacists and physiotherapists. Details of the number of institutes offering degree programmes in each speciality are given in Table 1.4.

Although other allied healthcare professions - such as occupational therapists, rehabilitation therapists, and speech and language therapists - are also involved in the direct provision of healthcare services to patients, they are in the minority in Pakistan and not easily accessible (Rathore et al., 2011). A small number of academic institutes in Pakistan, such as Aga Khan University and Ziauddin University, offer courses and training programmes in these specialities. According to Rathore et al. (2011), there are only 150 registered occupational therapists and 38 rehabilitation therapists in Pakistan, whereas the number of qualified speech therapists is only six (Siddiqui, 2013). These HCPs are not major groups. Therefore, they are not targeted for the current study.

Table 1.4: Number of registered academic institutes of medicine and allied health sciences in Pakistan

Speciality	Public sector institutes	Private sector institutes	Total
Medicine [a]	38	51	89
Dentistry [a]	10	29	39
Pharmacy [b]	15	13	28
Physiotherapy [c]	-	-	18
Nursing [d]	-	-	128

[a] Pakistan Medical and Dental Council (PMDC)
[b] Pharmacy Council of Pakistan (PCP)
[c] Higher Education Commission of Pakistan (HEC)
[d] Pakistan Nursing Council (PNC)

Consideration of participants from the major HCP groups in the current study will provide a holistic picture in terms of the magnitude of overweight, obesity and underestimation of body weight.

1.4 Selection of study setting: Why Pakistan?

This study was conducted in Dow University of Health Sciences (DUHS), Karachi, Pakistan. The reasons for conducting this study in Pakistan are:

- To the best of our knowledge, no study to date has explored the issue of underestimation of body weight among trainee HCPs in Pakistan. It is important to explore this issue in the context of developing countries where social, economic and cultural factors are different from the factors where earlier studies have been conducted, such as in the US, Mexico, Tonga, etc.
- The prevalence of overweight and obesity among trainee HCPs (such as students of medicine, nursing and dentistry) in Pakistan has been increasing.
- The studies which report this increase in obesity lack generalisability and validity because of non-representative study samples and have used inconsistent BMI cut-off points for weight assessment, which makes cross-comparison difficult across studies.

Within Pakistan, the main reasons for choosing specifically the DUHS as study settings are as follows:

- Being a graduate of this university, I was very familiar with the academic and administrative environment of the university
- Because of prior experience of conducting research studies among medical students of the DUHS, I was aware of the barriers to and facilitators of data collection
- Being a Faculty member of the university, I have connections which further facilitate the data collection process
- My PhD funder encouraged me to conduct this study in my home university so that appropriate measures could be implemented to address the growing problem of obesity in the DUHS

1.5 Aims and objectives

This study aims to understand the extent to which trainee HCPs underestimate their body weight, and to identify the factors which influence the extent to which these trainee HCPs underestimate their weight.

Having information on the extent and characteristics of underestimation of weight will help in the design of interventions for the prevention of obesity among HCPs. The specific objectives of this thesis are to:

- Describe the burden of overweight and obesity and associated factors in developed and developing countries and the suggested public health strategies for the prevention of obesity and to identify barriers to public health interventions
- Describe what is known about underestimation of weight and how it can affect efforts to reduce weight
- Discuss the learning theories and explain the issue of underestimation of body weight and obesity in the light of the trans-theoretical model (TTM) of change
- Identify the knowledge gaps relating to underestimation among trainee HCPs and factors influencing their underestimation of weight
- Choose an appropriate study design to answer the research question
- Explore the relationship between the perceived and actual weight status of trainee HCPs and to estimate the prevalence of underestimation of body weight
- Determine the demographic and personal profile variables associated with underestimation of body weight
- Make recommendations to the professional governing bodies [7] such as Pakistan Medical and Dental Council and their equivalent in allied fields specifically in Pakistan and other developing and developed countries.

1.6 Research questions

- What is the prevalence of underestimation of body weight among trainee healthcare professionals in Karachi, Pakistan?
- What are the factors associated with underestimation of body weight among trainee healthcare professionals in Karachi, Pakistan?

[7] The professional governing bodies are responsible for the curriculum development and training of HCPs in their respective specialties, such as medicine, dentistry, pharmacy, physiotherapy and nursing.

1.7 The target audience

There are three audiences for this thesis.

(i) The professional governing bodies who design the academic curriculum for trainee HCPs in Pakistan. These are

- Pakistan Medical and Dental Council (PMDC)
- Pakistan Nursing Council (PNC)
- Pharmacy Council of Pakistan (PCP)
- Pakistan Physical Therapy Association (PPTA)

(ii) The policy makers and stakeholders of the institution who implement the suggested recommendations and train HCPs in Pakistan, e.g. vice chancellor and registrar.

(iii) The equivalent professional governing bodies in South Asia, specifically in India and Bangladesh, and other developed and developing countries where obesity is a growing problem.

Chapter 2: The problem of overweight and obesity

2.1 Introduction

This chapter provides details of the current knowledge and literature to provide contextual information on the obesity problem and to establish the context of the main topic - ‘underestimation of body weight’.

2.2 Overweight and obesity among the general population

The magnitude of the problem has doubled since 1980 (WHO, 2015). According to the WHO (2015), in 2014 more than 1.9 billion adults (age ≥ 18 years) were overweight (BMI ≥ 25) including 600 million who were obese (BMI ≥ 30). In 2014, the global prevalence of overweight and obesity among the adult (age ≥ 18 years) population was 39% and 13% respectively (WHO, 2015). The mean BMI (95% confidence interval) of the general population has increased from 24.1 (24.0-24.2) in 2010 to 24.4 (24.3-24.6) in 2014 (WHO, 2015). This overall increase in BMI is likely to increase the burden of chronic disease which would result in major economic loss [further discussed in Section 2.5].

The following sections briefly describe the overall magnitude of obesity in the context of developed and developing countries. The division of developed[8] and developing[9] countries is based on the Gross National Income (GNI) per capita using the World Bank atlas method 2013 (World Bank, 2015).

2.2.1 Prevalence of overweight and obesity in developed countries

This section presents the prevalence of overweight and obesity among the most densely populated developed countries, such as the US, Canada, Australia, European Union countries, Japan, Kuwait, United Arab Emirates, Saudi Arabia, Bahrain and Qatar.

According to the National Health and Nutrition Examination Survey (NHANES) 2009-2010 which is a national level cross-sectional survey (n= 5926) with a complex multistage probability sampling technique collecting representative data through face-to-face interviews with actual anthropometric measurements of the civilian non-institutionalised population,

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[8] Countries with gross national income (GNI) per capita of $12,746 or more based on calculations using the World Bank atlas method for 2013.

[9] Include (i) low income countries whose GNI per capita is $1,045 or less; (ii) lower middle income countries whose GNI is $1,046 - $4,125 and (iii) upper middle income whose GNI is $4,126 - $12,745.

almost two thirds of American adults (age ≥20 years) are above normal weight (BMI ≥ 25.0). Ogden and colleagues (2012) stated that nearly 41 million women (35.8%) and 37 million men (35.5%) are obese (BMI ≥ 30). There was no significant difference in the prevalence of obesity between men and women. As far as socio-economic status is concerned, in the US obesity prevalence is generally similar at all income levels for men, whereas higher income women are less likely to be obese than low income women. According to Ogden et al. (2012) the Healthy People 2010 goal of 15% obesity among the adult population was not met which is alarming and needs further attention.

Similarly, the Canadian Health Measures Survey (CHMS) (2007-2009) which is the most comprehensive direct health measures survey conducted in Canada and contains a nationally representative sample (n=10,911) shows that more than 60% of Canadian adults (age 20-69 years) are of above normal weight (BMI ≥ 25.0). Nearly 25% of the adult population in Canada is obese (BMI ≥ 30) according to 2007-2009 data, with no significant gender difference (Shields et al., 2010). The findings are based on face-to-face interviews with measured height and weight data. The reported prevalence of obesity among the Canadian population is lower than that (35%) reported among the US population (Ogden et al., 2012). It is important to note that the overall non-response rate was very high (49%), and the given estimates could be biased if overweight or obese individuals were more likely to opt out.

According to European Union Eurostat (2011) data collected for a European Health Interview Survey (EHIS), in 19 out of 27 countries more than 50% of the adult population (age ≥ 18 years) suffered from overweight or obesity (BMI ≥ 25.0). The overall prevalence of obesity (BMI ≥ 30) was 17% (ranging between 8-25%) across member states. The lowest prevalence of obesity was observed in Romania (7.8 %) whereas the highest prevalence of obesity was found in the United Kingdom (24%). The prevalence of obesity in the adult population varied between 8.0% and 23.9% for women and between 7.6% and 24.7% for men with no systematic difference in obesity between women and men across the member states. Although EHIS aims to measure the health status, life style and health care of citizens across the EU Member States in order to ensure a high degree of comparability among member states, variability in terms of data collection (e.g. face-to-face interviews, telephone interviews, self-administered questionnaires or a combination of these) makes comparison difficult.

Similarly, the recent Health Survey for England (HSE) (2013) reported that in total (n= 8,795), 67% of men and 57% of women were above normal weight (BMI ≥25). Approximately 41% of men and 33% of women were overweight (BMI 25.0-29.9) and additionally 26% of men and 24% of women were obese (BMI ≥30). These statistics are similar to those in the recent years since 2006 (HSE, 2013). While interpreting the results, it is important to note that self-reported height and weight were available for a larger sample than measured height and weight. A natural tendency for overestimating height and underestimating weight would have given lower estimates for overweight and obesity.

The Australian Institute of Health and Welfare (AIHW) reported that 63% of their adult population is overweight or obese (BMI ≥ 25.0) (AIHW, 2015). These findings are based on the measured height and weight data (n=20,800) of the Australian Health Survey (2011-2012) conducted by the Australian Bureau of Statistics (ABS). The magnitude of the problem was higher among Australian men (68%) than women (55%). Similarly, the recent New Zealand Health Survey (NZHS) (2012-13) found a 31.3% prevalence of obesity (BMI ≥30) among the adult population, which is slightly higher than the 28.6% found in the last survey (2011-2012). According to the authors, this change may have been due to improved accuracy in BMI measurements. For example, more participants (92%) agreed to have their height and weight measured than last year (87%). Similarly, the method of measuring height also changed from using a stadiometer (2011-2012) to using a laser (2012-2013) which provided a more accurate reading. Findings from the next year's survey with the consistent use of laser technology would provide better information regarding overall trends.

Data from Japan reveal that the prevalence of overweight and obesity has increased threefold since 1962, however it is lowest among the member countries of the Organisation for Economic Co-operation and Development (OECD) (Yoshiike & Miyoshi, 2013). According to Yoshiike and Miyoshi (2013) the prevalence of overweight or obesity (BMI ≥25) among the adult population (aged ≥20 years) of Japan was 30.4% in men and 21.2% in women based on findings from the National Health and Nutrition Survey (NHNS) (2010), whereas the prevalence of obesity (BMI ≥30) was 3.8% in men and 3.2% in women. This survey contains a national representative sample (n=8,247) of the Japanese population as information is collected through face-to-face interviews from a large number of households (n=3,412) in the randomly selected 300 survey districts which participated in the survey. The actual height and weight of the participants were measured, though the survey allowed for self-reporting of height and weight which was rare.

Overweight and obesity is also a major problem in countries from the Eastern Mediterranean region - such as Kuwait, the United Arab Emirates (UAE), Saudi Arabia, Bahrain, and Qatar – with over 60% of the adult population overweight or obese (Al-Zenki et al., 2012; Memish et al., 2014; Musaiger et al., 2012; Ng et al., 2011). The first national nutrition survey in Kuwait collected information from the adult population (age ≥ 20 years) through multistage stratified cluster sampling (n=1,830). Face-to-face interviews (n=992) were conducted (2008-2009) and information was gathered on demographic and socioeconomic characteristics along with actual anthropometric measurements (Al-Zenki et al., 2012). Data shows that the prevalence of obesity (BMI ≥30) was higher among women (54.7%) than men (32.3%). Similarly, a 28.7% prevalence of obesity (BMI ≥30) was reported from Saudi Arabia by Memish and colleagues (2014) who collected information from the national representative sample of 10,735 participants (aged ≥15 years) through face-to-face interviews with actual anthropometric measurements. As in Kuwait, obesity (BMI ≥30) was more common among women (33.5%) than men (24.1%) (Memish et al., 2014). Similar obesity estimates have been reported from the UAE, Bahrain and Qatar which highlights the significance of the problem and demands urgent intervention (Musaiger et al., 2012; Ng et al., 2011).

Table 2.1 summarises the WHO's 2010 statistics on overweight and obesity in terms of gender (age ≥ 15 years) for the high (GNI ≥ $12,746 per capita) income countries.

Table 2.1: Prevalence of overweight and obesity (BMI ≥ 25.0) among the adult population (age ≥ 15 years) of developed countries by gender [2010]

Country	Men (%)	Women (%)	Country	Men (%)	Women (%)
United States	80.5	76.7	Bahrain	60.9	69.5
Australia	75.7	66.5	Qatar	59.5	65.5
New Zealand	73.9	74.2	Norway	57.2	45.8
Kuwait	69.5	80.4	Sweden	57.0	47.2
Uruguay	69.3	64.4	Spain	57.9	49.8
Chile	68.4	73.3	Switzerland	56.5	58.9
United Kingdom	67.8	63.8	Denmark	55.0	41.4
Germany	67.2	57.1	Italy	55.0	40.0
Finland	67.1	54.5	Ireland	53.9	43.9
Canada	66.9	41.4	Netherland	50.2	46.1
UAE	66.9	71.6	France	48.0	36.9
Saudi Arabia	63.1	65.9	Japan	29.8	16.2

[10]Source: WHO Global Infobase: Data for saving lives

[10] The WHO Global Infobase assembles non-communicable disease (NCDs) risk factor data with the help of population based surveys through the Department of Health (DoH) of Member States. Actual height and weight of participants are measured in Department of Health Surveys (DHS).

2.2.2 Prevalence of overweight and obesity in developing countries

A high prevalence of overweight and obesity has also been reported from the developing countries (Hou et al., 2008; Jafar et al., 2008; Misra & Bhardwaj, 2014; Valeggia et al., 2010; Wang et al., 2007). According to James et al. (2010) the main reason for the increasing burden of obesity, especially in low- and middle-income countries (LMICs), is the extraordinary economic and societal changes accompanying what is known as 'nutritional transition'[11]. A number of systematic reviews on the topic of overweight and obesity also explored the association of overweight and obesity with the social, demographic and economic characteristics of the population in developing countries (Dinsa et al., 2012; Lopez-Arana et al., 2013; Neuman et al., 2013; Razak et al., 2013).

Razak and colleagues (2013) examined the change in BMI across all segments of the BMI distribution in 37 LMICs, and assessed whether the BMI distribution is changing between cross-sectional surveys conducted at different time points. It was found that weight gain is occurring disproportionately among groups with already high baseline BMI levels. However, no firm conclusion can be drawn at individual level as the studies included with repeated population surveys did not examine weight gain within an individual over time. Findings of the review were limited to women (aged 20-49 years) only. Although data from the US suggests similar patterns of change in men and women in the distribution of BMI (Flegal et al., 2012), it would be useful if future studies could explore whether unequal weight gain occurs across segments of the BMI distribution in both men and women and across a broader range of countries.

Other systematic reviews conducted on this topic explored the association between overweight and obesity and social, demographic and economic variables (Dinsa et al., 2012; Lopez-Arana et al., 2013; Neuman et al., 2013). For example, the review by Dinsa et al. (2012) assessed the association between overweight and obesity, and the socioeconomic status in low- and middle-income countries. This review included 42 surveys from 33 developing countries conducted among the adult (≥15 years) population. It found that obesity is a problem of the rich in low-income countries for both men and women, while in middle-income countries the association is largely mixed for men while it is mainly negative for women. The authors concluded that the observed association between overweight and obesity and SES is a simple correlation, and no causal inference could be drawn because of the (cross sectional) nature of the survey's data. Similarly, Neuman et al. (2013) assessed the association between urban residence and BMI in LMICs and revealed that the association between urban residence and obesity in LMICs is driven largely by higher

[11] Change of diets from high in cereal and fibre to diets high in sugars, fat, and animal-source food.

individual- and community-level SES in urban areas. A review conducted by Lopez-Arana et al. (2013) examined trends in overweight by educational level in 33 LMICs and found that there was a consistent pattern of increasing overweight trends across all educational groups. Higher parity, shorter breast feeding, and young age at first birth were associated with overweight. The findings of these two reviews are limited to women only (Lopez-Arana et al., 2013; Neuman et al., 2013). Similarly, reviews by Dinsa et al. (2012) and Neuman et al. (2013) did not look at the trends of overweight or obesity over a period of time, which could have given more useful information regarding the change in the prevalence of obesity.

The following sections briefly describe the magnitude of overweight and obesity in LMIC according to the regional classification of the WHO.

The Eastern Mediterranean Region (EMR)

In this region, Iran, Syria, Algeria, Jordan and Libya are the larger countries. From Iran, Hajian-Tilaki and Heidari (2010) collected information from participants (n=3600) aged 20-70 by face-to-face interviews through the cluster sampling technique and reported an 18.8% (men 7%, women 27.8%) prevalence of obesity (BMI ≥30). The prevalence of obesity is lower than the one (28.7%) reported from the neighbouring country Saudi Arabia by Memish and colleagues (2014). However, gender-wise trends remain the same (higher among women than men) as those found for Saudi Arabia (Memish et al., 2014). The actual height and weight of participants were measured.

A high burden of overweight and obesity has also been reported among adolescents (Musaiger et al., 2012). Musaiger and colleagues (2012) conducted a school-based study and collected information by face-to-face interviews from n=4698 participants (aged 15-18 years) in Arab countries (Algeria, Jordan, Libya, Palestine, Syria) through a multistage stratified random sampling technique. Among males, the burden of overweight and obesity was highest among Jordanian (31.8%) and lowest among Algerian (13.4%) adolescents. Among females, the highest burden of overweight and obesity was reported in Libyan adolescents (36.6%), and the lowest among Palestinian adolescents (16.0%). These estimates are based on actual anthropometric measurements using the Internal Obesity Task Force (IOTF) criterion.

It is important to note that obesity in this region is more common among women than men, contrary to the majority of the developed countries. Cultural factors are likely to play an important role in the occurrence of obesity, especially among women. For example, Rguibi and Belahsen (2004) conducted a study in Morocco and reported that there is a cultural preference for body fatness among women of the Sahraoui ethnic group. Similarly, Abdollahi and Mann (2001) pointed out the traditional dress of women as a contributory factor and stated that the practice of full-body covering among women reduces the emphasis on their physical features, which is otherwise important in the self-assessment of an individual's body. Al-Tawil and colleagues (2007) found that the proportion (77.9%) of obesity (BMI ≥ 25) was greater among women who wore the full-length gown or abaya[12] at home than those (70.6%) who wore pyjamas ($p < 0.024$). Another important factor that contributes towards obesity among women could be their limited opportunities for physical activities such as exercise and participation in sports (Tawil et al., 2007).

The Western Pacific Region (WPR)

In this region Nauru, the Cook Islands, and Micronesia have the highest (>90%) prevalence of overweight and obesity (BMI ≥25) (Ono et al., 2010). According to Parry's (2010) report published in the Bulletin of the World Health Organization, traditional foods have been replaced with imported and processed food which has contributed to the high prevalence of obesity and related health problems in the Pacific islands. Other countries in this region include China, Vietnam, the Philippines and Malaysia.

Hou et al. (2008) analysed the data of a population-based longitudinal study collected from 5,364 (aged 25–95 years) participants in China and reported a 27.5% and 9.1% prevalence of overweight and obesity (BMI ≥25) respectively. A lower prevalence of overweight and obesity (BMI ≥25) was reported from Vietnam (Hoang et al., 2007) and the Philippines (Dahly et al., 2010). From Vietnam, an overall 3.5% (men 3%, women 4%) prevalence of obesity (BMI ≥30) was reported by Hoang and colleagues (2007) who collected information from a national representative sample (n=2000) of adults aged 25 to 64 years. Similarly, from the Philippines an overall 6.3% (men 6.1%, women 6.5%) prevalence of obesity (BMI ≥30) was reported by Dahly et al. (2010) based on the Cebu Longitudinal Health and Nutrition Survey (CLHNS) which is a community-based study (n=1885) of birth cohorts residing in Metropolitan Cebu. On the other hand, a higher magnitude of overweight and obesity (BMI ≥25) was reported from Malaysia (Lim et al., 2000). According to Lim and colleagues (2000), 26.5% (men 24.1%, women 29%) of the adult (≥20 years) population was overweight or obese (BMI ≥25) based on the National Health and Morbidity Survey (NHMS) data (n= 28737), which is a representative sample of the population of Malaysia. All the studies included in this section gathered information through face-to-face interviews and measured the actual height and weight of participants.

[12] Traditional long dress covering the whole body.

The South East Asian Region (SEAR)

The most densely populated countries in this region are India, Bangladesh, Nepal and Sri Lanka. In South East Asia the magnitude of overweight and obesity is lower than the Eastern Mediterranean regions (Ono et al., 2010). According to the WHO's (2010) statistics, the prevalence of overweight or obesity (BMI ≥25) in India, Bangladesh and Nepal was 19.1%, 8%, and 11% respectively.

Balarajan and Villamor (2009) examined the trends of overweight and obesity among women of reproductive (15-49 years) age in Bangladesh, Nepal and India. Based on nationally representative data from eight Demographic and Health Surveys conducted in Bangladesh (n = 19,211), Nepal (n = 19,354) and India (n = 161,755), the authors stated that overweight and obesity (BMI ≥25) had increased substantially among the women of all three countries between 1996 and 2006. While comparing the first to the latest survey in Bangladesh, the prevalence of overweight or obesity (BMI ≥25) increased from 2.7 to 8.9%, in Nepal from 1.6 to 10.1% and in India from 10.6 to 14.8%. Demographic and Health Surveys measured the actual height and weight of the participants. Such analysis for men would be very useful. Similarly, overweight and obesity estimates based on the South Asian BMI cut-off points (BMI ≥23) would provide additional information.

The American Region (AMR)

The larger low- and middle-income countries in the American region are those in the south, which include Argentina, Bolivia, Brazil, Guatemala, Jamaica, Mexico and Venezuela. In this region, the magnitude of overweight or obesity (BMI ≥25) ranged from 40% to 77% (Ono et al., 2010). More than two thirds of the adult population were overweight or obese in Argentina, Venezuela and Mexico. The lowest (20%) burden of obesity (BMI ≥30) was found in Haiti (Ono et al., 2010). These countries are also going through a rapid demographic and nutritional transition.

Valeggia and colleagues (2010) collected data from two indigenous populations (the Toba and Wichi) of Argentina residing in the Province of Formosa. In this survey a total of 541 adults (>20 years) participated and the prevalence of overweight or obesity (BMI ≥25) was 60% among the Toba and 44% among the Wichí populations. The sample was representative of the communities and actual height and weight measurements were taken. In Brazil, Gigante et al. (2008) interviewed (n=4,198) participants for a longitudinal cohort study of youths born in 1982 in Pelotas. The survey reported that 29% of the participants were overweight (BMI 25-29.9) and another 8.2% were obese (BMI ≥30). In Jamaica, Mendez and colleagues (2004) conducted a cross-sectional population-based survey and randomly recruited (n=2096) participants from a sub-urban area. The authors reported a higher prevalence of obesity (BMI ≥30) among women (33.5%) than men (8.9%) (Mendez et al., 2004).

Similarly a higher prevalence of obesity (BMI ≥30) was reported among women (22.5%) than men (13.4%) in Mexico (Fernald, 2007). In this survey information was collected from 12,873 participants (18-65 years) from 364 communities as part of a National Social Welfare Survey which is representative of the poorest and rural communities in seven of Mexico's 31 states. The actual height and weight of participants were measured. Though Bolivia is one of the poorest among the Latin American countries, an increase of 9% for overweight or obesity (BMI ≥25) has been observed among women of the reproductive (20-49 years) age group (Pérez-Cueto & Kolsteren, 2004). These findings are based on the data collected for the Bolivian National Demographic and Health Surveys of 1994 and 1998. A further trend analysis of more recent surveys with the inclusion of men would provide more useful information as was compiled by Bovet and colleagues (2008) for the Seychelles.

The African Region (AFR)

Although the prevalence of obesity is still lower in the African region than in the rest of the WHO regions, the Seychelles is a country where nearly two-thirds of the population are overweight or obese (Bovet et al., 2008). Bovet and colleagues (2008), basing their study on a national representative sample (n=3343) of the population, looked at the 15-year (1989-2004) trends in the BMI among the adult (25-64 years) population of the Seychelles. According to the authors, the prevalence of overweight has increased from 50% to 67% in women and from 29% to 52% in men and in the same way the prevalence of obesity has increased from 23% to 34% in women and from 4% to 15% in men (Bovet et al., 2008).

Similarly, Fezeu et al. (2006) collected information from (n=2,813) the adult population (≥25 years) of 1,897 households in the capital of Cameroon and reported that 55% of the women and 37% of the men were overweight or obese (BMI ≥25). Another population-based survey conducted in Ouagadougou, the capital city of Burkina Faso, also reported an increasing burden of obesity (Ouédraogo et al., 2008). Based on information collected from (n=2,022) the adult (≥35 years) population, the authors reported that the overall prevalence of obesity (BMI ≥30) was 14.7%, which was again higher among women (29.1%) than men (5.5%). A recent population-based survey from Cape Town also revealed that the prevalence of overweight or obesity (BMI ≥25) is much higher (82.8%) among women than men (28.9%) (Peer et al., 2014). Peer and colleagues (2014) collected information from (n=1,099) the adult (25–74 years) urban black population of Cape Town with the aim of estimating the prevalence of overweight or obesity (BMI ≥25) among the black South African population.

It has been observed that the prevalence of obesity is higher among women than men in many of the African countries as it is in the Eastern Mediterranean region, which is partially explained by social and cultural factors such as the acceptance of greater body weight among women (Abubakari et al., 2008). Case and Menendez (2009) also looked at factors to explain the greater obesity prevalence among African women than men and identified three main factors. According to the authors, women who were nutritionally deprived as children are significantly more likely to be obese as adults whereas men who were nutritionally deprived as children face no greater risk of obesity. Additionally, women of a higher socioeconomic status are significantly more likely to be obese which is not true for men. Moreover, women's perceptions of an 'ideal' female body are larger than men's perceptions of the 'ideal' male body, and thus individuals with larger 'ideal' body images are significantly more likely to be overweight or obese (Case & Menendez, 2009).

Table 2.2 summarises the findings of the studies in terms of the prevalence of obesity (gender wise), the study sample, the age of the population, the country and the year of publication. Countries are grouped according to the WHO's regional geographical classification.

It is important to acknowledge that all of the above reviewed studies used the same BMI cut-off points for defining overweight (≥25.0-29.9) or obesity (BMI ≥30) including the one from the South East Asian region (Balarajan & Villamor, 2009). It would have been better if Balarajan and Villamor (2009) had given obesity estimates based on the South Asian BMI criterion along with the WHO criterion. Almost all of the studies reported the use of actual height and weight measurement except one (HSE, 2013) where self-reported height and weight was available for a larger sample than measured height and weight and this might have given lower estimates for overweight and obesity. The response rates for these surveys are generally high (85-95%), except in one where it was only 51% (Shields et al., 2010). Some of the studies have nationally representative samples (Balarajan et al., 2009; Bovet et al, 2008; Hoang et al., 2007; HSE, 2013; Mendez et al., 2004; Ogden et al., 2012; Perez-Cueto et al., 2004; Shields et al., 2010; Yoshiike & Miyoshi, 2013) which ensured the generalisability of findings, whereas others have limited generalisability because participants were recruited from one city/province or a single socio-economic class (Fernald et al., 2007; Hoang et al. 2007; Ouedraogo et al., 2008; Peer et al., 2014). Similarly, the focus of two of the studies was on women only, which limited their generalisability (Balarajan et al., 2009; Perez-Cueto et al., 2004). There was also a large variation among the studies, especially in terms of the age of the participants, ranging from as young as 15 years to as old as 95 years. Although some of the obesity patterns are identifiable, international comparisons of BMI and obesity across countries are challenging because of methodological heterogeneity (Finucane et al., 2011). The given obesity estimates are not always age standardised or adjusted for other known confounders, thus it needs careful interpretation before drawing conclusions.

Table 2.2: Prevalence of obesity (BMI ≥ 30.0) among the adult population of developing countries

Country	WHO region	Sample (n)	Age (years)	Men (%)	Women (%)	References
Benin	AFR	200	25-60	8	28	Sodjinou et al. (2008)
Burkina Faso	AFR	1999	≥35	5.5	21.9	Ouedraogo et al. (2008)
Cameroon	AFR	2831	≥25	7	22	Fezeu et al. (2006)
Ghana	AFR	1025	≥25	10	36	Addo et al. (2009)
Seychelles	AFR	3343	25-64	15	34	Bovet et al. (2008)
South Africa	AFR	1099	25-74	28.9	82.8	Peer et al. (2014)
Iran	EMR	3600	20-70	9.9	27.8	Hajian-Tilaki et al. (2010)
China	WPR	3032	20-95	8.3	10	Hou et al. (2008)
Malaysia	WPR	28737	≥20	24.1	29	Lim et al. (2000)
Philippines	WPR	1885	25-64	6.1	6.5	Dahly et al. (2010)
Vietnam	WPR	2000	25-64	3	4	Hoang et al. (2007)
Bangladesh	SEAR	19211	15-49	-	1.4	Balarajan et al. (2009)
India	SEAR	161755	15-49	-	3.4	Balarajan et al. (2009)
Nepal	SEAR	19354	15-49	-	1.1	Balarajan et al. (2009)
Argentina	AMR	541	≥20	13	20	Valeggia et al. (2010)
Bolivia	AMR	4527	20-49	-	10.5	Perez-Cueto et al. (2004)
Jamaica	AMR	2096	25-74	8.9	33.5	Mendez et al. (2004)
Mexico	AMR	12873	18-65	13.4	22.5	Fernald et al. (2007)

Similarly the majority of the surveys provided estimates for overweight and obesity at a given point except for three, which highlighted the increasing trends of overweight and obesity over a period of time in Bangladesh, Nepal and India (Balarajan & Villamor, 2009), Bolivia (Perez-Cueto & Kolsteren, 2004) and the Seychelles (Bovet et al., 2008). The generalisability of two of these surveys is limited to women only (Balarajan & Villamor, 2009; Perez-Cueto & Kolsteren, 2004). However, one of the recent systematic reviews conducted by Ng et al. (2014) tried to bridge the existing gap in knowledge by assessing the global, regional and national prevalence of overweight and obesity during 1980-2013. Ng and colleagues (2014) found that the overall prevalence of overweight or obesity (BMI ≥25) has increased between 1980 and 2013 from 28.8% (95% CI: 28.4-29.3) to 36.9% (95% CI: 36.3-37.4) in men, and from 29.8% (95% CI: 29.3-30.2) to 38.0% (95% CI: 37.5-38.5) in women. The authors concluded that a substantial increase in obesity prevalence and its established health risks warrant urgent global actions to help countries to more effectively intervene in this issue. There are certain limitations of this review which need consideration while interpreting the results. Firstly, the inclusion of self-reported height and weight data along with measured data might have introduced systematic bias. Secondly, this review considered reporting national-level rates of overweight and obesity and excluded subnational studies which might have obscured important subnational variations in terms of ethnicity and socioeconomic status. Thirdly, the use of the WHO BMI cut-off points might have given the underestimated prevalence of overweight and obesity especially for the South Asian countries.

In conclusion, it can be said that the available evidence from developed and developing countries suggests that overweight and obesity is widespread regardless of the socio-economic status of the country. There is a need to take concerted action to monitor the situation and more importantly assess the effect of population-wide interventions on the prevalence of obesity.

2.3 Overweight and obesity among HCPs

Prevalence of overweight and obesity is also increasing among HCPs (Mahmood et al., 2010 & 2013; Miller et al., 2008; Zhu et al., 2011). The following sections describe the overall magnitude of overweight and obesity among HCPs.

A study conducted among American paediatricians (n=355) showed 40% of them were overweight or obese (Perrin et al., 2005). Another study conducted among American nurses (n=760) revealed that almost 54% of the participants were overweight or obese (Miller et al., 2008). The majority (53%) of the nurses reported that they were overweight but lacked the motivation to make lifestyle changes. Although both US studies used the same WHO BMI cut-off points (BMI ≥ 25) for overweight or obesity, they were not comparable in terms of gender representation. The man-to-woman percentage was 53.8% vs. 46.2% in the paediatricians' study (Perrin et al., 2005), whereas the man-to-woman percentage was 8% vs. 92% in the nurses' study (Miller et al., 2008). Jimenez-Cruz and Bacardi-Gascon (2006) conducted a study among Mexican physicians (n=138) which reported a higher (74%) proportion of physicians as either overweight or obese. A study from one of the UK hospital settings (n=409) found that 39.8% of the qualified nurses were overweight or obese (Zhu et al., 2013). Similarly, a study conducted among nurses (n=34) in Tonga reported 82.4% of the nurses were overweight or obese (Kirk et al., 2008). All of these studies have highlighted the issue of obesity among physicians and nurses and used the WHO BMI cut-off point (BMI ≥ 25) for overweight or obesity, which makes cross-comparison easier across countries.

There are certain limitations of these studies which need consideration in the interpretation of results. For example, the findings of studies conducted by Perrin and colleagues (2005) and Zhu and colleagues (2013) are based on self-reported height and weight information which is likely to provide an underestimation of obesity status as it is well known that body weight is generally under-reported and height is overestimated, which may result in a 4-8% underestimation of the prevalence of obesity (Mongeau et al., 2005). Similarly, studies conducted by Jimenez-Cruz and Bacardi-Gascon (2006) and Kirk et al. (2008) had small sample sizes, thus lacking generalisability.

Along with qualified HCPs, trainee HCPs also have an issue of overweight and obesity. A study from the Howard University, USA (n=151), collected information from undergraduate health sciences students and found that 24.3% of students were overweight and another 18.4% were obese (Adderley-Kelly, 2007). The findings were based on the actual measured height and weight of participants, but the small convenient sample, consisting solely of girls, limited the generalisability of the study. Pérusse-Lachance and colleagues (2010) collected information on lifestyle factors through an online questionnaire from undergraduate students (n= 2,490) of health sciences in Laval University (Quebec City, Canada) and found 22.9% of the students were overweight or obese. However, this study relied on self-reported height and weight information which is likely to provide an underestimated figure for obesity, as concluded earlier by Mongeau and colleagues (2005). A study from Greece collected information from third-year medical students (n=989) and reported that approximately 23% of female students and 40% of male students were overweight or obese (Bertsias et al., 2003). Similarly, Kolarzyk and colleagues (2012) assessed the nutrition and food choices of first year medical students (n=1,517) from four Central Eastern European countries (Poland, Russia, Lithuania and Belarus). They found a higher proportion of male students (22.3%) were overweight or obese compared to females (11.3%). Furthermore, overweight and obesity was more prevalent among male students from Russia (24.2%) and Poland (23.8%) as compared to male students from Lithuania (19.4%) and Belarus (18.3%).

The studies conducted among trainee HCPs have representative samples, measured actual height and weight and used the same WHO BMI cut-off point (BMI ≥ 25) for overweight or obesity, which makes cross-comparison easier across countries. At the same time, it is important to accept that obesity is a complex problem and it is difficult to comment on definite causes of the observed obesity trends across countries. The differences in dietary intake (of energy dense food such as burgers, chips, potatoes, noodles, confectionary and soft drinks, etc.) across countries, as found by Kolarzyk and colleagues (2012), may be one of the possible factors. There are other factors, such as nutritional environment, access to leisure and exercise facilities, the cultural and social norms according to which individuals live, all of which are likely to contribute to the causes of obesity (Vandenbroeck et al., 2007).

Overweight and obesity is also a growing problem in non-western countries. Numerous studies have highlighted the magnitude of the problem among trainee HCPs. A study conducted among undergraduate students of medicine, nursing, health services, management, sciences and rehabilitation (n=1,150) at the Iran University of Medical Sciences found a 12.4% prevalence of overweight and obesity with no significant differences across degree programmes (Nojomi & Najamabadi, 2006). Sawsan and Elsadig (2010) conducted a study among medical students (n=500) at the National Ribat Medical University of Sudan in the faculties of Medicine, Dentistry and Pharmacy and found a 27% (men 28.2%; women 26.5%) prevalence of overweight and obesity. However, Sawsan and Elsadig (2010) did not examine obesity status across degree programmes, which could have provided information to compare with the study from Iran (Nojomi & Najamabadi, 2006). A similar finding was reported from the United Arab Emirates (UAE) (Carter et al., 2003). According to Carter and colleagues (2003), 24% of the medical students were (BMI ≥ 25) overweight and obese. Sabra and colleagues conducted a study in King Faisal University of Dammam city in Saudi Arabia (n=159) and collected information from the College of Medicine, Parallel Medicine, Applied Medical Sciences, Dentistry, and Architecture and Planning. Their findings suggest a 47.1% prevalence of overweight and obesity. However, there was very low representation of students from Medicine (2.5%), Dentistry (3.2%), and Applied Medical Sciences (10.7%), hence researchers could not provide obesity comparisons across degree programmes, which again could have provided information to compare findings with the study from Iran (Nojomi & Najamabadi, 2006). A greater magnitude (49.4%) of overweight and obesity has also been reported among medical students of Ain Shams University, Egypt (Bakr et al., 2002). These studies highlighted the growing burden of obesity among trainee HCPs from countries in the Eastern Mediterranean region which share similar cultural, religious and dietary patterns. However, these studies do not provide enough information regarding obesity status among women trainee HCPs which needs further exploration in the future.

Studies from the Western Pacific region and South East Asian region also showed a growing burden of overweight and obesity among trainee HCPs. A study (n=240) conducted among students of a Malaysian medical school showed a 30.1% prevalence of overweight and obesity by using the WHO BMI cut-off points for the Asian population (Boo et al., 2010). A similar finding is reported by Gopalakrishnan and colleagues (2012) who collected information from (n=290) medical students of peninsular Malaysia and found 14.8% (men 13.7%; women 15.7%) of students overweight and another 21.1% obese (men 27.5%:

women 15.7%). Gopalakrishnan et al. (2012) also used the WHO BMI cut-off points for the Asian population as did an earlier study from Malaysia (Boo et al., 2010).

A study conducted by Chatchai et al. (2011) collected information from (n= 5,441) students in 13 medical schools in Thailand and found that 10.1% of students were overweight and 6.7% were obese. Additionally, Chatchai et al. (2011) examined obesity information across academic years and found an association between them. According to researchers, overweight and obesity was more likely among students who were in higher academic years than those who were in the first academic year (Chatchai et al., 2011). A similar association was revealed by Bian and colleagues (2012) who conducted a study among medical students of the Inner Mongolia Medical College of China and found that 14.3% of the students were overweight and obese. According to Bian and colleagues (2012), students in year 1 were less likely to be overweight or obese compared with students in higher years of education. However, earlier studies did not provide information in this regard (Boo et al., 2010; Gopalakrishnan et al., 2012). Chatchai and colleagues (2011) also used the WHO BMI cut-off points for the Asian population like earlier studies from Malaysia (Boo et al., 2010; Gopalakrishnan et al., 2012). In neighbouring India, Gupta and colleagues (2009) conducted a study in West Bengal and collected information from (n=114) medical students at Midnapore Medical College, Paschim Medinipur. According to Gupta et al. (2009), 20.9% of the students were overweight and obese. Contrary to the earlier studies from this region, Gupta and colleagues (2009) used the WHO BMI cut-off points (BMI ≥ 25) for overweight or obesity, which provided an underestimate of burden when compared with other studies which used South Asian BMI cut-off points (Boo et al., 2010; Chatchai et al., 2011; Gopalakrishnan et al., 2012). Table 2.3 summarises the findings of studies in terms of the prevalence of obesity, type of HCPs, sample size, response rate, the use of BMI cut-off points and nature of anthropometric measurements (measured or self-reported).

The reviewed studies have certain limitations. For example, the use of different BMI cut-off points for the assessment of overweight and obesity in studies makes it difficult to compare the burden of obesity across countries or even within a country. Future research, especially from the South Asian countries, would need to provide information based on both the criteria of overweight and obesity (BMI ≥ 23 and BMI ≥ 25) so that appropriate comparison and assessment of obesity can be made at national and international level.

Table 2.3 (a): Prevalence of overweight & obesity among HCPs

Country	Type of HCPs	Sample (n)	Response rate	Overweight & Obesity (%)	BMI cut-off points	Weight & height data	References
Belarus	Medical students	303	Not reported	12.7	≥25	Measured	Kolarzyk et al. (2012)
China	Medical students	7,156	Not reported	14.3	≥23	Self-reported	Bian et al. (2012)
Canada	Health Sciences students	2,490	Not reported	22.9	≥25	Self-reported	Perusse-Lachance et al. (2010)
Egypt	Medical students	317	Not reported	49.4	≥25	Measured	Bakr et al. (2002)
Greece	Medical students	989	98.2%	31.5	≥25	Measured	Bertsias et al. (2003)
India	Medical students	114	Not reported	20.9	≥25	Measured	Gupta et al. (2009)
Iran	Medical, nursing, health sciences students	1,150	86%	12.4	≥25	Measured	Nojomi & Najamabadi, (2006)
Lithuania	Medical students	316	Not reported	14.7	≥25	Measured	Kolarzyk et al. (2012)
Malaysia	Medical students	240	Not reported	30.1	≥23	Measured	Boo et al. (2010)
Malaysia	Medical students	290	69	35.9	≥23	Self-reported	Gopalakrishnan et al. (2012)
Mexico	Physicians	138	Not reported	74	≥25	Self-reported	Jimenez-Cruz et al. (2006)
Poland	Medical students	614	Not reported	17.4	≥25	Measured	Kolarzyk et al. (2012)
Russia	Medical students	284	Not reported	20.4	≥25	Measured	Kolarzyk et al. (2012)

Table 2.3 (b): Prevalence of overweight & obesity among HCPs

Country	Type of HCPs	Sample (n)	Response rate	Overweight & Obesity (%)	BMI cut-off points	Weight & height data	References
Saudi Arabia	Medical, dentistry, health sciences	159	77.6	47.1	≥25	Measured	Sabra et al. (2007)
Sudan	Medical, dentistry, pharmacy students	500	100	27	≥25	Measured	Sawsan & Elsadig, (2010)
Thailand	Medical students	5,441	54	16.8	≥23	Self-reported	Catchai et al. (2011)
Tonga	Nurses	34	Not reported	82.4	≥25	Measured	Kirk et al. (2008)
UK	Nurses	409	70%	39.8	≥25	Self-reported	Zhu et al. (2013)
UK	Nursing students	355	78%	22	≥25	Self-reported	Zhu et al. (2013)
US	Paediatricians	355	71%	40	≥25	Self-reported	Perrin et al. (2005)
US	Nurses	760	15.5%	54	≥25	Self-reported	Miller et al. (2008)
US	Health Sciences students	151	Not reported	42.7	≥25	Measured	Adderley-Kelly, (2007)

Similarly, different data collection approaches have been used in studies. Some have taken actual health and weight measurements (Adderley-Kelly, 2007; Bertsias et al., 2003), whereas others relied on self-reported information from participants (Perrin et al., 2005; Pérusse-Lachance et al., 2010; Zhu et al., 2013), which is prone to a biased estimate. Small and unjustified sample sizes have also been noted, which further limit the generalisability of those studies (Adderley-Kelly, 2007; Jimenez-Cruz et al., 2006; Kirk et al., 2008; Sabra et al., 2007). Most of the studies did not report response rate, which has important implications in the interpretation of their findings as larger individuals are more likely to opt out of a measurement programme and so, if the opt out is large, this may have an implication (Adderley-Kelly, 2007; Bian et al., 2012; Boo et al., 2010; Jimenez-Cruz et al., 2006; Kirk et al., 2008; Kolarzyk et al., 2012). Among those who reported, a large (15.5% to 100%) variation has been observed which made data comparison and interpretation difficult (Gopalakrishnan et al., 2012; Miller et al., 2008; Perrin et al., 2005; Sawsan & Elsadig, 2010; Zhu et al., 2013).

Moreover, there is a need to explore the issue of overweight and obesity among a wider range of trainee healthcare professionals, such as physiotherapists and pharmacists who also have an important role in the prevention of obesity. So far a majority of the studies have focused on the issue of obesity among medical students (Bian et al., 2012; Boo et al., 2010; Catchai et al., 2011; Gupta et al., 2009; Kolarzyk et al., 2012) and a few among nurses (Kirk et al., 2008; Zhu et al., 2013), dentistry and pharmacy (Sabra et al., 2007; Sawsan & Elsadig, 2010).

In conclusion, the available evidence so far from various countries suggests that HCPs (qualified as well as trainee) face the issue of overweight and obesity, which warrants prompt attention.

2.4 The situation in Pakistan

Pakistan belongs to the Eastern Mediterranean region of the WHO. Like other developing countries, the prevalence of overweight and obesity is also on the rise in Pakistan and this is true for both the general population and HCPs (Jafar et al., 2006; Mahmood et al., 2013; Mozaffer et al., 2009).

2.4.1 Prevalence of obesity among the general population

The overall prevalence of overweight and obesity (BMI ≥ 23.0) in the general population was approximately 25% according to the National Health Survey of Pakistan (NHSP-1994) (Jafar et al., 2006). This data is over 20 years old and the authors predicted a rapid rise in the prevalence of adult obesity due to changing lifestyles, urbanisation and, more importantly, due to the rise of obesity in the young population. The prediction of Jafar et al. (2006) about the increasing burden of obesity is proven correct by Aslam and colleagues (2010) who conducted a population-based study (n=2,000) in Multan, which is one of the major cities of Pakistan, and reported a higher magnitude of overweight and obesity (Aslam et al., 2010). According to the study's findings, 18.9% of the population was overweight (BMI 23.0-24.99), whereas another 27.8% was obese (BMI ≥ 25.0). The magnitude of overweight and obesity was higher in urban areas than rural, which points towards the role of urbanisation and nutritional transition. Nanan (2002) reported a 22% and 37% prevalence of obesity (BMI ≥ 25.0) among men and women from urban settings, whereas obesity was 13.5% and 14.1% among men and women from the rural areas. According to Begum and Yasmeen (2011), one of the most likely reasons for the higher burden of obesity among women in urban settings is the limited opportunities for physical or outdoor activities compared to rural settings where women are the main workforce in agriculture, which involves extensive laborious work.

The burden of overweight and obesity is also on the rise among children. Jafar and colleagues (2008) from Aga Khan University of Pakistan (with a nationally representative sample) reported a rapid rise in rates of overweight and obesity among children and adolescents in urban Pakistan. According to the researchers, an approximately twofold increase in the prevalence of overweight and obesity has been observed in the last decade, regardless of whether the WHO (from 3% to 5.5%) or the IOTF (from 2.7% to 5%) criteria were used as a reference (Jafar et al., 2008).

2.4.2 Prevalence of obesity among healthcare professionals

Like the general population, HCPs in Pakistan also suffer from overweight and obesity. Mahmood and colleagues (2010) conducted a hospital-based study[13] among postgraduate doctors and reported 31.6% and 28.2% prevalence of overweight and obesity respectively, which was higher than (25%) among the general population (Jafar et al., 2008). A number of studies have highlighted the issue of obesity among trainee HCPs in Pakistan (Chaudhry et al., 2012; Mahmood et al., 2013; Mozaffer et al., 2009; Nighat et al., 2009; Raza et al., 2010; Shaikh et al., 2011). According to studies, overweight and obesity ranged from 10% to 50% across medical institutes (Chaudhry et al., 2012; Mahmood et al., 2013; Mozaffer et al., 2009; Nighat et al., 2009; Raza et al., 2010; Shaikh et al., 2011). The scale of overweight and obesity was higher (13% to 42%) among medical students in private sector institutes (Nighat et al., 2009; Shaikh et al., 2011) as compared to those in the public sector institutes (10% to 27%). One of the possible factors may be socio-economic status. For example, students in

[13] Adjusted for SES and education.

private institutes are more likely to be of higher socio-economic status, whereas those in public sector institutes are more likely to be of middle or low socio-economic status (Chaudhry et al., 2012; Mahmood et al., 2010; Raza et al., 2010). However, no single study has recruited participants from public and private institutes and this is worth exploring in future research.

It is important to note that the majority of the studies conducted on the topic of overweight and obesity among HCPs had small sample sizes and therefore the generalisability of the findings of these studies may be limited (Mahmood et al., 2010; Mozaffer et al., 2009; Raza et al., 2011). For example, sample size was only n=117 in the study conducted by Mahmood et al. (2010). In the case of Raza et al. (2011), the study sample was limited to n=132. Similarly, Mozaffer and colleagues (2009) had only n=192 participants in their study. None of the researchers provided justification for such a small study sample and all used a convenience sampling technique. Additionally, the use of different BMI cut-off points across studies for assessment of weight status made cross-comparison difficult as some of the studies have used the BMI cut-off points (BMI ≥ 25) recommended for the white population (Chaudhry et al., 2012; Minhas et al., 2010; Nighat et al., 2009; Raza et al., 2011), whereas others have used the recommended BMI cut-off points (BMI ≥ 23) for the South Asian population (Mahmood et al., 2013; Mozaffer et al., 2009; Shaikh et al., 2011). The use of different BMI cut-off points results in wide variations in reporting studies' findings. It is also important to note that no recent representative data on overweight and obesity is available at the national level in Pakistan. The National Health Survey of Pakistan (NHSP-1994) provided the last nationally representative data and is over two decades old and even the WHO global database for the prevalence of overweight and obesity still holds the information based on this survey (Pakistan Medical Research Council, 1998). Similarly, so far no study has explored the issue of obesity among pharmacists and physiotherapists who also provide healthcare services to a wider population.

After reviewing the burden of overweight and obesity, the next section examines the association of obesity with chronic disease and the resulting economic loss to provide an estimate for policy makers on the number of lives and the amount of money that could be saved globally by reducing the impact of overweight and obesity.

2.5 Obesity, chronic disease and economic loss

There is robust evidence that obesity increases the risk for chronic diseases (Kaidar-Person et al., 2011; Malloy & Kane, 2012; Niu et al., 2013; Tillin et al., 2015). Earlier studies also demonstrate that overweight (as compared to normal) children and adolescents have a greater tendency to remain overweight in later life (Freedman et al., 2009 & 2007; Guo et al., 1999; Must & Strauss, 1999). Moreover, obesity at an earlier age increases the risk of chronic disease in later life, such as hypertension, heart diseases, stroke, type 2 diabetes, kidney diseases, osteoarthritis and different types of cancer (Biro & Wien, 2010; Gielen & Hambrecht, 2004; Guh et al., 2009; Kaidar-Person et al., 2011; Kushi et al., 2005; Lavie et al., 2009; Malloy & Kane, 2012; Niu et al., 2013; Renehan et al., 2008). Looking at its multiple adverse health effects, the Heart and Stroke Foundation of Ontario (2003) labelled obesity (fatness) as the “new tobacco”. The WHO has stated that approximately 44% of diabetes cases, 23% of cardiovascular diseases (CVDs) and 7- 41% of various cancers are attributed to overweight and obesity and these are causing approximately 2.8 million deaths per year worldwide. This makes obesity the fifth leading risk factor for global deaths (WHO, 2013).

Obesity and the resulting chronic diseases waste a significant part of a country’s total healthcare expenditure (Withrow et al., 2011). A systematic review on the economic burden of obesity conducted by Withrow and colleagues (2011) including studies from the developed countries reported that overweight and obesity are estimated to account for between 0.7% and 9.0% of a country’s total healthcare expenditure. The researchers further highlighted the fact that the medical cost of diseases among obese individuals was approximately 30% greater than for diseases among their normal weight peers. Dele et al. (2007) estimated the burden and costs of chronic diseases for 23 low- and middle-income countries. According to the authors, these countries are not only combating with infectious disease, but also contributed 50% of the total global burden of chronic diseases in the year 2005. It was estimated that these countries will have lost approximately 84 billion US dollars in economic production due to chronic diseases within ten years (2006-2015) if no intervention is applied. The prevention of overweight and obesity alone could save approximately 24 million lives and an estimated 8 billion US dollars (Dele et al., 2007). However, it is difficult to compare the costs incurred by a country in terms of obesity and chronic diseases across studies because of the inconsistent methods used for estimation and, more importantly, the variations in the delivery and financing of health services between countries.

In order to suggest and design an effective intervention, it is important to understand what leads to overweight and obesity. The following section highlights the factors contributing to overweight and obesity.

2.6 Factors contributing to overweight and obesity

The WHO (2000) has acknowledged the multi-factorial aetiology of overweight and obesity in its technical report on 'Preventing and managing the global epidemic'. According to this report, the development of obesity involves complex interactions among genes, hormones and various social and environmental factors, such as unhealthy diet and lifestyle.

Similarly, the obesity system map [Fig 2.1] developed and published by the Foresight Programme of the UK Government Office for Science shows the complex nature of obesity (Vandenbroeck et al., 2007). The map shows 108 factors which have direct or indirect links with obesity. These factors are interconnected and the (positive and negative) relationships between the factors are illustrated with more than 300 solid or dashed lines. These (108) factors are grouped under the key subsystems that need to be considered in the obesity epidemic and include an individual's biology, psychology, amount of activity, activity environment, food consumption, food production and societal influences (Vandenbroeck et al., 2007).

The report by the UK Government's Foresight Programme on 'Tackling obesities: Future choices' integrated these key subsystems and provided a holistic picture of the causes of obesity in terms of biology, early life growth pattern, an individual's behaviour, the living environment, and the economic drivers of food and drink consumption (Foresight, 2007). These themes are discussed in the following sections.

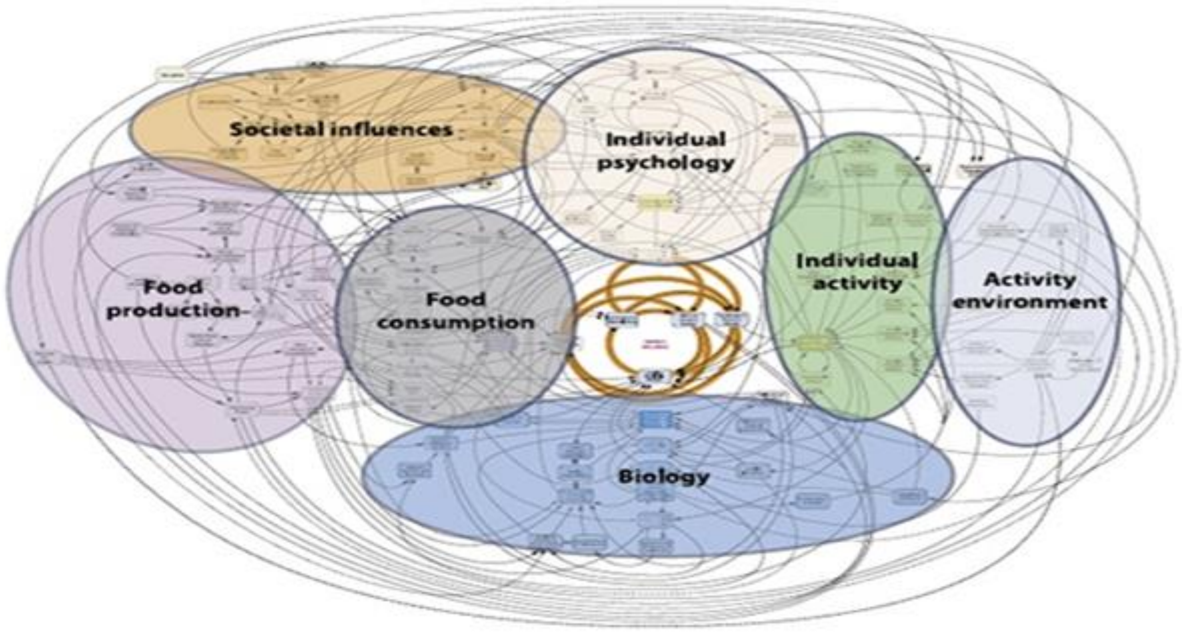

Figure 2.1: Foresight obesity map of the Foresight Programme of the UK Government Office for Science
[Figure use permitted by the UK Government Office for Science]

2.6.1 Biology

The biology of obesity is complex and, despite a century of inquiries, understanding of the causes and biological mechanisms of obesity owes much to advances in the area (Jou, 2014). A lot of research has been undertaken to determine the genetic origin of obesity, since the identification of the 'ob' gene in 1994 (Farooqi & O'Rahilly, 2007; Foresight, 2007; Robitaille et al., 2004; Song et al., 2007). Available evidence suggests that the genetic mechanisms involved in the predisposition to obesity in most of the affected individuals have more of a polygenic nature, rather than monogenic (Hinney et al., 2010). According to Hinney and colleagues (2010), polygenic variants have been confirmed in a total of 17 independent genomic regions so far and more variants are expected in future research, which reflects the complex nature of obesity.

However, analysis of the function of these genes draws attention towards the role of hormonal and neural pathways and feedback loops, especially for the leptin hormone and melanocortin system (Bloom, 2007; Farooqi & O'Rahilly, 2007; Speakman et al., 2007; Trayhurn, 2007). Figure 2.2 shows the interlinking between emotional prompts to eat, food intake and absorption. The release of gut hormones and insulin, regulating mechanisms from the hypothalamus, and how adipose tissue and muscles use nutrients for energy, are also summarised in Figure 2.2.

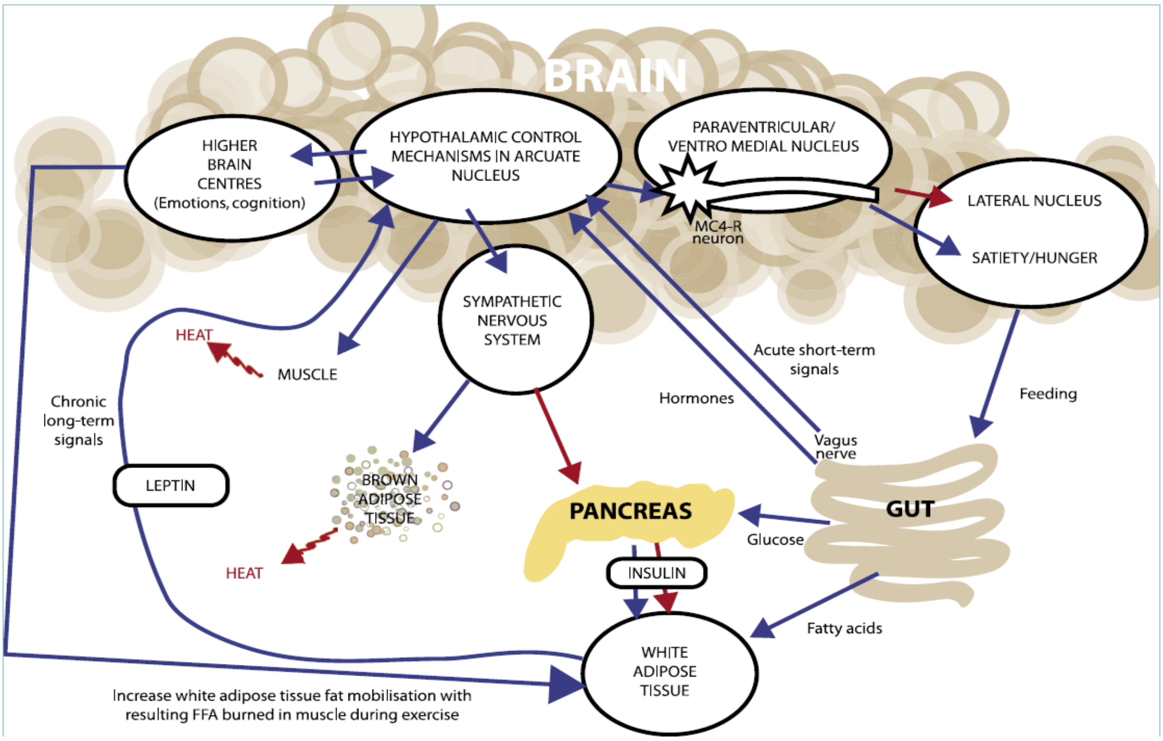

Figure 2.2: The regulation of energy balance in the human body - the complexity of appetite and weight management [Figure use permitted by the Foresight Programme of the UK Government Office for Science]

Adipose tissue plays an important role in appetite regulation through the release of the hormone 'leptin'[14] which circulates in the blood and crosses the blood-brain barrier to act centrally to increase satiety (Trayhurn, 2007). This results in the inhibition of the drive to eat, which leads to a period of negative energy balance and ultimately reduction in leptin secretion from adipose tissues (Bloom, 2007). Adipocytes also secrete multiple protein signals and factors known as 'adipokines' which have a wide diversity in terms of structure and functions, such as the proteins involved in glucose homeostasis (e.g. adiponectin), vascular homeostasis (e.g. tissue factors), growth factors and classical cytokines (e.g.TNFα, IL-6) etc. (Rajala & Scherer, 2003; Trayhurn & Wood, 2004).

In addition to neuropeptide Y, melanin-concentrating hormone and agouti-related peptide, other orexigenic systems have also been identified, such as orexin A (induces hyperphagia) and the endogenous cannabinoids (e.g. anandamide) (Harrold & Williams, 2003; Rodgers et al., 2002). Some of the peripheral signals have also received recent attention - such as ghrelin[15] and peptide YY which regulate food intake (Nakazato et al., 2001). Ghrelin stimulates food intake rather than inhibiting it. Similarly, there has been increasing support for the hypothesis that adipose tissue-derived inflammatory factors may play a causal role in the development of obesity associated pathologies, such as insulin resistance and metabolic syndrome (Bastard et al., 2000; Bullo et al., 2003; Chiellini et al., 2004; Yudkin, 2003). On the other hand, the level of adiponectin is reduced in obesity, which has been reported to have an anti-inflammatory effect (Yokota et al., 2000).

It is important to mention that research exploring the association of body fat distribution and ethnicity revealed that the South Asian population have more visceral adipose tissue than the White population, which is responsible for higher insulin resistance even at lower BMI values (Misra, 2003; Snehalatha et al., 2003). This places the Asian population at greater risk of diabetes and cardiovascular diseases (Jafar et al., 2004; McKeigue et al., 1991; Misra & Shrivastava, 2013). Sniderman and colleagues (2007) looked at the reasoning behind why the South Asian population are susceptible to central obesity and resulting atherogenic consequences and came up with an adipose tissue overflow hypothesis which needs further assessment. There is a lack of knowledge of the patterns of genetic variation, especially for South Asians, which limits the identification of disease specific genetic variants (Kooner et al., 2011). A recent genomic project (n=168) by Chambers and colleagues (2014) carried out whole genome sequencing, including whole-exome sequencing of the South Asian population, and provided deeper characterisation of coding regions. This will greatly facilitate

[14] Cytokine-like hormone which interacts with orexigenic and anorexigenic pathways in hypothalamus.

[15] A 28 amino acid polypeptide which is released from the stomach and upper small intestine.

the future research into the disease-specific genetic variants, such as obesity, diabetes and cardiovascular diseases.

Thus, the understanding of gene-environment interactions in the context of obesity is in its initial phase and needs extensive research to understand the relative importance of different metabolic pathways and their interactions within the system (Farooqi & O'Rahilly, 2007).

2.6.2 Impact of early life and growth patterns

An individual's growth pattern during his/her early life is one of the determinants of his/her future risk of obesity (Barker, 2007). According to Barker (2007), a child's growth rate in the womb and beyond is partially determined by parental factors, such as the mother's diet and what she feeds her baby. Singhal and Lanigan (2007) stated that a child's health conditions in early life are more likely to continue to have an impact on health risks in adult life, which highlights the intergenerational component of obesity.

The nutritional status of children is likely to have long-lasting consequences as it appears to set a particular developmental trajectory for them (Barker, 2007). Barker (2007) revealed an association of low birth weight with an increased risk of cardiovascular disease and diabetes. However, the direct link between birthweight and adulthood obesity could not be found (Barker, 2007). Similarly, Singhal and Lanigan (2007) found that growth rate among breast-fed babies is slower than among formula-fed babies, which is likely to reduce the risk of obesity among breast-fed babies. Although the evidence is limited and needs further research, the existing work suggests that the early years of a child's life are a critical period for healthy development.

2.6.3 Behaviour

An individual's eating and physical activity behaviours have the potential to influence the energy balance of his/her body (Foresight, 2007). According to Fox and Hillsdon (2007), an overall reduction in energy expenditure has been observed over a period of time as a result of fewer manual jobs, an increase in car ownership and an increase in the use of labour-saving devices at home and at work. Television viewing has also been identified as another sedentary behaviour which is contributing to the obesity problem (Fox & Hillsdon, 2007). Similarly, research has looked into the social and cultural context within which the food and activity-related habits of an individual develop (Maio et al., 2007; Ulijaszek, 2007). It has also been stated that social and cultural factors are likely to influence family dynamics, school policies and urban design (Wardle, 2007; White, 2007).

Social psychology research details the complexity of what motivates the individual's decisions and choices in terms of diet and physical activity (Maio et al., 2007). In daily life, we observe that there is a psychological conflict between what individuals want (such as energy dense fast food) and their willingness to be healthy and/or slim. This psychological conflict highlights other important dimensions of behaviour, such as overcoming existing habits and beliefs, the degree of control an individual has over his/her environment and, more importantly, their perceived vulnerability to risk (Maio et al., 2007). According to the Foresight (2007) report, it is important to take into consideration the wider social and cultural context of an individual's behaviours, such as organisational cultures, social processes and the media. For example, the decisions about the availability and contents of vending machines and the range of snacks in a workplace are made by organisations and therefore individuals may have little or no control over this aspect of their environment and the impact of this environment on their behaviour (Foresight, 2007).

2.6.4 The living environment

The term 'obesogenic environment' highlights the role of environmental factors in determining the energy intake and expenditure of an individual (Foresight, 2007). Swinburn and Eggar (2002), Professors of Population Nutrition and Global Health at the University of Auckland, defined an obesogenic environment as,

> *"The sum of the influences that the surroundings, opportunities or conditions of life have on promoting obesity in individuals and populations"* (Swinburn & Eggar, 2002).

Thus this term covers the entire range of cultural, social and infrastructural conditions that are likely to influence an individual's ability to adopt a healthy lifestyle (Foresight, 2007). According to Jones et al. (2007), there are certain environmental factors which may shape the availability and consumption of different foods and the levels of physical activity undertaken by populations, as a result of limiting choices.

The overall amount of physical effort is also reducing due to technological developments such as the car, computer, television and indoor games (Brock et al., 2009; Juneau et al., 2011; Poskitt, 2009). Similarly, the overall level of physical activity in terms of average walking distance has declined significantly across the world (McDonald, 2007; Ng et al., 2009; Petersen et al., 2010; Stamatakis et al., 2007). Numerous studies reveal positive associations, but it is difficult to infer a direct causal association between obesity and any single technological development (Sharpe et al., 2007). This is because of the fact that patterns of technology use are closely bound to lifestyle choices and social norms which make it difficult to rule out the part played by one kind of technology alone. Despite this limitation, Sharpe and colleagues (2007) argued that there is no reason to suppose that the direction of this trend will change in response to new technologies.

The association between supportive environment and walking habits has also been explored (Jones et al., 2007). Jones and colleagues (2007) revealed that people living in highly walk-able neighbourhoods are more active and have slightly lower body weights than people living in less walk-able neighbourhoods. This suggests the importance and application of positive environmental influences on physical activity. However, there is a need for more research to examine the relationship between environmental characteristics and overall activity levels in detail.

2.6.5 Economic drivers of food and drink consumption

A marked change in food consumption has been observed worldwide (WHO, 2000). Numerous studies have reported increased intakes of energy dense diet (high fat and sugar content), increased meat-based consumption and reduced consumption of vegetables, fruit and dietary fibre (Bleich et al., 2008; Madanat et al., 2008; Zhai et al., 2009). According to James (2008), a strong market and consumer environment encourage the use of cheaper energy dense food (James, 2008). For example, people's low earning power and the availability of a cheaper high calorie diet leave people with limited choice, which has consequently adversely affected the health of the population (Drewnowski, 2009). On the other hand, nutrient rich food (such as fruit and vegetables) is costly and thus consumed mainly by affluent groups (James, 2008). Along with pricing, a wide variety of marketing techniques are being used to increase the total sell of specific products, which include discounts, special offers, and the packaging and positioning (checkout displays) of selected products (Lobstein & Leach, 2007).

A systematic review conducted by Osei-Assibey et al. (2012) on the influences of the food environment on overweight and obesity status in children concluded that environmental exposure, especially the portion sizes, availability of sugar-sweetened beverages and food promotion campaigns have the most impact on the weight status of children. Harris and colleagues (2009) also highlighted the issue of the marketing of food and stated that an unhealthy alliance of producers and marketers is successfully promoting unhealthy energy dense foods which contribute to obesity. As a result, eating habits become more unstructured and individuals mainly take into consideration the access to and availability of food, especially from takeaways, restaurants and even from supermarkets for home consumption (Foresight, 2007). A study conducted by Mahmood and colleagues (2010) among postgraduate trainee doctors reported that 64% of the doctors were taking lunch outside home and individuals who ate food from outside home (canteen, cafeteria or restaurants) were more (odds ratio: 7.11) likely to be obese than those who brought food from home. Similar findings were reported in other studies conducted among adolescents (Mahmood et al., 2013) and young children (Thompson et al., 2004).

On the other hand, research evidence illustrates the effectiveness of food prices and taxes in modifying the consumer environment, which could result in a more lasting effect on behaviour change and ultimately on the prevalence of obesity (Andreyeva et al., 2010; Escobar et al., 2013; Thow, et al., 2014). According to a recent systematic review conducted by Thow et al. (2014), 1.8% to 50% subsidies on healthy food (e.g. fruit and vegetables) increased the consumption of these targeted foods by at least half the amount of the tax applied. Similarly, 5% to 30% taxes on sugar-sweetened beverages demonstrated a 5% to 48% reduction in the consumption of these products. Thus, subsidies and taxes are an effective way to improve the consumption patterns associated with overweight and obesity (Thow et al., 2014).

In conclusion, the review of factors associated with overweight and obesity has shown that the issue of overweight and obesity is complex. Multiple factors contribute towards obesity, including biology, early life growth pattern, the pattern of food consumption at an individual level, food production and availability in the market, economic drivers for food (e.g. subsidies and taxes) and access to an environment that promotes physical activity.

2.7 Obesity and weight stigmatisation

Weight stigma is found to be associated with overweight and obesity and it is important to note that weight stigma is not a beneficial public health tool for the prevention of obesity. Instead, it threatens the health of obese individuals, generates health disparities, and even interferes with effective obesity interventions (Puhl & Heuer, 2010). Weight stigmatisation, weight bias and weightism are interchangeable terms used for weight-based discrimination. According to Dr Washington, the chief medical officer, Rocky Mountain Hospital for Children, University of Colorado School of Medicine US,

> *"Weight bias is the inclination to form unreasonable judgments based on a person's weight whereas stigma is the social sign that is carried by a person who is a victim of prejudice and weight bias"* (Washington, 2011).

Weight stigma among overweight individuals is frequently observed in educational settings, employment settings, the media, interpersonal relationships, and even in healthcare settings (Puhl & Heuer, 2010). People believe that weight stigmatisation motivates overweight and obese individuals to adopt a healthy diet and lifestyle (Averett & Korenman, 1999; Hebl & Heatherton, 1998). However, Puhl and Heuer (2010) argued that, if weight stigma is a motivator for weight loss, then the increasing prevalence of weight stigmatisation should have reduced the amount of overweight and obesity over the past several decades, rather than increasing it.

Similarly, Schwartz and Brownell (2007) stated that stigma may worsen the problem of overweight and obesity through mechanisms such as fear of going out, fear of being laughed at while exercising, repetitive emotional eating and consequently development of eating disorders. A number of other studies have also demonstrated that weight stigmatisation among overweight and obese individuals led to a lower level of physical activity, and negative attitudes about sports activities (Bauer et al., 2004; Storch et al., 2007). Studies also reported frequent binge eating among overweight individuals who experienced weight stigma (Ashmore et al., 2008; Faith et al., 2002).

Evidence suggests that weight stigma is not helpful in the prevention of obesity. Instead, it adversely affects the health of obese individuals and negatively interferes with obesity interventions. The following sections describe the public health strategies suggested for the prevention of overweight and obesity.

2.8 Public health strategies for the prevention of overweight and obesity

The complex nature of obesity demands appropriate and comprehensive public health strategies for the prevention of obesity. Chan and Woo (2010) emphasised the importance of targeting factors contributing to overweight and obesity in the development and implementation of obesity prevention strategies. According to Sacks and colleagues (2009), such public health interventions should (i) target food, physical activity and socio-economic environment, (ii) support clinical and supportive health services and (iii) target individual behaviours. The following sections provide further detail in this regard.

2.8.1 Food, physical activity and socio-economic environment

Food, physical activity and the socio-economic environment of an individual play an important role in maintaining healthy weight (Sacks et al., 2009). It is important at the policy level to provide individuals with easier healthy dietary choices along with a supportive physical activity environment to minimise sedentary lifestyles. This includes fiscal food policies[16], implementation of nutritional advice and bans on the advertising and marketing of unhealthy foods (Sacks et al., 2009). A study conducted by Jeffery and colleagues (1994) on food buying behaviour found that half-price food offers and increased healthy food (fruit and salad) varieties tripled food consumption. Food consumption returned to its original level after resuming normal prices. Jeffery (2001) concluded that food buying behaviour is markedly influenced by food prices. On the other hand, the goal of the food industry is to maximise profit, which does not match the objectives of public health measures for the prevention of obesity which need to be addressed through policy (Ludwig & Nestle, 2008).

[16] The use of government revenue collection (taxation) and expenditure (spending) to influence the economy (Arthur & Sheffrin, 2003).

Similarly, the review by Sallis and Glanz (2009) stated that provision of a supportive physical environment - such as playgrounds and parks - is consistently associated with higher physical activity levels. From the economic perspective, Sacks and Glanz (2009) highlighted that little attention has been given to trade agreements, income tax regimes and social security areas and need alteration at the national and international level to support efforts for obesity prevention. Drewnowski (2009) emphasised the need to reduce social and economic inequalities through policies in order to address the issue of obesity.

2.8.2 Provision of clinical and support health services

Certain barriers to the effective management of obesity have been identified at physician as well as at patient level (Jones et al., 2007; MacLean et al., 2009; Villagra, 2009). Physicians do not have enough time to address the issue of obesity and, more importantly, they lack training for the management of obese patients (Frank, 1998; Villagra, 2009). At patient level, weight stigmatisation, difficulty in accessing weight management services and lack of financial incentives were the main barriers to effective obesity management (Jones et al., 2007; MacLean et al., 2009; Villagra, 2004).

2.8.3 Targeting individual behaviours

Targeting individual behaviours in terms of diet and lifestyle modification is an effective way of preventing obesity. According to Sacks and colleagues (2009), home environment, school, community and the workplace are the key settings to influence the eating and physical activity behaviours of individuals. The review by Katz and colleagues (2008) concluded that school-based interventions are effective in preventing obesity and schools are an attractive setting for promoting positive health behaviours. In the home, parents have a responsibility as the role model for healthy eating along with providing healthy homemade food, serving individual food portions, eating at regular mealtimes and setting down family rules to limit television viewing, especially whilst eating (Golan & Weizman, 2001; van Zutphen et al., 2007). Similarly, cafeterias, restaurants, workplaces and supermarkets need to provide healthy food options, good food quality and portion sizes along with nutrition information at the point of choice (Sallis & Glanz, 2009).

In conclusion, public health strategies for the prevention of overweight and obesity need a comprehensive approach to obesity policy action that is strategic and systematic and must target the underlying determinants of health. It is therefore important to incorporate different public health approaches which include policies that (i) target the food and physical activity environments which would make healthy eating and physical activity choices easier, (ii) ensures provision of clinical and support health services and (iii) target population behaviours in terms of diet and lifestyle modification.

The next section focuses on individual behaviour change, in particular the various learning theories that have been used for the modification of individuals' attitudes and behaviour.

2.9 Learning theories

Learning is a complex and lifelong process (Bastable et al., 2011). Numerous theories are available on how leaning occurs and what encourages an individual to learn (Hilgard & Bower, 1966; Ormrod, 2004). These theories have multiple implications at the individual, group and community levels for the purposes of teaching, solving problems, modifying diet and lifestyle, modifying attitude and behaviours and building positive (doctor-patient) interpersonal relationships (Bastable et al., 2011). The most commonly used learning theories include behaviourist learning theory, cognitive learning theory, social learning theory, psychodynamic learning theory, humanist learning theory, modelling and role-modelling theory and the behaviour change models. The following sections critically evaluate these theories and explore the most relevant theory which has application in terms of the accurate estimation of body weight.

2.9.1 Behaviourist learning theory

According to this theory, learning is the product of stimulating conditions (S) and the reactions or responses (R) that follow. It is also termed as 'the S-R model of learning'. This theory mainly focuses on what is directly observable and ignores what goes on inside the individual which is difficult to measure. In order to change the attitudes and responses of individuals, behaviourists either modify the stimulus conditions in the respective environment or modify what happens after a response takes place. This theory is easy to apply and has an objective and clear analysis of observable outcomes in the form of individuals' actions and attitudes (Bastable et al., 2011).

However, it has been criticised because (i) it is a teacher-centred model (the learner is passive and being manipulated), (ii) the emphasis is on external rewards and incentives rather than taking the self-initiative, (iii) evidence arises mainly from animal models, and (iv) individuals' changed behaviour may deteriorate with the passage of time. This theory is commonly used in combination with other theories, e.g. cognitive theory (Bush, 2006; Dai & Sternberg, 2004).

2.9.2 Cognitive learning theory

Contrary to behaviour theory, cognitive theory pays special attention to the internal learning processes of an individual, assuming that this is the key to learning and cognition, e.g. memory, thought, perception, ways of structuring and processing the information (Bastable et al., 2011). According to this theory, learning is an active process which is directed by the learner, and involves the perception of information, its interpretation on the basis of previous experience and the rearrangement of the information according to new situations (Bandura, 2001; Hunt & Ellis, 2004).

The major advantage of this theory to healthcare is its recognition and appreciation of individual responsibility and the diverse ways individuals learn and process different experiences. This has resulted in the successful implementation of different interventions in healthcare (Papadakis, 2006). The main criticism of this theory is that it is difficult for the educator to fully understand what is inside the mind of an individual and then design learning activities accordingly to encourage people to restructure their own perceptions, thinking, attitude, behaviours and emotions and come up with solutions (Bastable et al., 2011).

2.9.3 Social learning theory

Social learning theory is mainly the work of Bandura (1977) who brought together the personal characteristics of the learner, behaviour patterns and the environment into a learning perspective. This theory has been applied generally in the field of crime and criminality to explain a diverse array of criminal behaviours (Akers & Sellers, 2004). This theory is best summarised by Ronald L. Akers, one of its leading proponents,

> *"The probability that persons will engage in criminal and deviant behaviour is increased and the probability of their conforming to the norm is decreased when they differentially associate with others who commit criminal behaviour and espouse definitions favourable to it, are relatively more exposed in-person or symbolically to salient criminal/deviant models, define it as desirable or justified in a situation discriminative for the behavior, and have received in the past and anticipate in the current or future situation relatively greater reward than punishment for the behaviour"* (Akers, 1998, p. 50).

The major criticism of this theory concerns its principal concept which states that friends, colleagues or family members contribute to the individual's learning and subsequent acceptance of deviant conduct. Siegel and McCormick (2006) argued that young individuals likely to develop these deviant attitudes and values without prior exposure to it then look for friends and colleagues with similar attitudes and behaviours, thus the problem is one of temporal association.

2.9.4 Psychodynamic learning theory

This theory is not generally considered a learning theory. However, a couple of its constructs have implications for learning and changing behaviour. For example, conscious and unconscious forces are the central concept of this theory which mainly guides behaviours, attitudes and personality conflict (Hilgard & Bower, 1966; Slipp, 2000).

The psychodynamic approach reminds healthcare professionals to pay attention to emotions, unconscious motivations, and the psychological growth and development of all individuals involved in healthcare (Pullen, 2002). It is well suited to understanding patient and family noncompliance, the anxieties of working with long-term psychiatric residents, trauma and loss (Duberstein & Masling, 2000; Goodwin & Gore, 2000; Menahern & Halasz, 2000).

Psychodynamic theory has been criticised for being difficult to put into practice and measure and because of subjective and speculative analysis (Braungart, 2007). According to Braungart (2007), it is not recommended that health professionals with little or no psychiatric training probe into the personal lives of patients.

2.9.5 Humanist learning theory

The underlying assumption of this theory is that every individual has unique characteristics and all individuals have a desire (Bastable et al., 2011). According to Bastable et al. (2011), some of society's expectations and values (e.g. women are more emotional than men, making money is more important than taking care of people) may damage positive psychological growth. The underlying concept of humanist theory is the realisation of the importance of feelings, emotions, the right of a person to make their own choices, and human creativity in the context of learning (Rogers, 1994; Snowman & Biehler, 2006).

Motivation is the core of this theory which results from personal needs, subjective feelings about the self and a personal desire to grow. According to Rogers (1994), the role of the educator should be as a facilitator rather than leader and listening is the main skill required rather than talking. It is the learner not the educator who chooses what is to be learned and the educator serves as a resource person within that framework, hence it is termed a learner-directed approach (Snowman & Biehler, 2006).

In professional education - e.g. medicine or nursing - the aim is to provide safe classrooms and clinical settings, and apply the humanist principles through role modelling, caring, case discussions, small group discussion, role-playing and videotaping (Biderman, 2003). Students in such an environment should follow-up with feedback and reflection and providing time for student reflection is essential. Feedback from the instructor is recommended to be sensitive and thoughtful (Fryer-Edwards, 2006). The major criticism of the theory is that it is promotes self-centred learning and some of its claims have not been proven by research yet (Bastable et al., 2011).

2.9.6 Modelling and role-modelling theory

This theory was laid down by nursing theorists in 1983. According to Erickson (1983), modelling refers to the process of an understanding of the client's world. In practice, a nurse tries to acquire knowledge and understanding of a patient's life, and norms, and appreciate its importance from his/her perspective. Role modelling refers to the process by which the nurse takes care of an individual in terms of attaining, maintaining and promoting health. The important thing is that role modelling accepts the client unconditionally by accepting that the client (patient) is an expert and knows best about his/her needs and the way he/she may be helped. The limitation of this theory is that it is based on nursing concepts which make it generalisable for the professional nursing practice only (Schultz, 2004).

2.9.7 Trans-theoretical model of change (TTM)

The trans-theoretical model of change (TTM) is also known as the "stages of change model" (Greene, 1999). It is the most commonly used behaviour change model in physical activity and nutrition research (Nutbeam & Harris, 2004), although it has faced some criticism (Armitage, 2009a). This model was initially developed in 1977 based on an analysis of different theories of psychotherapy (Prochaska & Norcross, 2010). Thereafter, certain modifications were made to the model on the basis of research (DiClemente, 1985; McConnaughy, 1983; Prochaska, 2001; Prochaska & DiClemente, 1983).

According to the TTM of change, an important step in addressing any problem is first recognising that it is a problem. An individual's perception of their risk and their willingness to change play a crucial role in an effective intervention (Prochaska & Velicer, 1997). An individual will only adopt a behavioural change when they feel that there is a "need to change", i.e. when they think that they are open to possible risk (Bhanji et al., 2011; Maximova et al., 2008; Robert, 2005). In the case of obesity, if there is a discrepancy between actual and perceived weight, then the individual is less likely to be involved in appropriate weight-related behaviours (Alwan et al., 2011; Lynch et al., 2009).

The trans-theoretical model (TTM) of change evaluates an individual's willingness to follow a new, healthier behaviour and provides appropriate strategies to guide an individual through the stages to action and maintenance. According to the TTM of change, health behaviour change is a staged process and has four main constructs: (i) stages of change (ii) process of change (iii) decisional balance (iv) self-efficacy (Prochaska & Velicer, 1997).

The TTM of change is applicable in cases of underestimation of body weight because individuals will not change their behaviour until they feel that there is a need to change. Therefore, the TTM of change is considered in more detail in the following sections.

(i) Stages of change

There are the following stages of change in the TTM.

Pre-contemplation (not ready): Individuals in this stage are unaware of their problematic behaviour and it is less likely they will take any action.

Contemplation (getting ready): Individuals become aware of their problematic behaviour and start thinking about the positive and negative aspects of their attitude.

Preparation (ready): In this stage individuals are positive and thinking about small actions to modify their behaviour accordingly.

Action: Individuals in this stage take appropriate action and modify their behaviours.

Maintenance: Individuals in this stage try to keep themselves on track so that they do not return to their previous behaviour. This stage may last indefinitely.

Termination: Individuals in this stage are confident that they will not adopt their previous unhealthy attitude.

It is assumed by researchers that "relapse" is not a stage but a process and individuals may go back to maintenance, action or to an earlier stage.

(ii) Process of change

There are numerous processes of change (activities) which people use in order to move from one stage to another (Prochaska & Velicer, 1997). Individuals usually use a cognitive, affective and evaluative process when going through early stages, whereas they depend mostly on commitments, conditioning, contingencies, environmental control and support when going through maintenance and/or termination stages (Prochaska et al., 2008). According to Prochaska and colleagues (2008), there are ten processes which include:

Consciousness raising: Increasing awareness through education, information and personal feedback regarding the healthy behaviour.

Dramatic relief: Feeling fear, anxiety, or worry because of the unhealthy behaviour, or feeling inspiration and hope when they hear about how people are able to change to healthy behaviours.

Self-re-evaluation: Realising that the healthy behaviour is an important part of who they are and what they want to be.

Environmental re-evaluation: Realising how their unhealthy behaviour affects others and how they could have more positive effects by changing.

Social liberation: Realising that society is more supportive of the healthy behaviour.

Self-liberation: Believing in one's ability to change and making commitments and recommitments to act on that belief.

Helping relationships: Finding people who are supportive of their change.

Counter conditioning: Substituting healthy ways of acting and thinking for unhealthy ways.

Reinforcement management: Increasing the rewards that come from positive behaviour and reducing those come from negative behaviour.

Stimulus control: Using reminders and cues that encourage healthy behaviour as substitutes for those that encourage the unhealthy behaviour.

(iii) Decisional balance

This construct defines how much weight an individual gives to the pros and cons of changing (Prochaska, 1997). The balance between gains and losses depends upon the stage of change that the individual is going through. According to research conducted by TTM researchers across 48 behaviours and over 100 populations, they found the following relationship between pros, cons and stage of change (Hall & Rossi, 2008):

(a) In the pre-contemplation stage, the cons of changing outweigh the pros.
(b) In the middle stages, the pros and cons remain the same.
(c) In the action stage, the pros outweigh the cons.

(iv) Self-efficacy

Self-efficacy defines the self-confidence of individuals such that they can deal with certain high risk situations on their own and they are sure they will not go back to their unhealthy behaviour (Prochaska & Velicer, 1997).

Although the TTM of change is arguably the dominant model of health behaviour change, it has received criticism (Armitage, 2009a; Mastellos et al., 2014). Stages of change are the only components of the TTM which have been the target of criticism (Littell & Girvin, 2002; Weinstein et al., 1998). According to Armitage (2009a), there are only five experimental studies which have assessed the advantages/disadvantages of stage matching. Two of the studies supported stage matching (Dijkstra et al., 1998 & 2006), one study revealed the disadvantages of stage matching (Quinlan & McCaul, 2000), whereas two of the studies did not find any difference between matching and non-matching of stages (Blissmer & McAuley, 2002; de Vet et al., 2008). According to Armitage (2009a), the evidence is still inconclusive as to whether the stages of change possess concurrent validity or not and more studies of this kind are required. Similarly, a recent systematic review by Mastellos and colleagues (2014) also explored the use of the TTM of change in weight loss interventions and found only three studies. Based on available evidence, Mastellos et al. (2014) concluded that the evidence to support the use of the TTM of change is limited because of risk of bias and precision and emphasised the need for well-designed RCTs which would apply the principles of the TTM of change appropriately and offer conclusive evidence about the effectiveness of the model in terms of weight loss interventions.

It is important to note that such criticisms should not divert attention away from the more useful avenues of research based on the model. For example, there are studies which successfully utilise the processes of change to reduce alcohol consumption (Armitage, 2009b), encourage smoking cessation (Armitage, 2008) and increase physical activity (Armitage & Arden, 2008) and so offer a platform for future research.

When examining the issue of obesity in terms of the TTM of change, overweight and obese individuals should recognise their overweight status without which it is less likely that they will think about any intervention (Alwan et al., 2011; Lynch et al., 2009; Wang et al., 2009). There is evidence to suggest that overweight and obese individuals do not recognise their overweight status and underestimate their body weight (Bhanji et al., 2011; Howard et al., 2008; Rahman & Berenson, 2010). Similarly, research demonstrates that overweight and obese individuals who underestimate their weight are more likely to gain weight (0.31kg/m^2 per annum), while those who accurately know their overweight status are likely to lose weight (0.09 kg/m^2 per annum) (Alwan et al., 2011).

This section has presented information about various learning theories which have been used for the modification of individuals' attitudes and behaviour. More information was given about the TTM of change as it is the most relevant theory to the current study and has applications in terms of the underestimation of body weight.

2.10 Summary

- Obesity is an epidemic both in developed and developing countries
- HCPs are gaining weight like the general population and they are not good role models for their patients in terms of healthy weight. Some may argue that being overweight, HCPs could empathise with their patients' (overweight) condition and patients might feel comfortable in discussing the obesity issue. However, the available evidence does not support this notion (Feller & Hatch, 2004; Foster et al., 2003; Hash et al., 2003; Puhl et al., 2013; Warner et al., 2008).
- Obesity increases the risk of chronic diseases such as diabetes and cardiovascular disease which account for up to 9% of a country's total healthcare expenditure
- Overweight and obesity have a multi-factorial aetiology which involves complex interaction among genes, hormones and various social and environmental factors such as unhealthy diet and lifestyle
- Weight stigma is not a beneficial public health tool for the prevention of obesity. Instead, it threatens the health of obese individuals, generates health disparities and even interferes with effective obesity interventions
- The complex nature of obesity demands appropriate and comprehensive public health strategies for the prevention of obesity
- When examining the issue of obesity in terms of the TTM of change, overweight and obese individuals should recognise their overweight status without which it is less likely that they will think about any intervention
- Studies conducted on the topic of overweight and obesity among HCPs in Pakistan used inconsistent BMI cut-off points for assessment of weight status. Some researchers used the BMI cut-off points ≥ 25 while others used the BMI cut-off points ≥ 23 for labelling participants as overweight and obese, which makes it difficult to compare the scale of obesity across studies. It would be useful if future studies on the topic of obesity could analyse and report their findings by using both BMI cut-off points' criteria. This would enable future research to compare their findings nationally and internationally.

Chapter 3: Underestimation of body weight among healthcare professionals - A systematic review

3.1 Introduction

The aims of this chapter are to present a systematic review of the literature for the prevalence of underestimation of body weight among healthcare professionals and its impact on their practice. The PRISMA checklist was used as a guide to avoid missing out important information in compiling systematic review (Moher et al., 2009). This chapter also presents the literature around factors associated with underestimation of body weight.

3.2 Underestimation of body weight among healthcare professionals and its impact on their practice: A systematic review

3.2.1 Background

While the prevalence of obesity has increased in the last two decades, a number of studies from different countries (e.g. Australia, Canada, China, Malaysia, Mexico, UK, US) have highlighted the growing issue of underestimation of body weight among the general population (EASO, 2015; Johnson et al., 2008; Khor et al., 2009; Linder et al., 2010; Madrigal et al., 2000; Vandelanotte et al., 2011; Xu et al., 2011; Yaemsiri et al., 2011). For example a recent survey conducted by the European Association for the Study of Obesity across seven European countries (Belgium, Denmark, Finland, France, Germany, Italy, and the UK) highlighted the important issue of underestimation of body weight among the general population and reported that three quarters of the obese individuals described themselves as simply 'overweight' and a third of overweight individuals thought their weight was 'normal'. In terms of the TTM of change, it is less likely that these overweight and obese individuals will think about any intervention for reducing weight without recognising their overweight status (Alwan et al., 2011; Lynch et al., 2009; Wang et al., 2009). This places an additional responsibility on healthcare professionals who are in an ideal position to take steps to remedy such underestimations regarding weight (Lundahl et al., 2014).

However, the evidence regarding the growing burden of overweight and obesity among HCPs in the previous chapter (Section 2.3) suggests that they are not setting an example for their patients with regard to healthy weight. If HCPs are to be good role models in terms of healthy weight, there is a need to understand what contributes to, and how to help them in addressing, their weight issue. One reason may be that overweight and obese HCPs also underestimate their body weight like the general population, which might not only make them fail to take appropriate measures to reduce their own weight, but might also affect their professional practice and approach towards overweight patients. Therefore, it is worthwhile to explore this issue in detail to gain a better insight into the problem in order to suggest appropriate measures.

3.2.2 Objectives

The objectives of this review are:

1. To explore the studies with the primary aim of estimating the prevalence of underestimation of body weight among healthcare professionals
2. To explore the studies with the primary aim of assessing the impact of healthcare professionals' underestimation of their own weight on their practice

3.2.3 Selection criteria

Type of population:

The focus of the review was on healthcare professionals, which included doctors, dentists, pharmacists, physiotherapists and nurses. Healthcare staffs - such as administrators, technicians, phlebotomists and manual workers - were not considered. However, no restriction was applied during the initial literature search for population. Similarly, no restriction was made based on ethnicity or geographical location.

Type of outcome measure:

For objective 1: The outcome variable was 'underestimation of body weight' which occurred when HCPs' perceived weight status was less than their actual BMI weight status. No restriction was applied in terms of outcome assessment, whether the assessment was based on actual or self-reported height and weight data or it was based on individuals' responses on the Likert scale or given body image. Similarly, no restriction was applied based on the BMI criteria being used.

For objective 2: The outcome variable was 'impact on HCPs' practice' which included weight screening, diagnosis, counselling, treatment or management. No restriction was applied during the literature search.

Design of studies:

For objective 1: Prevalence, burden or magnitude of underestimation of body weight were expected to be reported in surveys or cross-sectional studies

For objective 2: Impact of HCPs' underestimation of their own weight on their practice was expected to be reported in cross-sectional analytical studies, prospective cohort studies or qualitative studies.

However, no restriction was applied in terms of qualitative or quantitative study design during the literature search for either objective.

Language: English only

Nature of literature: Published only

3.2.4 Search strategies for identification of studies

Separate searches were carried out for objective 1 and objective 2 with guidance and input from an information scientist from ScHARR, University of Sheffield.

Search terms:

For objective 1: Different search terms were used in various combinations which included: healthcare professional*[17], health personnel, physician*, doctor*, nurse*, physiotherapist*, pharmacist*, dentist*, underestimat*, perception*, misperception*, weight perception*, self-estimat*, self-report*, obesity, overweight, body weight, prevalence, burden, magnitude, estimate*.

For objective 2: Slightly different search terms were used this time with various combinations which included: healthcare professional*, health personnel, physician*, doctor*, nurse*, physiotherapist*, pharmacist*, dentist*, estimate*, underestimat*, perception*, misperception*, weight perception*, self-estimat*, self-report*, obesity, overweight, body weight, impact*, effect*, practice*, counsel*.

Searching engine and databases:

The search was carried out on Medline via OvidSP (1946 to April 30, 2015), PsychINFO via OvidSP (1967 to April 30, 2015), Embase via OvidSP (1974 to April 30, 2015) and CINAHL via EBSCO (1996 to April 30, 2015). The starting date for each database was set as default. These are the major bibliographic databases of medicine, life sciences, pharmacology, psychology and biomedical information which contain articles from academic journals covering medicine, nursing, pharmacy, dentistry and healthcare. Along with this, a search of the reference lists of all included studies was conducted.

[17] * Asterisk symbol shows search engine considered this term for singular and plural both words.

The purpose of conducting the literature search on multiple databases was to cover content from medicine as well as from other allied health sciences as our target population was broad (doctors, nurses, dentists, pharmacists and physiotherapists), though overlapping of information and published articles was expected across databases.

Summaries of search strategies for objective 1 and objective 2 on respective databases (Medline, PsychINFO, Embase and CINAHL) are shown in Appendix 1 and Appendix 2 respectively.

3.2.5 Methods of the review

Selection of studies:

All potential relevant studies were explored by using the above mentioned search terms in different combinations on Medline, PsychINFO, Embase and CINAHL. Studies selected for inclusion in this review met the following criteria.

- Focus of the study was on any of the healthcare professionals which included doctors, dentists, pharmacists, physiotherapists and nurses
- The outcome variable was underestimation of body weight or at least reported information regarding underestimation of body weight as a categorical variable OR
- Assessed the impact of healthcare professionals' underestimation of their own body weight on their practice i.e. management, screening, diagnosis, counselling or treatment of overweight/obesity among patients
- Be published in English only

The inclusion criteria were not restricted by types of studies, method of outcome assessment, ethnicity, or geographical location. Studies were excluded if:

- The data or information regarding underestimation of body weight were not explicitly reported or it was impossible to retrieve the required information from the given information
- The data or information on healthcare professionals were not reported independently, but were for example mixed with data from other hospital staff (e.g. technician, midwives, general employees, manual workers)

The studies singled out were checked for duplication. Thereafter, the titles of all identified studies were read for relevance. If the title of a study was found to be relevant then an abstract was read to check the objectives of the respective study and its relevance to the current review’s questions. After reading abstracts, full text articles were read to check if studies met the selection criteria of the review or not. Studies which met the selection criteria were considered for final review.

Quality assessment:

Various tools are available for the quality assessment of studies, such as “Users’ guides to the medical literature” by Guyatt et al. (1994) and a tool given by the Critical Appraisal Skills Programme (CASP, 2013). However, the methodological quality assessment of included studies was carried out by using the tool given by STROBE which is an international, collaborative initiative of epidemiologists, methodologists, statisticians, researchers and journal editors involved in the conduct and dissemination of observational studies with the common aim of STrengthening the Reporting of OBservational studies in Epidemiology (von-Elm et al., 2008).

This provides a detailed and focused checklist of items specifically for cross-sectional studies as compared to other available resources and includes the title, abstract, objectives, study design, setting, population, sample size, power calculation, description of variables, methods of measurement, adjustment for bias, statistical analysis, response rate, descriptive and inferential data analysis, adjustment of confounders, discussion of the limitations and the generalisability of results and reporting of funding source.

Extraction of data:

A structured data extraction form was designed specifically to extract information from the included studies for title, author, year of publication, journal, study’s objectives, study design, study setting, study population, gender, sample size, power calculation, response rate, any efforts to reduce source of bias, outcome, method of outcome assessment, BMI cut-off points used for overweight and obesity, results, generalisability, and reporting of source of funding (Appendix 3).

Data analysis:

Narrative data synthesis was carried out to describe the magnitude of underestimation of body weight among HCPs. However, meta-analysis could not be performed as there was heterogeneity among studies in terms of population (paediatricians, physicians, qualified and student nurses), sample size (smallest n= 34, largest n=409), sampling technique, response rate (71% to 100%) and variations in methods of outcome assessment (actual or self-reported height and weight data, individuals’ response on Likert scale or body image).

Similarly, narrative data synthesis was carried out to assess the impact of healthcare professionals' underestimation of their own weight on their practice as only one relevant study was found.

3.2.6 Description of studies

For objective 1: The numbers of citations identified from Medline, PsychINFO, Embase and CINAHL were 53, 28, 326 and 10 respectively. Additionally, nine more studies were revealed from secondary references. Hence the total number of citations was 426. After removal of 29 duplicate studies, the number of studies was reduced to 397. The titles of the remaining studies were read for relevance, which excluded a further 381 irrelevant studies which were not in accordance especially in terms of underestimation of body weight. Another 11 studies were excluded after reading abstracts because of objectives which were not in accordance with the current review. Thereafter, five of the studies were given a full text reading to check the inclusion criteria of the review, which resulted in the dropping of another study (Dorosty et al., 2014) because the researchers provided the overall statistics of misperception of body weight with no explicit information on underestimation of body weight. Similarly, it was not possible to differentiate information for physicians/dentists/pharmacists from other healthcare workers, e.g. technicians, midwives, manual workers and general employees. Finally, four studies were included in the review (Jimenez-Cruz & Bacardi-1ascon, 2006; Kirk et al., 2008; Perrin et al., 2005; Zhu et al., 2013). Prisma flow diagram 1 shows the summary measures of the studies selection process for objective 1.

For objective 2: The numbers of citations identified from Medline, PsychINFO, Embase and CINAHL were 150, 54, 581 and 33 respectively. Additionally, four more studies were revealed from secondary references. Hence the total number of citations was 822. After removal of 67 duplicate studies, the number of studies was reduced to 755. The titles of the remaining studies were read for relevance, which excluded a further 732 irrelevant studies which were not in accordance especially in terms of healthcare professionals' underestimation of their own body weight and its impact on their practice. Another 22 studies were excluded after reading abstracts because their objectives were not in accordance with the current review. Thereafter, one of the studies was given a full text reading which met the inclusion criteria of the review and finally included in the review (Perrin et al., 2005). Prisma flow diagram 2 shows summary measures of the studies selection process for objective 2.

Diagram 1: The studies selection process for underestimation of body weight among HCPs

Prisma Flow Diagram

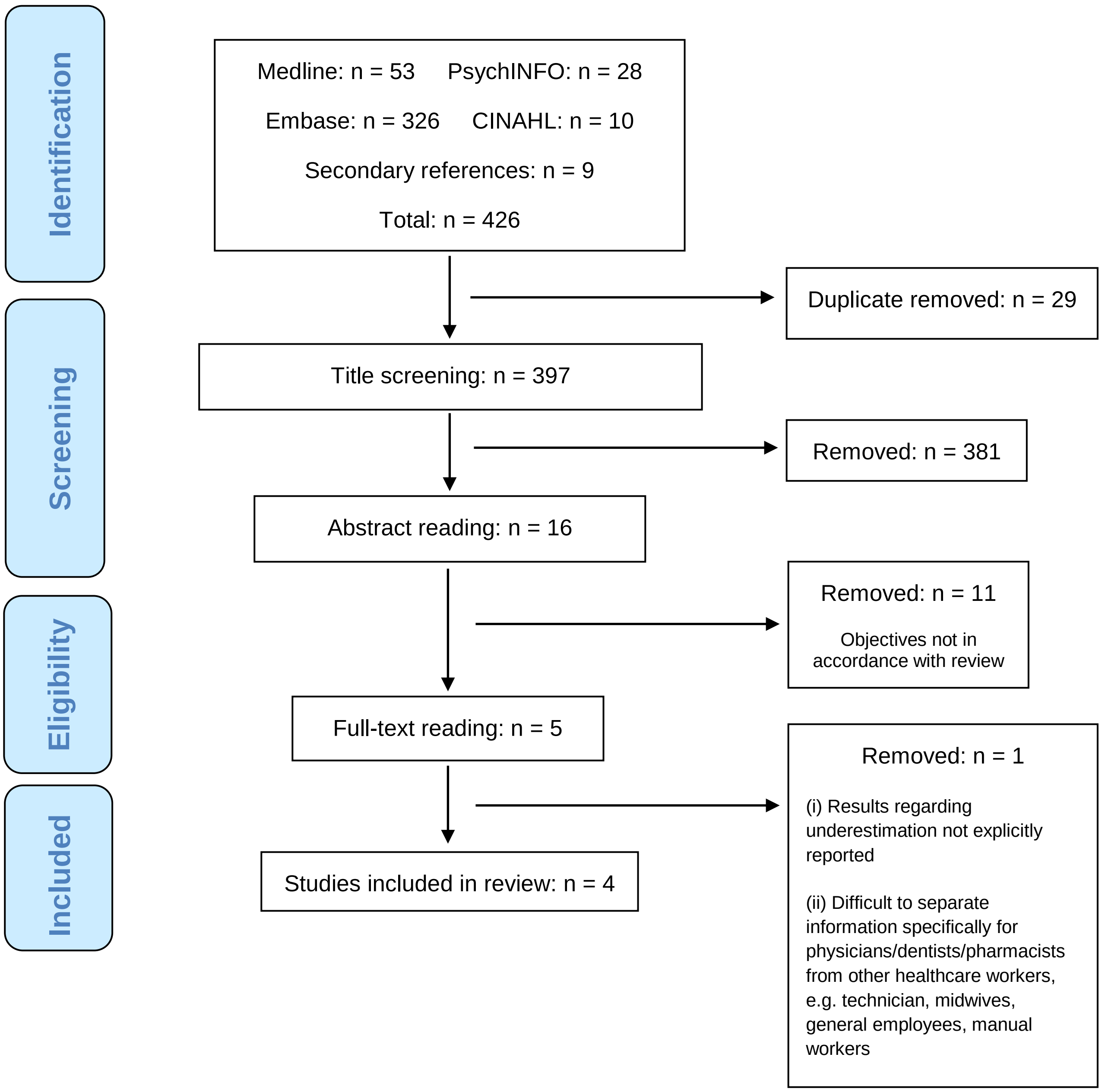

Diagram 2: The studies selection process for the impact of healthcare professionals' underestimation of their own body weight on their practice

Prisma Flow Diagram

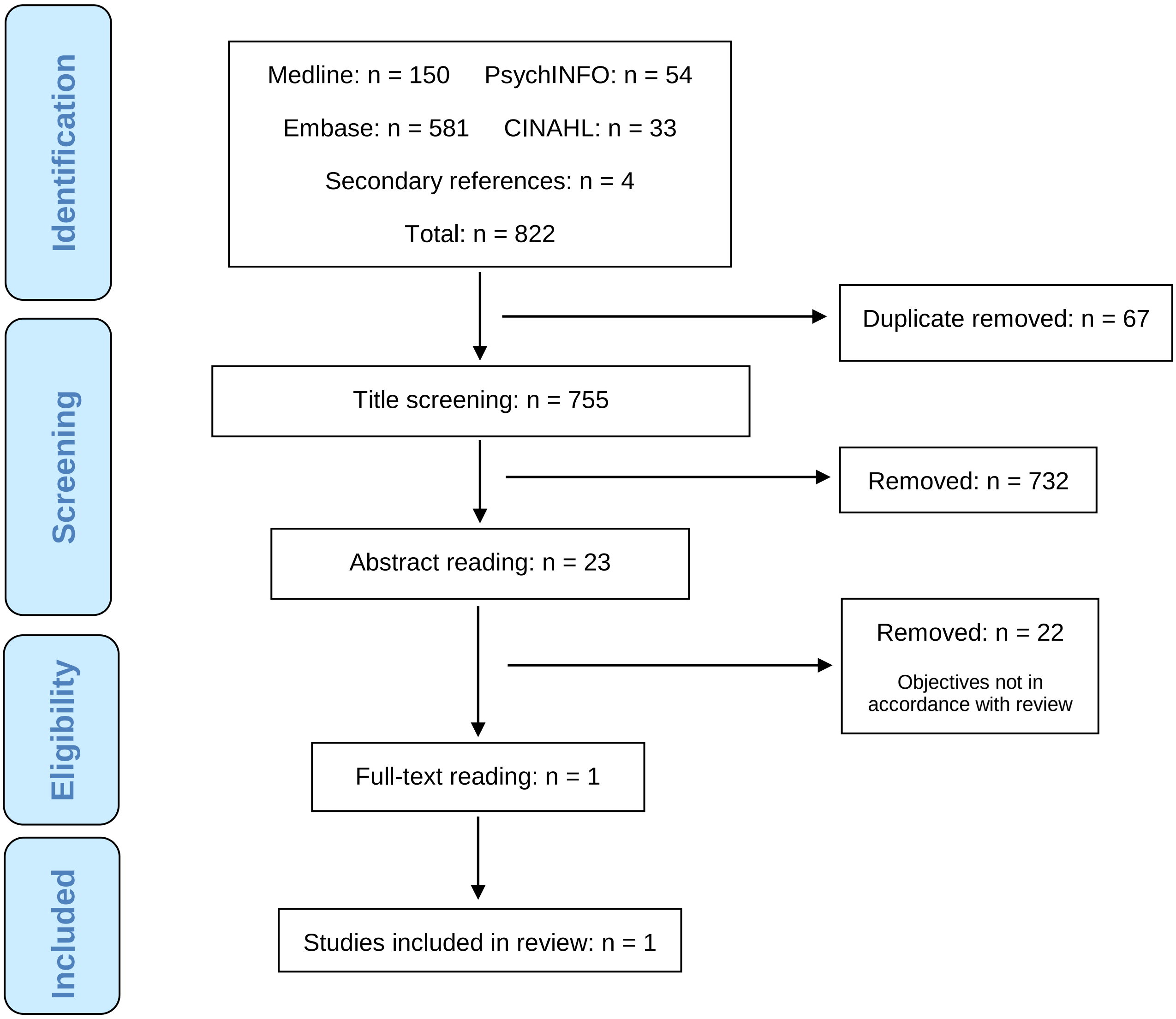

Table 3.1: Characteristics of the included studies

Author (Year) Country	Objectives	Population (Gender)	Sample size (Response rate) [Power calculation]	Outcome (Assessment criteria)	Results
Perrin et al. (2005) United States	To determine (1) the percentage of paediatricians who are overweight; (2) the accuracy of paediatricians' own weight status classification (3) the relationship between weight self-perception and perceived ease of obesity counselling	Paediatricians (Men & women)	355 (71%) [Power calculation not reported]	Underestimation of body weight (Self-reported height and weight)	(1) 40% were overweight (2) 49% underestimated their body weight (3) Those who self-classified "thin" (OR = 5.69; 95% CI = 2.30, 14.1) or "overweight" paediatricians (OR = 3.84; 95% CI = 1.11, 13.3) had reported greater obesity counselling
Jimenez-Cruz & Bacardi-Gascon (2006) Mexico	To compare the actual BMI with how they consider their weight status	Physicians (Gender not reported)	138 (Not reported) [Power calculation not reported]	Underestimation of body weight (self-reported height and weight, pictorial methods)	(1) 74% were overweight or obese (2) 27% of normal weight and 24% of overweight or obese physicians underestimate their body weight
Zhu et al. (2013) United Kingdom	To assess the agreement between self-perceived weight status and BMI status	Qualified & student nurses (Men & women)	409 (70%) 355 (78%) (Men & women) [Power calculation not reported]	Underestimation of body weight (Self-reported height and weight)	(1) Underestimation of body weight among qualified nurses: overall 24.6%, overweight 42.5%, obese 82% (2) Underestimation of body weight among student nurses: overall 15%, overweight 42.1%, obese 75.4%
Kirk et al. (2008) Tonga	To investigate perceptions of body size in Tongan lay people and nurses	Nurses & patients (Men & women)	34 (100%) 73 (100%) [Power calculation not reported]	Underestimation of body weight (Actual height and weight)	(1) Overweight or obese: 90% (n=66) patients, 82.4% (n=28) nurses (2) 83.3% of overweight or obese patients and 28.6% of overweight or obese nurses underestimated their weight

All of the included studies used WHO BMI cut-off point for overweight (BMI 25.0-29.99) and obesity (BMI ≥ 30.00)

Characteristics of the included studies:

Objective 1: Of the total of four studies included in the review, each was published in a different year, which were 2005, 2006, 2008 and 2013. Similarly, the country of origin of each study was different, these were Mexico (Jimenez-Cruz & Bacardi-Gascon, 2006), Tonga (Kirk et al., 2008), the UK (Zhu et al., 2013) and the US (Perrin et al., 2005). All the studies included were cross-sectional surveys. The convenient sampling technique was used in all the included studies and the overall response rate (where reported) ranged from 70% to 100%. Table 3.1 shows the characteristics of the included studies.

Objective 2: The literature search for objective 2 revealed only one study, which was conducted by Perrin et al. (2005) in the US. This is the same study which was earlier identified in the literature search for objective 1 and also met the criteria for objective 2.

Characteristics of the population:

The studies included in the review contained a total of 1,330 participants. However, participants were different in terms of their profession and age.

The population in study conducted by Perrin et al. (2005) was paediatricians who were members of the North Carolina Paediatrics Society and Fellows of the American Academy of Paediatrics. Those with sub-speciality affiliation or the retired were excluded. The mean age of the participants was 48. Eighty-nine percent of the sample were white. Forty-six percent of participants were women. Similarly, Jimenez-Cruz and Bacardi-Gascon (2006) conducted a study among physicians working in Tijuana and Ensenada, Mexico. Unlike the study conducted by Perrin et al. (2005), the inclusion and exclusion criteria for the study population were not reported explicitly. Similarly, information regarding age and gender distribution was missing.

Unlike the two earlier studies (Jimenez-Cruz & Bacardi-Gascon, 2006; Perrin et al., 2005), the population in the study conducted by Kirk and colleagues (2008) was comprised of qualified nurses and patients. Participating nurses were working in Vaiola Hospital, Tonga and similarly patients attending outpatient clinics or who were inpatients on surgical and medical wards were considered for the study. Those who were under18 years of age or pregnant were excluded from the study. Nurses were younger (mean age 26.9 years) than patients (mean age 39.0 years). The majority (nurses 73.5%; patients 57.5%) of the participants were women.

The final study included in the review was one conducted by Zhu et al. (2013) among qualified nurses. Along with these, Zhu and colleagues (2013) also gathered information from student nurses. Individuals who self-reported pregnancy or breast-feeding were excluded from the study. Ninety percent of the participants were women with a majority (66.5%) of white ethnicity. The mean age of the participants was 30.9 years (qualified nurses 36.3 years; student nurses 24.9 years).

Outcome assessment:

Outcome assessment for objective 1: For objective 1, the outcome variable was underestimation of body weight which was assessed by using different methods which included (i) comparison of individuals' responses given on Likert scale questions with their BMI weight category measured from the self-reported height and weight information (Jimenez-Cruz & Bacardi-Gascon, 2006; Perrin et al., 2005; Zhu et al., 2013) (ii) comparison of individuals' responses given on Likert scale questions with their BMI weight category measured from actual height and weight (Kirk et al., 2008) (iii) comparison of weight category selected on body image by participants with BMI weight status based on actual height and weight data (Kirk et al., 2008).

Outcome assessment for objective 2: For objective 2, the outcome variable was 'impact on HCPs' practice' which included weight screening, diagnosis, counselling, treatment or weight management. The only relevant study found was one conducted by Perrin et al. (2005) in which the outcome variable was ease of patients counselling about issues related to obesity. Perrin and colleagues (2005) asked paediatricians whether their weight made it 'more difficult', 'easier', or 'no difference' for them to counsel patients about their issues related to obesity.

3.2.7 Methodological quality assessment of the included studies

The quality assessment of the included studies was carried out by using the STROBE check list given for cross-sectional studies (von-Elm et al., 2008). Table 3.2 summarised the methodological quality assessment of the studies included in the review.

Table 3.2 (a): STROBE check list of items for cross-sectional studies

Information	Perrin et al., 2005	Jimenez-Cruz & Bacardi-Gascon, 2006	Kirk et al., 2008	Zhu et al., 2013
Does title/abstract indicate study's design with commonly used term?	+	-	+	+
Does abstract provide an informative and balanced summary?	+	-	+	+
Introduction				
Are scientific *background* and *rationale* for investigation explained?	+	+	+	+
Are specific *objectives* stated?	+	+	+	+
Any pre-specified hypothesis?	-	-	+	-
Methods				
Are key elements of *study design* presented?	+	-	+	.+
Are *setting*, *location* and relevant dates including *periods of recruitment* described?	+	+	+	+
Are the *eligibility criteria*, *sources* and *method of selection* of participants given?	+	-	+	+
Are *outcome, independent variables, potential confounders and diagnostic criteria* clearly defined?	+	+/-	+/-	+
Are *source of data* and details of *methods of assessment* provided?	+	+/-	+	+
Are there any efforts to *address potential bias*?	+	+	+	+
Is *sample size* justified?	-	-	-	-
Response rate	+	-	+	+
Is there a description of *statistical methods*, including those used to control confounders?	+	-	+/-	+

Colour key	
+	Yes
+/-	Partial
-	No

Table 3.2 (b): STROBE check list of items for cross-sectional studies

Information	Perrin et al., 2005	Jimenez-Cruz & Bacardi-Gascon, 2006	Kirk et al., 2008	Zhu et al., 2013
Is it explained how *missing data* was addressed?	-	-	-	+
Is any *sensitivity analysis* described?	-	-	-	-
Results				
Are numbers of *individuals at each stage of study* e.g. potentially eligible, confirmed eligible and analysed, provided?	+	-	-	-
Are reasons for *non-participation* given?	-	-	-	-
Are characteristics of *study participants, information on exposure and potential confounders* given?	+	+/-	+/-	+/-
Are *numbers of outcome events* given?	+	+	+	+
Are *unadjusted and adjusted estimates and precision* (e.g. confidence interval and p–value) given?	+	-	+	+
Sensitivity analysis?	-	-	-	-
Discussion				
Are *key results* summarised?	+	-	+	+
Are *limitations* of study, taking into account sources of bias, discussed?	+	-	+	+
Is a *cautious overall interpretation* of results considering objectives given?	+	-	+	+
Is the *generalisability* of the results discussed?	+	+	+	+
Is source of funding, if any, given?	+	-	-	+

Colour key	
+	Yes
+/-	Partial
-	No

According to von-Elm and colleagues (2008), indicating the study's design in the title or the abstract of the study is good practice. It was clearly stated in all of the included studies (Kirk et al., 2008; Perrin et al., 2005; Zhu et al., 2013) except one (Jimenez-Cruz & Bacardi-Gascon, 2006). Scientific background, rationale and specific objectives were clearly mentioned in all of the included studies. Although the purpose of the cross-sectional studies is to estimate the prevalence of a disease (outcome) in a population with respect to a set of risk factors and usually there is no hypothesis (Levin, 2006), it is best practice to report whether the researcher has any pre-specified hypothesis. The study conducted by Kirk et al. (2008) was the only one with a pre-specified hypothesis: "A significant difference would exist between the lay people and nursing personnel in terms of perceived body size, BMI status, knowledge about consequences of obesity and weight satisfaction".

Descriptions of the study settings, locations, recruitment period, eligibility criteria, sources and method of participants' selection were well reported in the included studies (Kirk et al., 2008; Perrin et al., 2005; Zhu et al., 2013) except the one conducted by Jimenez-Cruz and Bacardi-Gascon (2006) in which information regarding eligibility criteria and the method of selection of participants was lacking. Similarly, a description of outcome variables, independent variables, potential confounders, diagnostic criteria, source of data and method of assessment were well reported in studies by Perrin et al. (2005) and Zhu et al. (2013).

On the other hand, Jimenez-Cruz and Bacardi-Gascon (2006) and Kirk et al. (2008) failed to provide information regarding independent variables, especially potential confounders, diagnostics criteria and details of the method of outcome assessment. Various efforts undertaken were reported to minimise potential bias and to improve internal validity in the respective studies, such as training of research assistants for accurate measurement (Cruz & Bacardi-Gascon, 2006), piloting of questionnaire (Kirk et al., 2008; Zhu et al., 2013), test retest reliability of the Likert scale (Zhu et al., 2013) and statistical adjustment of confounders (Perrin et al., 2005; Zhu et al., 2013). However, three of the included studies (Jimenez-Cruz & Bacardi-Gascon; Perrin et al., 2005; Zhu et al., 2013) relied on the self-reported height and weight data for assessment of the BMI status of participants, which is a major threat to the internal validity of studies as consequently it might give an underestimation of the magnitude of the underestimation of body weight. Only Kirk et al. (2008) measured the actual height and weight of participants.

As far as sample size is concerned, none of the included studies mentioned sample size calculation with justification, which is essential for the generalisability of a study. The sample sizes of two of the included studies were very small (Jimenez-Cruz & Bacardi-Gascon, 2006; Kirk et al., 2008). The study conducted by Kirk and colleagues (2006) included only 34 qualified nurses, whereas the study conducted by Jimenez-Cruz and Bacardi-Gascon (2006) had 138 physicians. Comparatively, the other two studies had better sample sizes; the one conducted by Perrin et al. (2005) included 355 paediatricians and the one conducted by Zhu et al. (2013) had 409 qualified nurses and 355 student nurses. The highest reported response rate was 100% in the study conducted by Kirk et al. (2008) but this had limited importance because of the small sample size. The response rate of the other two studies was 71% (Perrin et al., 2005) and 73% (Zhu et al., 2013), whereas Jimenez-Cruz and Bacardi-Gascon (2006) did not report the response rate. Moreover, the convenient sampling technique in all of the included studies limited the generalisability of the findings and increased the chances of selection bias.

Statistical analysis was limited to the descriptive statistics in two of the studies (Jimenez-Cruz & Bacardi-Gascon, 2006; Kirk et al., 2008), whereas the studies conducted by Perrin et al. (2005) and Zhu et al. (2013) provided additional inferential statistics by running regression analysis to control confounders. Analysis and reporting of the missing information were only done by Zhu et al. (2013).

Critical evaluation of result reporting revealed that only Perrin and colleagues (2005) explicitly reported the number of participants at the stage of study, e.g. potentially eligible, confirmed eligible and those analysed. Again, information regarding the characteristics of participants, a description of the independent variables and the confounders were reported by Perrin et al. (2005). Reporting of the outcome variables along with unadjusted and adjusted estimates and precision were evident in all the studies except the one conducted by Jimenez-Cruz and Bacardi-Gascon (2006) which was limited to descriptive statistics. None of the studies documented the reasons for non-participation. Similarly, sensitivity analysis was not carried out in any of the included studies.

Summarising key findings, and reporting the overall interpretation of results while taking into consideration the limitations and potential sources of bias in discussion were characteristics of all of the included studies except one (Jimenez-Cruz & Bacardi-Gascon, 2006). However, the authors of all of the studies discussed and acknowledged the limited generalisability of the findings because of the small sample sizes and specific study populations. Information regarding the source of funding, which is important to assess conflict of interest, was provided by two of the studies only (Perrin et al., 2005; Zhu et al., 2013).

Hence, it is evident that the study conducted by Jimenez-Cruz and Bacardi-Gascon (2006) is of limited quality as compared to the one conducted by Kirk et al. (2008), whereas those conducted by Perrin et al. (2005) and Zhu et al. (2013) were of better quality than the remaining two. The external generalisability of the studies is limited by small unjustified sample size with no sensitivity analysis in terms of the outcome analysis.

3.2.8 Results

Objective 1: Underestimation of weight among HCPs

For objective 1, four of the studies were included in the review (Jimenez-Cruz & Bacardi-Gascon, 2006; Kirk et al., 2008; Perrin et al., 2005; Zhu et al., 2013).

Perrin and colleagues (2005) conducted a cross-sectional study and collected information from North Carolina paediatricians (n=355) regarding their weight status through a mail survey. The accuracy of the paediatricians' self-classification of weight status was compared with BMIs derived from self-reported height and weight. Of the respondents, 40% (n=142) were overweight or obese (BMI ≥ 25). The overall prevalence of underestimation of body weight among paediatricians was 49% (men 57%; women 33%) as they failed to identify their overweight status. Although the overall methodological quality of this study is better than the rest of the studies included in the review (Jimenez-Cruz & Bacardi-Gascon, 2006; Kirk et al., 2008), relying on self-reported height and weight data means that the actual prevalence of underestimation of body weight might be greater than reported in this study as earlier studies revealed that individuals are prone to over-report height and under-report weight, which gives an underestimated BMI (Faeh et al., 2008; Frances et al., 2013; Health Survey of England, 2011). Similarly, the authors stated that the study's generalisability is limited to paediatricians practising in North Carolina.

Jimenez-Cruz and Bacardi-Gascon (2006) conducted a study among Mexican physicians and obtained information from (n=138) physicians working in Tijuana and Ensenada to compare their BMI (based on self-reported height and weight data) status with their self-classification of weight status. Three-quarters (74%) of the participating physicians were overweight or obese (BMI ≥ 25). According to the authors, 27% of normal weight and 24% of overweight or obese physicians underestimated their body weight. The prevalence of underestimation of body weight in this study is nearly half of the estimate reported by Perrin et al. (2005). Although the study population and setting are different from the study by Perrin et al. (2005), its very low methodological quality according to the chosen assessment tool makes its findings among the other included studies unreliable.

As well as paediatricians and physicians, underestimation of body weight has been reported among nurses. Kirk and colleagues (2008) conducted a cross-sectional survey in Tonga which is a small island in the Western Pacific region where more than 90% of the population are overweight or obese (BMI ≥ 25). This survey explored the issue of underestimation of weight among (n=34) nurses and (n=73) patients of Vaiola Hospital in Tonga. Ninety percent of the sampled patients were overweight or obese as compared to 82.4% of the nurses. As compared to nurses (55%), a higher proportion of patients (82.6%) underestimated their body weight when their self-reported weight status was compared with BMI status based on the measured height and weight data. Similarly, participants' self-reported weight status on silhouettes was compared with their actual BMI weight status. No significant difference was revealed between patients and nurses in terms of the silhouette selected and their actual BMI status. Both groups underestimated their body weight, although the degree of underestimation was higher among patients than nurses. The average selected silhouette for patients and nurses was six, while the average BMI would have been better represented by image seven for nurses and nine for patients. It would have been better if the authors could have provided estimates of underestimation of body weight in percentages (or proportions) for ease of comparison with earlier studies' assessment methods.

The prevalence of underestimation of body weight is different than the estimates reported by earlier studies (Jimenez-Cruz & Bacardi-Gascon, 2006; Perrin et al., 2005) which can partially be explained by the baseline difference of obesity level at population level in Tonga and the US and Mexico. Secondly, the population in the current study (nurses and patients) is different to the population in the earlier studies (physicians and paediatricians). It is also important to mention that this is the only study which measured the actual height and weight of participants and assessed the underestimation of body weight by two different methods and so the methodological quality is better than in the study conducted by Jimenez-Cruz and Bacardi-Gascon (2006). However, the generalisability of the study's findings is markedly limited by the use of a small sample and convenience sampling technique.

The final study was conducted by Zhu and colleagues (2013) who collected weight-related information from (n=355) nursing students and (n=409) qualified nurses attending one large university in London. The researchers assessed the agreement between self-perceived weight status and BMI status, calculated from self-reported height and weight and found that 15% of the nursing students and 24.6% of qualified nurses underestimated their body weight. Among nursing students, 42.1% of overweight (BMI $\geq$ 25) and 75.4% of obese (BMI $\geq$ 30) students did not recognise their overweight status. Similarly, among qualified nurses, 42.5% of overweight (BMI $\geq$ 25) and 82% of obese (BMI $\geq$ 30) participants failed to recognise their overweight status. Among qualified nurses, overweight status (OR = 5.32; 95% CI = 2.66 – 10.67) was the only significant variable, whereas among nursing students overweight status (OR = 3.10; 95% CI = 1.31 – 7.33), black ethnicity (OR = 2.53; 95% CI = 1.01 – 6.32) and $\geq$ 3 family histories of obesity co-morbidities (OR = 2.51; 95% CI = 1.04 – 6.08) were significantly associated with underestimation of weight. Although the overall methodological quality of this study is better than the studies by Kirk et al. (2008) and Jimenez-Cruz and Bacardi-Gascon (2006) and has a large sample size to infer study findings, its failure to report the power calculation and use of self-reported data for height and weight again raises questions over the estimated magnitude of underestimation of body weight. Similarly, the use of a convenient sample from a single university may have introduced bias through selective recruitment of nurses with particular views and an interest in the topic. The authors also acknowledged that the sample included a very small subgroup of males who were of older age and non-white ethnicity, which further limited the generalisability of the study in terms of gender, age and ethnicity.

Objective 2: Impact of HCPs' underestimation of own weight on their practice

For objective 2, only one study was identified, conducted by Perrin et al. (2005), and this is the same study which also met the inclusion criteria for objective 1 of the review.

Perrin and colleagues (2005) aimed to determine the relationship between paediatricians' self-perception of weight and perceived ease of counselling. Accuracy of paediatricians' self-classification of weight status was compared with BMIs derived from self-reported height and weight. The overall prevalence of underestimation of body weight among paediatricians was 49%. Regarding self-perception of weight status, paediatricians who self-classified "thin" (OR = 5.69; 95% CI = 2.30, 14.1) or "overweight" (OR = 3.84; 95% CI = 1.11, 13.3) had reported greater difficulties with obesity counselling than those who self-classified "average" regardless of their actual weight status. Interestingly, further analysis which took into account the actual weight status of paediatricians revealed that those who underestimated their weight (inappropriately classifying themselves as "thin" or "average" when they were actually overweight) had lower odds (Unadjusted OR = 0.21; 95% CI = 0.05, 0.09) of difficulty in counselling about overweight than their appropriately classified non-overweight colleagues. However, after controlling for confounders (e.g. age, gender, ethnicity, practice type) through regression analysis, this association was found to be insignificant (adjusted OR = 0.21; 95% CI = 0.05, 0.09) regarding the ease of counselling.

According to Perrin and colleagues (2005), it is worthwhile to explore this association in further research with a large sample size and in-depth qualitative research. Moreover, relying on self-reported height and weight data is another limitation of the study which might have given a lower estimate for underestimation of body weight and consequently its distorted association with the ease of counselling (Faeh et al., 2008; Frances et al., 2013). Similarly, the study's generalisability is limited to paediatricians practising in North Carolina.

3.2.9 Discussion

The findings of the review suggest that the underestimation of body weight is common among HCPs, especially those who are overweight or obese. The reported prevalence of underestimation of body weight ranged between 15% and 55% (Jimenez-Cruz & Bacardi-Gascon, 2006; Kirk et al., 2008; Perrin et al., 2005; Zhu et al., 2013), which is not significantly different from the percentages (17% to 48.7%) reported among the general population (Johnson et al., 2008; Linder et al., 2010; Vandelanotte et al., 2011; Yaemsiri et al., 2011).

The reported prevalence of underestimation was 17% in Canada (Linder et al., 2010), 25% in the UK (Johnson et al., 2008), 34.4% in Australia (Vandelanotte et al., 2011), 35.5% in the US (Yaemsiri et al., 2011), 36% in China (Xu et al., 2011) and 54% in seven of the EU countries (EASO, 2015). Similarly, the prevalence of underestimation of body weight among adolescents has also been reported, which ranged from 12.6% to 52.5% based on studies' findings from the US, Mexico, Spain, the Netherlands, Germany, Malaysia and India (Andrade et al., 2012; Brug et al., 2006; Christine et al., 2004; Comb et al., 2009; Jouregui-Lobera et al., 2011; Khor et al., 2009; Priya et al., 2010).

The variation in reporting of underestimation of body weight is partly reflected by the difference in the prevalence of overweight and obesity (US >70% vs. India <20%) across countries. Other factors, such as socio-economic status, cultural differences, ethnicity and education, are likely to contribute towards reported variations. Some of the variations can be explained by the use of different assessment methods, such as Likert scale and body images, for weight assessment. Similarly, the combination of subjective (self-reported) and objective (actual measured) height and weight measurement is likely to give variations in weight assessment. Sometimes, variations in the reporting of weight status can also be due to the use of different BMI cut-off points used for categorising individuals into overweight and obese categories. Thus, comparison of the prevalence of underestimation of body weight across studies is difficult because of the methodological heterogeneity of studies, which needs to be minimised in future research through the use of standardised techniques and tools.

As far as the study population is concerned, so far the issue of underestimation of body weight has only been explored among paediatricians (Perrin et al., 2005), physicians (Jimenez-Cruz & Bacardi-Gascon, 2006) and nurses (Kirk et al., 2008; Zhu et al., 2013). No study has assessed the level of underestimation of body weight among physiotherapists, pharmacists and dentists who also provide direct healthcare services to patients. Only one study has highlighted the problem of underestimation of body weight among undergraduate nursing students (Zhu et al., 2013) which suggests that there is a need to explore this problem among other undergraduate students, especially those of medicine, dentistry, physiotherapy and pharmacy, so that interventions can be suggested while they are in training if a problem exists.

This review also revealed that there is a lack of information regarding the impact of HCPs' underestimation of their own body weight on their practice as this association was assessed in only one of the studies (Perrin et al., 2005). Perrin and colleagues (2005) looked at physicians' underestimation of their body weight and its impact on their patient counselling regarding overweight, but they did not find any significant association between them. This may be because of the small study sample which was insufficient to ensure study strength and, more importantly, relying on self-reported height and weight information might have resulted in a lower estimate for the underestimation of body weight and consequently its distorted association with the ease of counselling (Faeh et al., 2008; Frances et al., 2013). Future studies with a large sample size and in-depth qualitative interviews would help in exploring this association in detail. More importantly, it would have been interesting if this study could have explored whether physicians with underestimation of their own body weight also underestimate the weight of their patients, which could give a better insight into the problem in order to suggest appropriate measures (training needs).

Implications for future research:

The available studies on the topic of the prevalence of underestimation of body weight among HCPs are of low methodological quality In future there is need to design cross-sectional studies with similar objectives but with a rigorous methodology by considering sample size/power calculation, better sampling techniques (e.g. simple cluster, multistage cluster, stratified), inclusion of important variables especially confounders (age, gender, ethnicity), actual anthropometric (height/weight) measurement instead of relying on reported data, assessment of underestimation of body weight with Likert scale as well as body images for ease of cross comparison, clear reporting of the BMI cut-off points used (especially researchers from the South Asian countries), rigorous statistical analysis (regression technique for adjustment of confounders) including sensitivity analysis and, more importantly, explicit reporting of findings. Similarly, future studies could consider other groups of HCPs, e.g. pharmacists, physiotherapists and dentists along with doctors and nurses. This information would be helpful in guiding the training needs of those HCPs. Similarly, it would be worthwhile if future studies could explore whether physicians who underestimate their own body weight also underestimate the weight of their patients. This information is also missing in the literature.

The current review revealed only one study (Zhu et al., 2013) that highlighted the issue of underestimation of body weight among student nurses, which suggests HCPs could have this problem while in training. Therefore, it would be more beneficial if future studies could explore the issue of the underestimation of body weight among undergraduate students of medicine, nursing, dentistry, pharmacy and physiotherapy. This would provide baseline information for policy if there is a need to tailor a future curriculum which could better equip students while in training regarding healthy weight and accurate weight assessment to bring positive behaviour change against unhealthy body weight.

Moreover, there is a need for cross-sectional studies with strong methodology (large representative sample, and actual anthropometric measurements) which could better reflect the prevalence of underestimation of body weight among HCPs. It would also be worthwhile to explore this issue through qualitative research by using focus group discussions or in-depth interviews in order to understand the problem better.

Implications for policy:

Though the available information is not sufficient to recommend any specific interventions, such as modifications in HCPs' training or the arrangement of training sessions regarding perceptions of weight, it can be suggested that HCPs should be aware of their weight status and its importance in their daily practice. They can also make sure every patient has an objective measurement of weight on their visits, instead of being subjectively assessed. Evidence regarding the underestimation of body weight among undergraduate students is very limited so far. The curriculum and training can be enhanced on the basis of future studies.

Limitations:

It is worthwhile to consider the limitations of the review while interpreting its results. The review was carried out by only one reviewer, so the chances of a mistake/error cannot be ruled out in the process of the literature search on databases, selection of studies, data extraction, data synthesis and interpretation of the findings. Similarly, this review is based on published studies and the language was restricted to English only. The overall methodological quality of the included studies was not up to the required standard, especially in terms of sample size and sampling techniques. The variation among study population, information on independent variables, the method of outcome assessment and the plan of analysis made it difficult to determine the overall prevalence of underestimation of body weight and to generalise its findings to a broad population of HCPs.

Conclusion:

On the basis of this review, it can be concluded that there is some evidence to suggest that underestimation of body weight is as prevalent among HCPs as it is in the general population. This is quite alarming as because of underestimation of body weight, HCPs may fail to take appropriate measures to reduce their own weight. Impact of healthcare professionals' underestimation of their own body weight on their practice is explored by only one study which did not show any significant association. However, the studies included in the review were methodologically weak and not up to the required standard to recommend any specific interventions at this point in time. Moreover, the studies were limited to doctors and nurses only. Therefore, future research on this topic is highly desirable to provide overall estimates of the prevalence of underestimation of body weight among HCPs, especially undergraduate students including those in medicine, nursing, pharmacy, physiotherapy and dentistry. Thus, a curriculum and training can be tailored based on the findings of future studies.

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3.3 Factors contributing to the underestimation of body weight

Having looked at the magnitude of the underestimation of body weight in the previous section, this section highlights and discusses the factors which are likely to contribute towards underestimation of weight. The factors found to be associated with underestimation of body weight in the literature are gender, age, BMI, ethnicity and the media (Bhanji et al., 2011; Bolton-Smith et al., 2000; Brown et al., 2010; Brug et al., 2006; Combs, 2009; Duncan et al., 2011; Joshi et al., 2007; Kuchler & Variyam, 2003; Machado et al., 2006; Mackey & Annette, 2008; Madrigal et al., 2000; Maximova et al., 2008; Paeratakul et al., 2002; Pattullo et al., 2011; Rahman & Berenson, 2010; Rand & Resnick, 2000; Rhodes & O'Neill, 1997; Tang et al., 2012; Vandelanotte et al., 2011; Ver-Ploeg et al., 2008; Wing-Sze et al., 2009).

Table 3.3 summarises the factors associated with underestimation of body weight. These factors are further discussed in the following sections.

3.3.1 Gender

Gender is the main factor associated with underestimation of body weight (Bhanji et al., 2011; Blokstra et al., 2009; Brug et al., 2006; Madrigal et al., 2000). It appears that men underestimate their body weight more than women; possibly because overweight status among men (as compared to women) is acceptable to a certain extent in certain societies

Table 3.3 (a): Factors contributing to the underestimation of body weight

Risk factors	Summary of findings	Sample size (n)	Country	References
Gender	Underestimation of weight is higher among men than women	493	Pakistan	Bhanji et al. (2011)
		4,601	Netherlands	Blokstra et al. (1999)
		3,290	Netherlands	Brug et al. (2006)
		36,807	US	Combs et al. (2009)
		1,342	Australia	Crawford et al. (1999)
		15,235	EU	Madrigal et al. (2000)
		1,317	US	Rand et al. (2000)
Age	Underestimation is higher among an elderly population than a younger	493	Pakistan	Bhanji et al. (2011)
		1,836	UK	Bolton et al. (2000)
		4,442	Sweden	Bostrom et al.(1997)
		3,290	Netherlands	Brug et al. (2006)
		75	US	Tang et al. (2012)
Body mass index	Underestimation of weight is higher among overweight and obese individuals than those of normal weight	27,095	India	Joshi et al. (2007)
		12,987	US	Machado et al. (2006)
		273	Canada	Pattullo et al. (2011)
		12,789	US	Martin et al. (2009)
Ethnicity	Underestimation of weight is higher among the black population than the white population.	36,807	US	Combs et al. (2009)
		16,209	US	Kuchler et al. (2003)
		1,162	US	Rahman et al. (2010)
Socio-economic status (SES)	No conclusive results so far: underestimation has been associated with low as well as high SES	1,836	UK	Bolton et al. (2011)
		2,535	Australia	Corneel et al. (2011)
		16,209	US	Kuchler et al. (2003)
Educational level	Low level of education was found to be associated with underestimation of body weight	16,209	US	Kuchler et al. (2003)
		1,162	US	Rahman et al. (2010)

Table 3.3 (b): Factors contributing to the underestimation of body weight

Risk factors	Summary of findings	Sample size (n)	Country	References
Knowledge of ideal body weight	Lack of knowledge regarding ideal body weight was associated with underestimation of body weight	493	Pakistan	Bhanji et al. (2011)
Social network	Being in an overweight and obese friends/peer environment tends to make an individual underestimate his/her body weight	6,630 3,665 236	US Canada US	Brown et al. (2010) Maximova et al. (2008) Mackey et al. (2008)
Weight-related comments from others	Incorrect comments from friends/peers/parents may lead an individual to underestimate body weight	22,612	Hong Kong	Lo et al. (2009)
Media	A behavioural frame is being promoted that places responsibility on individuals for being overweight	Content analysis of articles Content analysis of articles Content analysis of articles	Ireland Australia UK	De-Brun et al. (2012) Bastian et al. (2011) Patterson & Hilton, (2013)

(Bhanji et al., 2011; Blokstra et al., 2009; Madrigal et al., 2000). Rand and Resnick (2000) collected information on body perception from young schoolchildren (grades four and five), high school adolescents, university students and working adults. Eighty-seven percent of all these participants considered their body size socially acceptable. Gender specific statistics showed a higher (92%) proportion of males than females (79%) said their body size was socially acceptable.

3.3.2 Age

Age is yet another factor, as shown in a study of Scottish women whose older members aged (55-65) were more likely to underestimate their body weight than those in a younger age group (Bolton-Smith et al., 2000). Similarly, increasing age was associated with the underestimation of weight in the elderly population (Bhanji et al., 2011; Brug et al., 2006; Ver-Ploeg et al., 2008). A similar association of age with underestimation has been reported in China, Mexico and Spain (Andrade et al., 2012; Jáuregui-Lobera et al., 2011; Xu et al., 2011).

3.3.3 Weight status (BMI)

Underestimation of body weight also depends on an individual's weight status. Earlier studies revealed that underestimation of weight is more prevalent among overweight and obese individuals than those of normal weight. A study from the US reported that 40% of overweight and 13% of obese individuals were unaware of their raised weight status (Paeratakul et al., 2002). Though underestimation of body weight is prevalent even among normal weight individuals, the degree of underestimation becomes greater as the BMI of the individuals increases (Joshi et al., 2007; Machado et al., 2006). According to Martin and colleagues (2009), 16.4% of normal weight and 25.4% overweight/obese adolescents underestimate their body weight.

Similarly, Maximova and colleagues (2008), based on a provincially representative school-based survey from Quebec, reported an overall 32.4% prevalence of underestimation among children and adolescents. Underestimation among normal weight was 30%, whereas it was much higher among the overweight (71.4%) and obese (59.4%). Similar findings were reported by Pattullo and colleagues (2011) from Australia.

3.3.4 Ethnicity

The role of ethnicity in the underestimation of body weight has been studied several times. These studies have reported that underestimation appears more among the black populations as compared to white populations regardless of gender difference (Combs, 2009; Duncan et al. 2011; Kuchler & Variyam, 2003; Rahman & Berenson, 2010; Ver-Ploeg et al., 2008). This is possibly best explained by the cultural differences whereby certain body images are considered as attractive (Mossavar-Rahmani, 1996; Rahman & Berenson, 2010; Strauss, 1999). Tang and colleagues (2012) conducted a study among Asian Americans and found that underestimation was more prevalent among Asian communities than other US ethnic groups. A study conducted in the United Kingdom also revealed that overweight Asian women were more likely to underestimate than overweight white women (Patel et al., 2001).

3.3.5 Socio-economic status

There is no conclusive evidence regarding the association between socio-economic status and underestimation of body weight. A study conducted by Kuchler and Variyam (2003) revealed that US adults of low socio-economic status were more likely to underestimate their body weight than people of higher socio-economic status, whereas a study of Scottish women did not reveal any difference in the underestimation of body weight in terms of socio-economic status (Bolton-Smith et al., 2000). The importance of socio-economic status remains unclear and needs further research in the context of the underestimation of weight.

3.3.6 Education level and knowledge of healthy body weight

Underestimation was more prevalent among those with a lower level of education (Kuchler & Variyam, 2003; Rahman & Berenson, 2010). A study conducted by Kuchler and Variyam (2003) revealed that the underestimation of body weight was more likely among individuals who did not complete high school education. Similarly, a study which assessed the association between women's education and their assessment for overweight status of their children found that mothers with a low education level (high school degree or less) were more likely to underestimate their child's body weight than those with a higher educational level (at least some college or more) (Baughcum et al., 2000). Similarly, Bhanji and colleagues (2011), who conducted a study among hospital patients, found that patients who had knowledge about healthy weight were less likely to underestimate their weight than those who did not.

3.3.7 Social networks

The social network of an individual was also found to be associated with the underestimation of body weight (Brown et al., 2010; Mackey & Annette, 2008; Maximova et al., 2008). It appears that individuals assess their body weight by looking at people around themselves, instead of using the recommended BMI classification (Mackey & Annette, 2008). Another study finds that being in such an environment where peers' body weight is above average makes an individual underestimate his/her body weight (Brown et al., 2010). It has also been found that there is an association between weight-related comments given by peers, friends and parents and the underestimation of body weight by an individual (Wing-Sze et al., 2009). Wing-Sze and colleagues (2009) reported that adolescents receiving incorrect weight-related comments were at increased risk of underestimating their body weight. Similarly, receiving conflicting comments was positively associated with underestimation of body weight among normal weight adolescents.

3.3.8 The media

The media have the power to influence public opinion and to raise awareness of public health problems (Thorson, 2006). In the last decade, an increase in media coverage of overweight and obesity has been observed (De-Brun et al., 2012). According to the authors, the content analysis of obesity-related articles revealed that the media target and blame overweight and obese individuals for being overweight or obese, rather than acknowledging the multi-faceted aetiology of obesity. Similar results were found by Bastian (2011) who looked at material targeting childhood obesity. This sensitises individuals and makes them self-conscious about their weight and also prone to weight stigma, which is not a motivator for weight loss (Puhl & Heuer, 2010). Schwartz and colleagues (2007) stated that stigma may worsen the problem of overweight and obesity through mechanisms such as fear of going out, fear of being laughed at while exercising, repetitive emotional eating and consequently the development of eating disorders. A number of other studies have also demonstrated that weight stigmatisation among overweight and obese individuals led to lower levels of physical activity, and negative attitudes to sports activities (Bauer et al., 2004; Storch et al., 2007). Thus overweight and obese individuals remain overweight or obese, which has a strong association with underestimation of body weight (Joshi et al., 2007; Machado et al., 2006; Martin et al., 2009). Thus, the media are indirectly contributing to the underestimation of body weight.

Similarly, it has been observed that the media also contribute towards the societal normalisation of obesity which threatens to harm obese individuals along with undermining public health efforts to prevent obesity (Patterson & Hilton, 2013). Patterson and Hilton (2013) studied 119 articles and images from the five major national newspapers in the UK. Based on visual content analysis, the researchers revealed that descriptions of subjects' body sizes in articles were different from coders' estimates while morbidly obese individuals were described as obese so general obesity is not recognised as such (Patterson & Hilton, 2013). Researchers from other countries, such as Sweden and the US, have also analysed obesity-related content on the media and reported that the media have a tendency to misrepresent the range of body sizes within the obese category as well as to stigmatise (Gollust et al., 2012; Sandberg, 2007).

3.4 Identified gaps in knowledge

There are a number of gaps in knowledge which need to be addressed.

- There is some evidence to suggest that HCPs also underestimate their weight but this evidence is weak due to the use of (i) small and unjustified sample sizes (ii) the convenient sampling technique and (iii) inclusion of a selected and limited group of HCPs, all of which limit the validity and generalisability of existing studies
- Identified studies explored the issue of underestimation of body weight among the group of doctors and nurses. There is a need to explore this issue among other HCPs, such as dentists, pharmacists and physiotherapists, who are also involved in direct healthcare provision
- So far no study has explored whether HCPs who underestimate their own body weight also underestimate the weight of their patients
- Only one study explored the issue of underestimation of body weight among student nurses, which suggests HCPs could have this problem while in training, but the weak methodological quality of the study limits the generalisability of its findings. So there is uncertainty whether trainee HCPs also underestimate their weight. If they do, it is not known by how much nor what factors are associated with underestimation of weight. Therefore, it would be worthwhile to explore this issue among the wider population of undergraduate students, including medicine, nursing, dentistry, pharmacy and physiotherapy, to bridge this knowledge gap.
- There is also limited information regarding the factors associated with underestimation of body weight specifically among HCPs. Future studies, while estimating the prevalence of underestimation of body weight, could assess the association of important variables by using advance analysis, e.g. the regression technique.
- None of the studies on the topic of underestimation of body weight among HCPs was conducted in Pakistan, where social, cultural and economic factors are likely to be different. Those conducted on the topic of overweight and obesity have used inconsistent BMI cut-off points, which makes it difficult to compare the burden of obesity across studies.

Chapter 4: Methodology

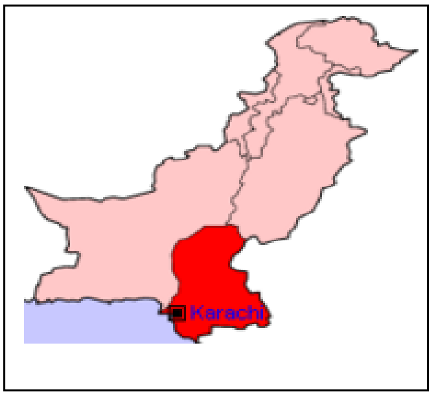
4.1 Study design

This is a university based cross sectional analytical study. According to Thompson and colleagues (1998) the main aim of the cross sectional study (or survey) conducted in the health field is to measure the magnitude of a disease or health condition. Secondly, the analytical component of such a study enables researchers to assess the association of various risk factors with the disease or health condition under consideration (Thompson et al., 1998).

This design is appropriate to meet the objectives of the current study. The first objective of the study was to estimate the prevalence (magnitude) of underestimation of body weight (health condition). Furthermore, the second objective of the study was to determine the factors associated with underestimation of body weight among undergraduate students of medicine and allied health sciences.

4.2 Study setting

This study was conducted in Karachi, the biggest city in Pakistan, located in the south, directly north of the Arabian Sea. It is one of the most highly populated cities in the world at approximately 18 million including diverse populations of economic and political, migrants and refugees from different national, provincial, linguistic and religious origins (City District Government Karachi, 2013).



Six of the public sector academic institutes which offer undergraduate degree programmes in medicine, dentistry, pharmacy, physiotherapy and nursing were selected for the current study. These included (i) Dow Medical College (DMC) (ii) Sindh Medical College (SMC) (iii) Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences (DIKIOHS) (iv) Dow College of Pharmacy (DCOP) (v) Institute of Nursing (IoN) (vi) College of Physiotherapy (COP).

DMC, SMC, DIKIOHS, DCOP, ION, and COP are affiliated with the Dow University of Health Sciences (DUHS) whereas COP is affiliated with the University of Karachi (UoK). Table 4.1 summarised information of each institute in terms of degree programme, duration and the number of places available per annum.

Table 4.1: Participating institutes, degree programme, duration and number of available places per annum

Institute	Degree programme	Duration (years)	Number of places/annum
DMC	Bachelor of Medicine and Bachelor of Surgery (MBBS)	5	1750
SMC	Bachelor of Medicine and Bachelor of Surgery (MBBS)	5	1750
DIKIOHS	Bachelor of Dental Surgery (BDS)	4	400
DCP	Doctor of Pharmacy (Pharm.D)	5	500
IoN	Bachelor of Science in Nursing (BSc. Nursing)	4	183
COP	Bachelor of Science in Physiotherapy (BSPT)	4	200

4.3 Study population

4.3.1 Inclusion criteria

The focus of the study was only on the undergraduate students of medicine and allied health sciences who are our future health professionals. The study population was comprised of;

- The undergraduate students of medicine, dentistry, pharmacy, nursing and physiotherapy enrolled at DMC, SMC, DIKIOHS, DCOP, ION, and COP respectively
- Students of both genders (men and women)
- Students from each academic year

4.3.2 Exclusion criteria

- The postgraduate trainees of other institutes such as Ojha Institute of Chest Diseases and Sarwar Zuberi Liver Centre affiliated with DUHS were excluded from the study, because these trainees are already health professionals and practising in their field, thus not the focus of this research.
- Students of the biological sciences, chemistry, physics, computer, social and political sciences enrolled in other institutes affiliated with the University of Karachi were excluded from the study. This is because the graduates of these institutes will not serve the community as HCPs in the future.

4.4 Sample size

4.4.1 Calculation

The sample size was calculated so as to measure the prevalence of underestimation of body weight among trainee HCPs. At 5% level of significance, with 5% bound on error of estimation and using a reported range from 11.90% to 42.74% (Gualdi-Russo et al., 2007; Kuchler & Variyam, 2003; Mahmood, 2009; Oliver & Thelen, 1996; Thelen & Cormier, 1995) for the prevalence of underestimation of body weight, the sample size was calculated to be 376 using the software Epi-Info.

Similarly, the sample size was calculated for multiple regression analysis in order to determine the factors associated with underestimation of body weight. The minimum sample size for multiple regression analysis was calculated to be 122, given the desired probability level of 0.05, assuming 11 independent variables in the model (on the basis of the literature search section 2.11, table 2.3), with the medium anticipated effect size (f^2=0.15), and the desired statistical power of 80% (Soper, 2012).

There is another approach (rule of thumb) for the number of questionnaires to be completed for regression analysis based on the expected number of independent variables in the final model. According to Peduzzi et al. (1996) at least 10 cases are required for each prognostic factor (variable) to be tested in the final regression model. On the basis of this criterion, a minimum of 110 questionnaires should be completed in order to run multivariate regression analysis on the data set assuming a maximum of 11 variables (on the basis of the literature search section 2.7, table 1) in the final model. Thus a total of 376 completed questionnaires is required to meet both objectives.

4.4.2 Adjustment for the design effect

The study was intended to collect information from the 376 participants from the 27 academic classes of the six different institutes. According to Rowe and colleagues (2002) a similarity amongst participants in each institute and within each academic class reduces the variability of their responses, compared with that expected from a random sample. This leads to a loss of statistical power for the study to detect any differences in the group of participants with and without the health conditions under consideration. In this situation, there is a need to increase sample size to maintain the power of the study (Rowe et al. 2002). Thus, the calculated sample size is adjusted for the design effect which is an estimate of unit variance (Moonseong et al., 2010). This adjustment for design effect inflates the variance of parameter estimates and ensures an enhanced variability in participants' responses which is desirable to maintain the power of study when the used sampling technique in study is other than the simple random sampling.

In the current study, the maximum sample size was calculated to be 376. It was multiplied by 2 for design effect as used in an earlier survey conducted among schoolchildren in Pakistan (Mahmood, 2009). Hence, a minimum of 752 completed questionnaires was required to meet the objectives of the study.

4.4.3 Anticipated response rate

Other studies using self-administered questionnaire in medical college setting in Pakistan have had response rates of 25% (Mahmood et al., 2013) and 47.5% (Minhas et al., 2010). Minhas and colleagues (2010) also reported an excellent (93.2%) questionnaire completion rate when conducting a study in a single institute of the DUHS. On the basis of these earlier studies, a response rate of approximately 30% was anticipated. It was decided to administer at least 2500 questionnaires to the participants in order to obtain a minimum of 752 completed questionnaires.

4.5 Sampling technique

There are two types of sampling methods used in research; probability and non-probability sampling. Probability sampling methods are used to ensure the representativeness of a sample which is based on a random selection of participants (Punch, 1998). Among probability sampling methods, four techniques are widely used; simple random sampling, systematic sampling, stratified sampling, and cluster sampling. In the first three sampling techniques, the researcher needs a complete list of participants (unit) for selection of the individuals whereas in the last one the researcher selects clusters/groups (unit) of participants for participation (Levy & Lemeshow, 2008). Thereafter, individuals are selected from among clusters (groups) for participation in the study (Bryman, 2004). Among the non-probability sampling methods, census, convenience and quota sampling techniques are the most common. In these techniques, selection of participants is non-random (Bryman, 2004).

In the current study, the researcher selected six different professional institutes purposively as the focus of research was on undergraduate students of medicine and allied health sciences only. The use of probability sampling was not appropriate in this case, as this could have led to selection of institutes such as Ojha Institute of Chest Diseases or the Institute of Computer Sciences which are irrelevant to the study question.

Within each institute, there was only one section of each academic year and again probability sampling was not applicable at this level. The researcher recruited participants from each academic year. Also, in each academic year participants could have been selected using simple random sampling. However, lack of availability of a complete list of participants (a prerequisite for simple random sampling) for each academic year was a practical limitation to using this technique. Thus, efforts were made to approach everyone in each academic year to ensure they all had equal chance of participation.

Participants were recruited from the six institutes which included DMC, SMC, DIKIOHS, DCOP, ION and COP. There were five academic years (1st, 2nd, 3rd, 4th, final year) in DMC, SMC and DCOP and four academic years (1st, 2nd, 3rd, final year) in DIKIOHS, COP and ION[18]. This makes a total of 27 academic year sets. The total number of students enrolled in the selected institutes at the time of the study was 4785 (DMC 1750; SMC 1750; DCOP 500; DIKIOHS 400; COP 200; ION 185). The sampling technique is summarized in Figure 4.1

4.6 Data collection tool

A self-administered questionnaire was used for data collection as is common for survey studies in research (Bourque, 2004). The advantage of this methodology is that it allows for the collection of required information from a large number of participants in a small amount of time compared to conducting one-to-one interviews in qualitative research (Levy & Lemeshow, 2008). However, depth of information collected in qualitative research cannot be ignored. The following sections describe how the study questionnaire was developed.

4.6.1 Development of questionnaire

As there was no existing questionnaire that could collect all the relevant information on this topic according to the study objectives, a new study questionnaire was developed. The first step for designing a questionnaire is 'a thorough search' of the literature to explore and identify the relevant questionnaires which could be adapted or modified.

Initially, a comprehensive literature search was carried out using the major electronic databases (Medline, CINAHL and EMBASE). Various search terms (such as misperception, underestimation, overestimation, body weight, overweight, obesity, role model) in different combinations were used to find questionnaires of the studies conducted on similar topics previously. A number of questionnaires were identified containing relevant material (Blokstra et al., 1999; CDC, 2010; Krista & Mark, 1996; Kuchler & Variyam, 2003; Mahmood, 2009; Mendelson & White, 1982; Perkin et al., 2010; Relton et al., 2011; Sa´nchez-Villegas et al., 2001; Thomson et al., 2004). Although these questionnaires were related to weight, body

[18] BSc. Nursing is a four year program. As the program started recently, the first intake was in the 3rd year at the time of data collection.

Figure 4.1: Sampling technique

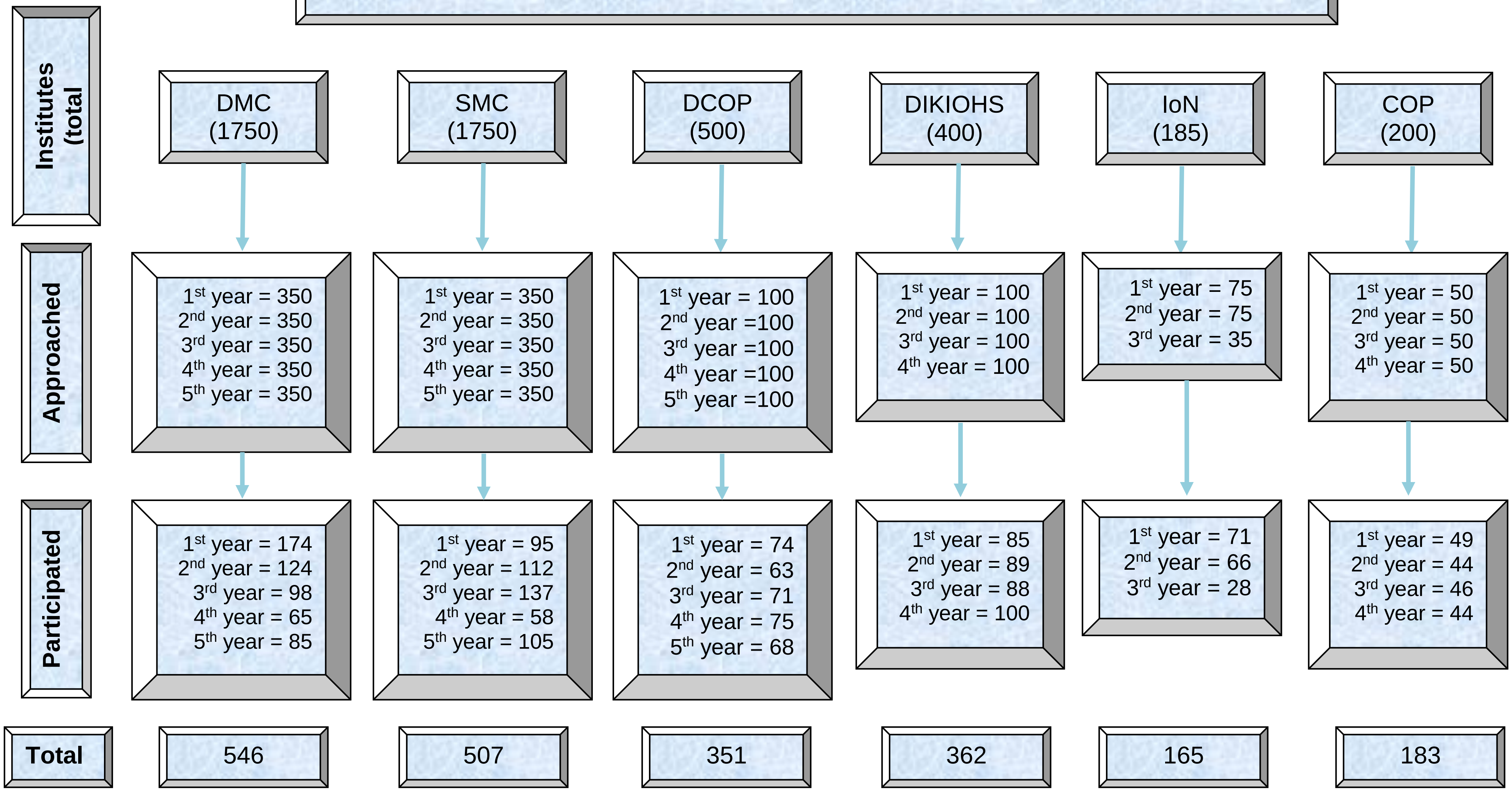


Table 4.2 (a): Brief description of the studies

Author & Year	Study title	Study objectives	Population	Setting	Sample size
Blokstra et al. (1999)	Perception of weight status and dieting behaviour in the Dutch population	To study the perception of weight status, the accuracy of self-assessment of weight status and weight control practices relative to the degree of adiposity in Dutch men and women	Adults aged 20-65 years	Denmark	4601
CDC (2010)	National Health and Nutrition Examination Survey 2009-2001	To assess the health and nutritional status of adults and children in the United States and to determine the prevalence of major diseases and risk factors for disease	Adults and children	US	5,000
Krista et al. (1996)	Children's perceptions of peer influence on eating concerns	To explore how children's perceptions of peer influence were associated with their eating and body image concerns and how children's eating concerns and perceptions of peer influence differed by grade and gender	Schoolchildren aged 8-12 year	US	264
Kuchler et al. (2003)	Mistakes were made: misperception as a barrier to reducing overweight	To examine the agreement between individuals' weight status as measured by their body mass index (BMI) and their perceptions of their weight status in the US population	Adults aged 20 or over	US	16209
Mahmood (2009)	Perception of body weight among schoolchildren	To estimate the prevalence of underestimation of body weight among schoolchildren in grades 9-10	Schoolchildren	Pakistan	914

Table 4.2 (b): Brief description of the studies

Author & Year	Study title	Study objectives	Population	Setting	Sample size
Mendelson et al. (1982)	Relation between body esteem and self-esteem of obese and normal children	To explore the relation between body esteem and self-esteem of obese and normal children	Schoolchildren	Canada	36
Perkin et al. (2010)	Peer weight norm misperception as a risk factor for being over- and underweight among UK secondary school students	To assess the misperceptions of peer weight norms and their association with being overweight or underweight among UK youth	Secondary school students	UK	2104
Relton et al. (2011)	South Yorkshire Cohort: a ‘cohort trials facility’ study of health and weight	To report the prevalence of obesity and overweight and associated variables	All patients registered with GP practices in South Yorkshire aged 16 to 85 years	UK	20,000
Sa´nchez-Villegas et al. (2001)	Perception of body image as an indicator of weight status in the European Union	To identify the factors associated with an adequate perception of body image in relation to body weight.	Adults aged 15 or over	European Union	15232
Thompson et al. (2004)	The Socio-cultural Attitudes Towards Appearance Scale-3 (SATAQ-3): Development and Validation	To develop and validate a revision of a widely used measure of societal influences on body image and eating disturbances	Women aged 17-25	US	370

image and perception of body weight, they were diverse in terms of the collected information and studied population. A brief description of these studies is provided in Table 4.2. The following paragraphs describe the type of questions found in these questionnaires and their relevance to the current study.

The majority of the questionnaires found were designed for adult participants. The South Yorkshire Cohort health questionnaire (Relton et al., 2011) was developed to collect weight, health, exercise, diet and work related information from those aged 16-85 in the UK. The questionnaires used by Sa´nchez-Villegas et al. (2001) and Kuchler & Variyam (2003) targeted adults in European countries (age ≥15 years) and America (age ≥20 years) respectively and collected information about perception of body weight. Similarly, Blokstra et al. (1999) used a questionnaire to explore the perception of weight status and dieting behaviour in Dutch adults (aged 20-65). A number of questionnaires on the topics of "Feedback on physical appearance scale", "Physical appearance comparison scale" and "Obligatory exercise questionnaire" were found (Thompson et al., 2004; Thompson, 1999). For example Thomson (1999) used a frequency scale (1 to 5) to measure participants' responses to different aspects of physical appearance whereas the other questionnaire was a validated tool to measure the societal influences on body images and eating disorders among women in the US (Thompson et al., 2004).

The remaining questionnaires found were used among children. For example, questionnaires used by Mahmood (2009) and Perkin and colleagues (2010) collected information from schoolchildren regarding their body weight and perception. Heinberg and colleagues (1999) developed a questionnaire on the socio-cultural attitudes of children towards appearance and formulated the questions especially in the context of the media e.g. television and magazines. Similarly, Krista & Mark (1996) used the frequency scale (ranges from "never" to "a lot") to measure participants' responses regarding peers' and friends' influence on self-perception of body weight. The questionnaire used by Mendelson & White (1982) provides a binary response option (Yes/No) for self-esteem questions. The CDC's (2010) National Health and Nutrition Examination Survey questionnaire was used to collect detailed information about weight and diet of children as well as the adult population.

Relevant questions regarding body weight, perception of body weight, influence of friends, peers and the media on perception, and dieting behaviour were taken from the above-mentioned questionnaires and modified according to the needs of the current study as described below. Also, two of the researchers (Bhanji et al., 2011; Kuchler & Variyam, 2003) who are experts in the field were approached for guidance in this regard.

In the light of previous studies, and expert advice, an initial questionnaire was developed in English, and was piloted on the students on Institute of Physical Medicine and Rehabilitation before starting the actual study to evaluate the language, content and structure. The details of the pilot study are given in section 4.10.3. According to the majority of students, the developed questionnaire had clear instructions and questions, and the choices provided for response were exclusive and exhaustive.

However, some students commented on the way questions were phrased and provided suggestions to improve them. Careful attention was paid to the phrasing of questions in order to reduce ambiguity for the students as emphasized by McColl et al. (2001). Similarly, the response categories of a couple of questions were revisited and modified in order to ensure validity as recommended by Ehrlich et al. (2006). After suggested modifications, the questionnaire was finally discussed again with the supervisors [JF, CR] until a consensus was agreed as to its final content.

4.6.2 Questionnaire

The study questionnaire had 54 questions spread over five double sides of A4 page size. These questions covered; personal characteristics and details (such as gender, date of birth, self-reported height and weight, degree programme, year of study, ethnicity), family characteristics (such as number of family members, siblings, birth order, parents' qualifications and occupations), self-perception of body weight, social characteristics and anthropometric measurements (height, weight, waist and hip circumference). Participants' information sheet, consent form and study questionnaire are in appendix 4, 5 and 6 respectively.

4.6.3 Types of question

Two types of question were included in the questionnaire; the open-ended and closed ended. Compared to open-ended questions, closed questions are more straightforward and easy to answer (Karen et al., 2008).

There were 38 closed questions, with single as well as multiple choice options, and among these, a Likert scale was also used in two sections of the questionnaire. In order to make it easy for participants to show their agreement or disagreement, a variety of response categories were used; (i) never, sometimes, often, usually, always (ii) strongly disagree, disagree, neither agree nor disagree, agree and strongly agree. Each response category represents an important aspect of the topic under investigation.

A good logical flow of information helps in building good rapport with participants in self-administered questionnaires (Shaughnessy et al., 2011). Care was taken to ensure this was the case for this study. The questionnaire was divided into six parts and started by seeking general information in the sections "About you" and "About your family" and then moved to specific questions on body weight in the sections "About your body weight" and "Your body weight and people around you". Next, participants were asked more specifically about self-perception of body weight in "Your opinion about development of self-perception of body weight". Finally, there was a section on "Anthropometric measurement" where actual measurements of the participants were taken by research officers. Each section of the questionnaire is briefly described in the following sections.

About you

In terms of self-perception of body weight, it is very important to take information about personal characteristics of participants e.g. gender (Bhanji et al., 2011; Madrigal et al., 2000), age (Bhanji et al., 2011; Brug et al., 2006), BMI (Joshi et al., 2007; Pattullo et al., 2011), ethnicity (Dustin et al., 2011; Rahman et al., 2010), and socio-economic status (Kuchler & Variyam, 2003; Bolton-Smith et al., 2000).

In this section, respondents were asked to record gender, date of birth, height, weight, name of degree programme they were enrolled on, and year of study. They were also asked about their mother tongue. This question had eight options giving the most common languages spoken in the city. In the case of the last option (others), they were asked to specify their language. Respondents were also asked about the type of family set-up they were living in.

About your family

Apart from educational institute, students spend most of their time at home with the family and this can play a significant role in the development of self-perception of body weight (Brown et al., 2010; Lo WingSze et al., 2009; Maximova at el., 2008).

Here, respondents were asked about their family characteristics including the total number of family members, and siblings, and their birth order, with four possible response categories. This question was thought important as birth order can affect attitude and behaviour of an individual. For example the eldest in a family is often expected to take more responsibility (Argys et al., 2006). They were also asked if they live in nuclear family system (live with parents and siblings) or combine family system (live with parents, siblings, and grandparents/uncles/aunties/cousins). However, living with partner (without formal marriage) is socially unacceptable and nearly impossible to be reported in our setting. Similarly, it is unlikely among medical students to get married during studies as 100% students reported single marital status in one of the studies conducted among medical students of Pakistan (Shah et al., 2010). Thus information of marital status and living with partner were not explored in current study.

Parents' qualification is an important factor which shapes and modifies the overall personality of an individual (Aboutalebi & Tahmasian, 2010). Participants were asked separately for their mother's and father's qualification level, and were offered seven possible response categories ranked according to the current education system of Pakistan.

Finally, the last two questions in this section were to determine socio-economic status (SES) of participants as this has a strong association with self-perception of body weight (Corneel et al., 2011; Kuchler, 2003; Bolton-Smith et al., 2000). Participants were asked about their accommodation (owned or rented), then about the number of household items they had in the home. Of a list of ten items; radio, television, telephone, computer, washing machine, fridge, air conditioner, bicycle, motorcycle, and car, they were asked to mark all which applied to them. The assessment of SES through household items is a commonly used method in Pakistan because people are very sensitive to direct questions about family income. That is why, the SES of participants is assessed by using household items information such as in Pakistan's official survey 'National Health Survey of Pakistan' (Pakistan Medical Research Council, 1998).

About your body weight

According to Bhanji et al. (2011) knowledge about personal body weight also has an influential role in development of self-perception of body weight.

Initially, a set of nine body images [Figure 4.2] adopted from Stunkard et al. (1983) were shown to participants. A separate set were shown for men and women, ranging from underweight to obese. They were asked 'In the following images, please circle the one body image that you think the best represents your current body weight'. These figures correspond to body weight on a scale ranging from 1 to 9; figure 1 being the thinnest and 9 being the most obese. These figures were finally categorized into four groups; figure 1 and 2 = underweight, figure 3 and 4 = normal weight, figure 5, 6 and 7 = overweight, and figures 8 and 9 = obese. Earlier studies have also used these body images (Alwan et al., 2011; Bhuiyan et al., 2003; Lo et al., 2012).

Next, respondents were asked 'when did you last measure your weight?', whether they knew their BMI and if they had calculated their BMI in the last six months. Participants were also asked to report the BMI value if they knew.

Respondents were then asked about their current body weight status. They were provided with five weight categories to choose from; very underweight, underweight, about right, somewhat overweight, and very overweight. This was compared with their actual BMI to assess whether he/she had correct perception or not. This was the main outcome variable in the study and enabled to assess the proportion of participants who underestimated, overestimated or correct estimated their body weight.

Figure 4.2: Body figures for self-perception of body weight (Stunkard et al., 1983)

1	2	3	4	5	6	7	8	9
BMI ≤ 18.5		BMI 18.5 – 24.99		BMI 25.0 – 29.99			BMI ≥ 30.0	
Underweight		Normal weight		Overweight			Obese	

In order to explore the basis for their self-perception, they were asked ‘how do you know about your weight category?’, and given five possible response categories; ‘you checked it, doctor/nurse told you, friends/colleagues told you, siblings told you, or/and parents told you’. Participants were further asked ‘In the past year, did you seek help from a dietician, nutritionist, doctor or any other health professional to gain/lose weight?’. They were also asked about weight modification practices ‘In the past year which of the following statements best describes your situation?’, and given three response categories; ‘I tried to lose weight, I tried to gain weight, I did not try to do anything about my weight’.

Your bodyweight and people around you

Friends, colleagues, parents, siblings and other people around an individual may also influence the development of self-perception of body weight as earlier research has demonstrated that such people have tendency to change an individual’s perception about his/her body weight (Baughcum et al., 2000; Jones & Crawford, 2006; Mackey et al., 2008)

Here, respondents were asked whether their friends, colleagues, siblings, and parents pointed out their body weight to them. Participants were asked questions such as ‘Do your colleagues/friends point at you because of your weight’, and ‘Do your colleagues/friends make fun of you because of your body weight'. These questions had five response categories; never, sometime, often, usually and always.

Similarly, respondents were asked about the influence of parents and siblings on how they perceive their body weight. These are the most influential people who usually have direct contact with individuals. Therefore, participants were asked 'In the past year, have your parents commented on your weight?'. If they replied 'Yes', participants were then asked 'have your parents said that your weight is too low or high?' Similar questions were asked regarding their siblings.

Finally, respondents were asked about the role of the media e.g. magazine, television in influencing their self-perception of body weight. These were closed questions with five response categories: never, sometime, often, usually and always.

Your opinion about development of self-perception of body weight

It was also important to explore personal opinions of an individual about their development of self-perception of body weight. They were asked about the role of their friends, siblings, parents and the media in the development of their self-perception. For example in case of friend, they were provided with specific statements 'My friends influence how I perceive my body weight'. They were given five possible response categories: strongly disagree, disagree, neither agree nor disagree, agree and strongly agree. Similar questions were asked for siblings, parents and the media.

Thereafter, participants were asked 'Do you think being a health professional in future, people may consider you as a role model in terms of weight?', and 'Do you think that with ideal body weight, your education will be more effective to your patients in maintaining their healthy diet and lifestyle?'.

Your anthropometric measurements

This was the final section of the questionnaire, where respondents' height, weight, waist and hip circumference were measured and reported by research officers. Height and weight were used to calculate BMI. Waist and hip circumference measurement were also taken as it is suggested that waist and hip circumference are more important when assessing the risk for chronic diseases in overweight or obese individuals (Chan & Christakis, 2003; Wang et al., 2004).

At the end of the questionnaire, students were asked if they wanted to enter into a free prize (Parker pen) draw as a token of their participation in the study. They were requested to provide their name, email or postal address (optional) so that the principal investigator would be able to contact the winner of the prize. They were also asked if they would like to be contacted in future for the purpose of research.

4.6.4 Printing of questionnaires

A total of 2500 copies of questionnaire were printed locally (Karachi) because of logistics and low cost. They were printed in the form of a coloured booklet, printed separately for men and women in light green and pink respectively, each having the appropriate set of body images.

4.7 Anthropometric measurements

In anthropometric measurement, height, weight, waist circumference and hip circumference of the participants were measured by research officers.

Height and weight of the participants were measured by a portable Stadiometer (Seca Model 213, SecaGmbh Co, Hamburg, Germany) and electronic weight scale (Seca™, Hamburg, Germany) respectively. Waist circumference (WC) and hip circumference (HC) were measured by using non-stretch measuring tape (Gulick II, Country Technology, Gays Mills, WI). Instruments were checked for accuracy and calibrated prior to use on daily basis.

The following protocol was used for these measurements.

4.7.1 Measurement of height

- A portable height meter was used for measuring height.
- It was measured in centimetres, and rounded up to the nearest 0.5cm.
- The height scale was placed vertically to the hard smooth wall with its base at floor level. The floor next to the scale was hard.
- Participants were asked to take off their shoes
- Participants were also asked to remove any other heavy outer garments e.g. sweater, coat or jacket
- Participants were requested to stand against the scale, and facing toward the research officer with arms hanging loosely by their sides and feet together.
- Participants were asked to look straight ahead to ensure their head position was such that an imaginary line (also known as the Frankfurt plane) passing through the external auditory meatus (external ear) and lower bone of the eye socket would be horizontal or parallel to the ground.
- A light weighted horizontal metallic scale was used to place on the head of the participant for pressing hair flat and touching the height scale.
- Research officers were advised to stand on the platform provided in case the participant’s height was more than their own for an accurate reading.

Figure 4.3 provides an illustration of the height measurement procedure.

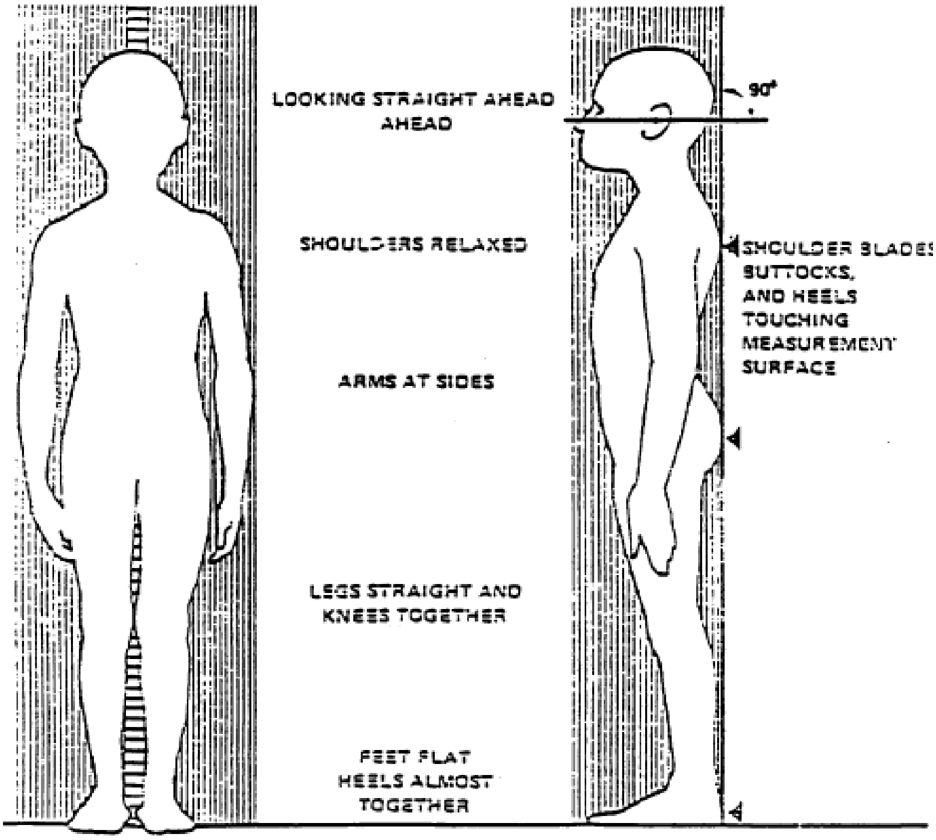


Figure 4.3: Height measurement

4.7.2 Measurement of weight

- Weight was measured by using a solar-powered digital weight machine.
- This was measured in kilograms, and rounded up to the nearest 0.1 Kg.
- Participants were requested to remove their shoes.
- Participants were also asked to empty their pockets (wallet, purse or mobile) and to remove any heavy outer garments e.g. sweater, coat or jacket
- The weight scale was placed on a horizontal, smooth, and hard surface, and exposed directly to the light in the room.
- Participants were asked to stand on the scale in such a way that their weight was distributed evenly on both feet.

4.7.3 Measurement of waist circumference

- It was measured in centimetres and rounded up to the nearest 0.5cm.
- The measurement was taken without extra or heavy outer garments e.g. sweater, coat and jacket.
- Participants were asked to face toward the research officer with arms hanging loosely by their sides and feet together.
- Waist circumference was taken from midway between costal margins and the iliac crests [Figure 4.4].

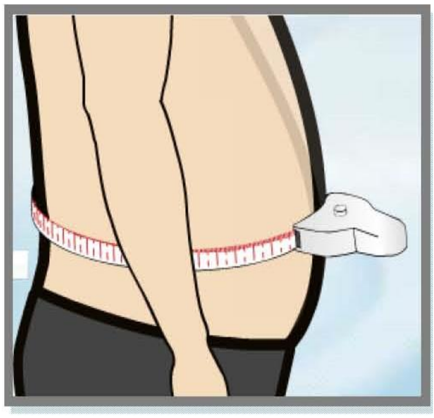


Figure 4.4: Waist measurement

- In order to avoid unnecessary contraction of the abdominal muscles, participants were asked to breathe gently.
- Research officers were advised to stand to the left of the participant and to hold the measuring tape against the participant's waist on his/her left side; then to pass it around the participant's waist, to meet the beginning.
- The research officers ensured that the tape should be neither too tight nor too loose. They were also advised to make sure the tape was horizontal or level.
- They were also advised to ask participant who appeared to be obese to hold the tape while they walked around them holding the other end of the measuring tape.

4.7.4 Measurement of hip circumference

- It is defined as the circumference at the level of the largest gluteal circumference as illustrated in Figure 4.5.
- It was measured in centimetres and rounded up to the nearest 0.5cm.
- The protocol for measurement of hip circumference is the same as described for waist circumference (section 4.8.3) except for the position of the measuring tape.

Figure 4.5: Hip measurement

4.8 Variables in the study

4.8.1 Dependent variable

The main dependent (outcome) variable in the study is "underestimation of body weight". This was assessed using four different methods, described below briefly.

Self-reported weight status versus weight status on the South Asian BMI criterion

For this method, self-reported weight categories for participants (underweight, normal weight, overweight, obese) on the questionnaires were compared with their actual body mass index (BMI) categories created on the basis of actual measured height and weight [Table 4.3]. The proposed South Asian (SA) body mass index (BMI) cut-off points were used for this purpose (Misra et al., 2009). According to the South Asian BMI cut-off points a person is labelled as underweight if BMI was <18.5, normal weight if BMI was between 18.5 to 22.99, overweight if BMI was between 23 to 24.99 and obese if BMI was ≥ 25. The reason for using lower BMI cut-off points for SA population is the higher risk associated with diabetes and cardiovascular diseases among this population even at lower levels of BMI as compared to the white population (Banerji et al., 1999; Jafar et al., 2006; Snehalatha et al., 2003; Tillin et al., 2015).

By comparing self-reported weight categories of an individual with his/her South Asian BMI category, the outcome variable was labelled as "Underestimation (yes)" if;

- ✓ A participant on the SA BMI criteria was normal weight, but verbally responded as underweight[1]
- ✓ A participant on the SA BMI criteria was overweight, but verbally responded as underweight[2], or normal weight[3]
- ✓ A participant on the SA BMI criteria was obese, but verbally responded as underweight[4], normal weight[5], or overweight[6]

Table 4.3: Self-perception of body weight (reported vs actual weight status): the South Asian BMI criterion

Self-reported weight categories	**Weight categories according to South Asian BMI criteria**			
	Underweight BMI <18.5	*Normal weight BMI 18.5 to 22.99*	*Overweight BMI 23.0 to 24.99*	*Obese BMI ≥25*
Under weight	√	**Underestimation[1]**	**Underestimation[2]**	**Underestimation[4]**
Normal weight	Overestimation	√	**Underestimation[3]**	**Underestimation[5]**
Overweight	Overestimation	Overestimation	√	**Underestimation[6]**
Obese	Overestimation	Overestimation	Overestimation	√

Self-reported weight status versus weight status on the WHO BMI criterion

This was decided to assess the outcome variable (underestimation) by using the widely used BMI cut-off points suggested by the World Health Organization (WHO) [Table 4.4]. This would enable to compare the difference of findings with those based on the SA BMI cut-off points. Additionally, this information would be useful (for comparison) in future research from developed countries where WHO BMI cut-off points are recommended and used.

Based on WHO BMI cut-off points, a person is labelled as underweight if BMI was <18.5, normal weight if BMI was between 18.5 to 24.99, overweight if BMI was between 25 to 29.99 and obese if BMI was ≥ 30 (WHO, 2000). By comparing self-reported weight categories of an individual with his/her WHO BMI category, the outcome variable is labelled as "Underestimation (yes)" if;

- ✓ A participant on the WHO BMI criteria was normal weight, but verbally responded as underweight[1]
- ✓ A participant on the WHO BMI criteria was overweight, but verbally responded as underweight[2], or normal weight[3]
- ✓ A participant on the WHO BMI criteria was obese, but verbally responded as underweight[4], normal weight[5], or overweight[6]

Table 4.4: Self-perception of body weight (reported vs actual weight status): the WHO BMI criterion

Self-reported weight categories	**Weight categories according to WHO BMI criteria**			
	Underweight BMI <18.5	*Normal weight BMI 18.5 to 24.99*	*Overweight BMI 25.0 to 29.99*	*Obese BMI ≥30*
Under weight	√	**Underestimation[1]**	**Underestimation[2]**	**Underestimation[4]**
Normal weight	Overestimation	√	**Underestimation[3]**	**Underestimation[5]**
Overweight	Overestimation	Overestimation	√	**Underestimation[6]**
Obese	Overestimation	Overestimation	Overestimation	√

Self-reported weight status on body image versus weight status on the SA BMI criteria

The responses of students on the set of nine body images provided (shown in Figure 4.2; section 4.7.3) were compared with their actual weight status based on SA BMI cut-off points. This additional information would provide useful (estimate of underestimation) information to the future researchers especially who will use body images for the self-perception of weight instead of verbal response among adult population in South Asian countries.

By comparing self-reported weight category of an individual on body image with his/her SA BMI categories, the outcome variable is labelled as "Underestimation (yes)" if;

- ✓ A participant according to the SA BMI criteria was normal weight, but on figures responded as underweight (ticked figure 1, or 2)
- ✓ A participant according to the SA BMI criteria was overweight, but on figures responded as underweight, or normal weight (ticked figure 1, 2, 3, or 4)
- ✓ A participant according to the SA BMI criteria was obese, but on figures responded as underweight, normal weight, or overweight (ticked figure 1, 2, 3, 4, 5, 6 or 7)

Self-reported weight status on body image versus weight status on the WHO BMI criterion

The responses of students on the set of nine body images provided (shown in Figure 4.2; section 4.7.3) were compared with their actual weight status based on the WHO BMI cut-off points. This additional information would provide useful (estimate of underestimation) information to the future researchers especially those using body images for the self-perception of weight instead of verbal response among adult population especially in developed countries.

By comparing self-reported weight category of an individual on body image with his/her WHO BMI categories, the outcome variable is labelled as "Underestimation (yes)" if;

- ✓ A participant according to the WHO BMI criteria was normal weight, but on figures responded as underweight (ticked figure 1, or 2)
- ✓ A participant according to the WHO BMI criteria was overweight, but on figures responded as underweight, or normal weight (ticked figure 1, 2, 3, or 4)
- ✓ A participant according to the WHO BMI criteria was obese, but on figures responded as underweight, normal weight, or overweight (ticked figure 1, 2, 3, 4, 5, 6 or 7)

4.8.2 Independent Variable

There are many candidate independent variables that may have association with underestimation of body weight among students. Table 4.5 below summarizes the variables used in this study.

Table 4.5 (a): Independent variables

Variables	Categories provided	Nature of variable	Type of variable
	Variables related to participant's personal characteristics		
Age	In years or Date of birth	Continuous	Independent
Gender	Men or women	Nominal	Independent
Height (reported)	In feet and inches or centimetres (cm)	Continuous	Dependent
Weight (reported)	In kilograms (Kgs) or Pounds (lbs)	Continuous	Dependent
Degree programme	MBBS, BDS, Physiotherapy, pharmacy, or nursing	Nominal	Independent
Academic year of study	1^{st} year to 5^{th} year	Ordinal	Independent
Mother tongue (for ethnicity)	Urdu, Punjabi, Sindhi, Pashto, Hindko, Saraiki, Memmoni	Nominal	Independent
	Variables related to participant's family characteristics		
Family setup	Nuclear (parents and siblings), or Extended (parents, children plus grandparents or uncles/aunties/cousins)	Nominal	Independent
Total family members	Number	Discrete	Independent
Number of brothers	Number	Discrete	Independent
Number of sisters	Number	Discrete	Independent
Birth order	Eldest (1^{st}), Middle (neither 1^{st}, nor last), Last, Only child (no siblings)	Discrete	Independent

Table 4.5 (b): Independent variables

Variables	Categories provided	Nature of variable	Type of variable
Father's qualification	Illiterate (no formal education) Primary (below grade 5) Middle (grades 5 to 8) Matric (grade 10) Intermediate (grade 12 or College) Graduate (e.g. B.A, BSc, M.B.B.S) Post graduate (e.g. M.A, MSc, PhD)	Ordinal	Independent
Father's occupation	Open-ended	Nominal	Independent
Mother's qualification	Illiterate (no formal education) Primary (below grade 5) Middle (grades 5 to 8) Matric (grade 10) Intermediate (grade 12 or College) Graduate (e.g. B.A, BSc, M.B.B.S) Post graduate (e.g. M.A, MSc, PhD)	Ordinal	Independent
Mother's occupation	House wife, working woman, or both	Nominal	Independent
Socio-economic status on the basis of household items (National Health Survey of Pakistan)	Radio, television, telephone, washing machine, fridge, computer, bicycle, motor cycle, car, and air conditioner	Ordinal	Independent

Table 4.5 (c): Independent variables

Variables	Categories provided	Nature of variable	Type of variable
	Variables related participant's body weight		
Current weight status	Selection of a body figure from the set of nine given figures (separate for men and women)	Ordinal	Dependent
Time since last weight measurement	In weeks or months	Continuous	Independent
Knowledge of BMI	Yes or No	Nominal	Independent
Calculation of BMI in last six months	Yes or No	Nominal	Independent
Categorization of body weight	very underweight, somewhat underweight, about the right weight, somewhat overweight, very overweight	Ordinal	Dependent
Source of information about weight categorization	Self-checked, Doctor/nurse informed, parents informed, siblings informed, friends/colleagues informed	Nominal	Independent
Consultation with health professional e.g. dietician, nutritionist, doctor to gain/lose weight	Yes or No	Nominal	Independent
Best description of situation regarding weight modification	Did not try to change body weight, tried to gain weight or tried to lose weight	Nominal	Independent
Method of weight modification	Diet, exercise, or both	Nominal	Independent

Table 4.5 (d): Independent variables

Variables	Categories provided	Nature of variable	Type of variable
	Variables related to participant's bodyweight and people around them		
Do your colleague/friends point at you because of your body weight?	Never, Sometimes, Often, Usually, Always	Ordinal	Independent
Do colleague/friends make fun of you because of your body weight?	Never, Sometimes, Often, Usually, Always	Ordinal	Independent
Do you compare how your body looks with colleague/friends?	Never, Sometimes, Often, Usually, Always	Ordinal	Independent
Do you think your colleague/friends do not like you because of your body weight?	Never, Sometimes, Often, Usually, Always	Ordinal	Independent
Do you think you friends would like you more if you looked thinner/fatter?	Never, Sometimes, Often, Usually, Always	Ordinal	Independent
Do you think you colleague would like you more if you looked thinner/fatter?	Never, Sometimes, Often, Usually, Always	Ordinal	Independent
In the past year, have your parents commented on your body weight?	Yes or No	Nominal	Independent
Have you parents asked you to modify your weight	Yes or No	Nominal	Independent
Parents' suggested method for weight modification	Diet, exercise, or both	Nominal	Independent
In the past year, have your siblings commented on your body weight?	Yes or No	Nominal	Independent

Table 4.5 (e): Independent variables

Variables	Categories provided	Nature of variable	Type of variable
Have you siblings asked you to modify your weight	Yes or No	Nominal	Independent
Siblings' suggested method for weight modification	Diet, exercise, or both	Nominal	Independent
Do you compare your body with those of people on TV or in magazines?	Never, Sometimes, Often, Usually, Always	Ordinal	Independent
Do you feel pressure from TV or magazines to lose/gain weight?	Never, Sometimes, Often, Usually, Always	Ordinal	Independent
Variables related to external influences on participant's self-estimation of body weight			
My friends influence how I perceive my body weight	Strongly agree, Disagree, Neither agree nor disagree, Agree, Strongly agree	Ordinal	Independent
My siblings influence how I perceive my body weight	Strongly agree, Disagree, Neither agree nor disagree, Agree, Strongly agree	Ordinal	Independent
My parents influence how I perceive my body weight	Strongly agree, Disagree, Neither agree nor disagree, Agree, Strongly agree	Ordinal	Independent
The media influence how I perceive my body weight	Strongly agree, Disagree, Neither agree nor disagree, Agree, Strongly agree	Ordinal	Independent

Table 4.5 (f): Independent variables

Variables	Categories provided	Nature of variable	Type of variable
Variables related to participant's perception about role of health professionals			
Do you think being a health professional in future, people may consider you as a role model in terms of weight?	Yes or No	Nominal	Independent
Do you think that with ideal body weight, your education will be more effective to your patients in maintaining their healthy diet and body weight?	Yes or No	Nominal	Independent
Variables related to actual measurement			
Height	In centimetres (cm)	Continuous	Dependent
Weight	In kilograms (Kgs)	Continuous	Dependent
Waist circumference	In centimetres (cm)	Continuous	Independent
Hip circumference	In centimetres (cm)	Continuous	Independent

4.9 Planning for data collection

In the planning phase of data collection, research officers were recruited and trained. Pilot work was also carried out before collecting actual data for the study. The following sections provide details in this regard.

4.9.1 Recruitment of research officers

On the basis of previous research experience, the principal investigator personally contacted the research departments of two of the medical universities to check their curriculum vitae (CV) bank for recruitment of research officers. For research officers, it was essential to have at least a bachelor’s degree (Social Sciences) and prior work experience of at least one research project. Seven of the potential candidates were contacted. Within a week four of these were found to be available for the project within 10 days.

In order to suit the cultural norms and research setting, two male and two female research officers were recruited. Usually, female participants feel uncomfortable or reluctant to be physically measured by male research officers. Recruitment of male and female research officers provided a comfort zone for participants and enhanced study and questionnaire completion rate.

4.9.2 Training of research officers

A 15 hour training workshop spread over three days was arranged for research officers in the third week of March 2012. In training, the principal investigator gave them a briefing about the overall research project and significance of this research and its potential benefits to individuals and to society at large. They were also told about the sampling technique, inclusion criteria and significance of each.

Thereafter, research officers were told about the research questionnaire in detail in order to ensure they understood the entire questionnaire especially the response categories of the questions. The workshop was facilitated with a question and answer session to clarify any confusion. They were also given a briefing about standard techniques used for physical measurement and their importance in research, followed by an extensive practical session for anthropometric measurement of all four measurements. They were also given the opportunity to practise measuring and to critically evaluate each other and so were able to build up their confidence.

The importance of effective communication skills was also highlighted during training. Research officers were told about their role and responsibilities and the ways to respond to the questions of students if required. The main responsibilities of the principal investigator and research officers are described in **Appendix 7.**

4.9.3 Pilot study

According to Lancaster and colleagues (2004) a pilot study tests the logistics and helps in understanding the potential difficulties in the main study. It also helps to modify data collection techniques and approaches to maximize the study response rate. The content of the study questionnaire and data collection skills of research staff can also be assessed in piloting. Hence, a pilot study was conducted prior to the main study so that necessary modifications could be incorporated accordingly.

Aims

The aim of this pilot work was to assess the participants' response rate and questionnaire completion rate. It was desirable to check the content of the study questionnaire and modify it if required on the basis of participants' comments. It also aimed to assess the generic skills of research officers and to observe the overall logistics and any practical difficulties in the field that could not have been anticipated in advance.

Methodology

The pilot study was conducted in the Institute of Physical Medicine and Rehabilitation (IPM&R) of DUHS. The study population was the first year students of the Bachelor's degree in Occupational Therapy. Although the students on this degree programme do not fall into the inclusion criteria of our study, the entry level qualification of these students was the same as those of our actual study population (students of medicine and allied health sciences). These students were also in the same age group. A sample size calculation was not carried out for the pilot study. Instead, all first year students were targeted.

After permission from the principal of the institute, the first year students of Bachelor degree of occupational therapy were approached. The principal investigator (PI) was introduced to students by the principal of the institute. The PI explained the objectives and significance of the study to students and asked for their participation. Interested students collected study questionnaires from the research officers who were waiting just outside the lecture theatre. Students were asked to complete the questionnaire and returned it in a week's time. They were also informed that research officers would take their anthropometric measurements upon returning completed questionnaires.

Main findings and observations

Class attendance was 92% (46/50) at the time of this meeting, and one reminder was given by class room announcement three days later. More than 95% (44/46) of the students expressed an interest and took questionnaires from the research officers. The questionnaire completion rate was 72.7% (32/44). Overall students were enthusiastic because of the involvement of weight and height measurements. They visited research officers in groups and were found to compare their anthropometric measurements with each other. They were found to be more interested in the measurements of their friends and colleagues than in their own. However, in order to maintain confidentiality, each individual was asked if he/she is comfortable and want to be measured in presence of his/her friends/colleagues. Only those who were happy and gave consent were measured in groups.

Many of the students completed the questionnaires in 10 to 15 minutes. As far as content of the questionnaire was concerned, it was understood by students as the majority of the students were able to complete it. According to students the developed questionnaire had clear instructions and questions and the language was clear. However, some provided comments on how certain questions were expressed (questions 2, 13, 16, 17, 24, and 44), and also suggested modifications.

Some did not respond to Q.3 and Q.4 and at their measurement they said they did not know their height and weight. Similarly, some of students responded to Q.51 and Q.52 which supposed to be filled by research officers after actual weight and height measurements.

Interestingly, three of the students offered their services as an advocate of the study. It was also observed that some students knew of others who had not yet returned the questionnaire and encouraged them so as to discover their height and weight. Though volunteers were not required, this provided the opportunity to consider the role of volunteers to enhance response rate. Hence, volunteer students and participants were requested at the same time for the main study.

One final observation was that the research officers lacked confidence when under pressure. For example, if more than two students turned up to be measured, this was where mistakes in measurement techniques were most likely to occur.

Outcomes and recommendations

Importance of rapport with departmental staff: It was observed that introduction of the PI by the principal of the institute helped in building rapport with students quickly. It was decided to involve the principal or staff members at the time of announcement to increase the study response in the main study.

Content of questionnaire: Some of the students commented on the way questions were phrased and provided suggestions to improve them. For example, question 1 was asking about date of birth and students preferred to write age in years instead of providing date of birth. Thus, in the final version of questionnaire, we added the option of 'age in years' in case someone does not want to provide exact date of birth. Similarly, questions 13 (parents' qualification), 16 (mother's occupation), 17 (residency status), and 24 (current weight status) were also rephrased and modified in the light of participants' feedback after consultation with supervisors.

Providing clear instructions: The PI decided to announce that students need to respond to Q.3 and Q.4 even on the basis of a guess, but should not fill in the last section as it would be completed by research officers who were also advised to make these points clear to students when distributing the questionnaire.

Checking questionnaire for completeness: Research officers were further advised to check these four questions (Q.3&4, Q.51&52) during measurement of each participant even if they had completed the last section by mistake.

Learning from the field mistakes: Another two hour session was arranged for research officers to reflect on their field experience and mistakes observed during measurement were highlighted and practised again in order to reduce their potential to occur in the main study.

Conclusion

A high study response rate is achievable with the involvement of faculty members in the institutes. Though content of the study questionnaire was further improved, participants found it easy to understand and complete. Piloting provided an opportunity to improve overall skills essential for the data collection.

4.10 Data collection

In order to get access to the selected institutes of the university for data collection, it was important to get written permission from the Vice Chancellor (VC) of DUHS. In his absence, the pro-vice chancellor was approached. After several attempts and repeated office visits, meeting was arranged and permission was granted after viewing the study protocol and ethics approval.

Permission for data collection was sought from the principal of institutes and head of departments in each institute. Meetings were also arranged with teaching faculty. One institute was selected at a time for data collection. The data collection was carried out during university working hours (8:30am to 3:00pm from Monday to Saturday). The principal investigator aimed to distribute the maximum number of questionnaires so that the required sample size could be achieved. The following steps were taken in this regard.

Placing the letter of invitation on university notice boards

The letter of invitation for study participation was placed on the main notice board of each institute with permission of the principals and head of departments.

Approaching participants in lecture theatres

After each selected lecture, the teaching faculty took the principal investigator in to lecture theatres and introduced to the students and request their cooperation.

Class room announcement for study participation

The principal investigator briefly explained the study, its objectives and significance and asked students to participate. After introducing the research team, students were shown the questionnaire and asked to collect one from the member of the team waiting outside. They were requested to return completed questionnaires within two weeks. They were also informed about the free entry for a prize. Since female students might have reservations about their measurements being taken by male research officers, it was clarified that measurements would be by same sex officers. They were also told that participation was on a voluntary basis and non-participation would be of no consequence to them.

Involvement of students as study advocates

The principal investigator also asked students to contact members of the research team if they wanted to contribute in the capacity of volunteer or advocate. Similarly, class representatives (only in one institute: DIKIOHS) were specially requested for study advocacy because of their good rapport with students.

Reminders

After a week, students were reminded about completion and returning of questionnaires through class room announcements by teaching faculty and through notice boards.

Availability of research team on stalls

The principal investigator and research team were available on stalls during college lecture time, six days a week so that students could acquire questionnaires. The presence of the research team on the stalls was itself a reminder for students.

Additional efforts to approach students

Class representatives and advocates approached other students in common rooms, cafeteria, library and corridors and asked them to find study participants among their friends, distributing questionnaires to those who agreed. They also encouraged other students to return their completed questionnaires.

Identification of a resource person in each institute

The principal investigator identified a member of university staff as a resource person in each institute. Any change in plan for the field activities was communicated to him. Due to political strikes and the difficult law and order situation, field activities had been suspended on a number of occasions and rescheduled with their help.

4.11 Study Management

Study management was an important aspect of the project and it was the responsibility of the principal investigator. The participating institutes were coordinated accordingly for arranging appointments, scheduling of visits, and any changes in the case of strikes etc. In this regard, a resource person from administration in each institute was chosen to ensure smooth running of activities. The principal investigator maintained the record of the number of questionnaires distributed and returned on a daily basis.

4.11.1 Checking completeness of questionnaires

Field checking

The principal investigator and research officers quickly reviewed the completed questionnaires when participants returned them. The amount of time taken for anthropometric measurements was sufficient for reviewing the completed questionnaire. In the case where a question was found to be incomplete or missing, research officers asked participants if they needed more explanation or clarification on a specific question. Very few questionnaires were found to have incomplete or missing information. Almost all were completed by participants on the spot before submission. Many of the students left Q.3 and Q.4 unanswered as they did not know their measurements. It was explained that they had to guess before going for the actual anthropometric measurements. Some participants filled in Q.51 and Q.52 having recently checked these themselves, but these were replaced by the measurements made by research officers. Field checking of questionnaires at the time of these measurements helped avoid missing information.

Office checking

The principal investigator reviewed the returned questionnaires daily and discussed with research officers any commonly found mistakes. Research officers were also instructed to check specifically questions 3 and 4. As questions 51 to 54 were supposed to be filled in by research officers after actual measurement, this was identified as a potential source of error and addressed accordingly.

4.11.2 Data entry and cleaning

Data entry was done using the software Epi-data version 3.1. The principal investigator developed a file for data entry with all the variables **[Appendix 8]**. Codes were allocated to different response categories for the closed ended questions e.g. Man = 1 and Woman = 2. Similarly, free space was provided for responses given in open-ended questions e.g. father's occupation. Field spaces were provided for each question on the basis of the number of characters in the allocated codes and free space.

Data entry was done by two separate data entry operators in order to minimize the chances of entry errors (Days, 1998). Each data entry operator provided data entry files after entering all the questionnaires. The principal investigator compared both data entry files and generated an error list with the help of the software. The total number of discrepancies identified was 27 **[Appendix 9]** and the data entry operators were asked to check the original questionnaires and correct these. After making corrections, an error list was again generated which showed no discrepancies for both entries.

4.11.3 Data validation

The final data file was transferred to the data analysis software Statistical Package for Social Sciences (SPSS) version 18. In this software the type of variable was defined (e.g. numeric, or string). Similarly, the width of the given codes was changed from default width of 8 characters to the required width, with decimal places defined according to need. Each variable and their response categories were also labelled (e.g. Man = 1 and woman = 2).

Thereafter, the principal investigator again double-checked 300 (15%) randomly selected entries in SPSS with the original questionnaires to ensure the entered data exactly matched the questionnaires. No discrepancy was found. This was followed by logical cleaning of the data. Each variable was sorted out in ascending and descending orders to check for any missing information. No duplicate case (questionnaire) was found because software EPI-data does not allow any duplicate entry of questionnaire number. Frequency tables were made to check missing information. Variables with initial missing information was checked and found that it resulted from the logical sequence of responses and was further confirmed with the help of cross-tabulation.

4.11.4 Data quality control

In order to ensure quality of data the following measures were taken;

- A copy of the manual of instructions was provided to research officers for guidance regarding study procedures.
- Research officers were given extensive training about how to explain the questionnaire to students and answer any queries in order to limit errors during data collection.
- Research officers were given training for anthropometric measurements and these skills were again assessed during piloting with the appropriate feedback.
- Questionnaires upon receipt were checked by research officers for missing information which was completed during anthropometric measurement.
- Questionnaires were reviewed by the principal investigator on a daily basis to check for frequent mistakes which were covered at each subsequent class announcement.
- Maintenance of diaries on a daily basis for field activities.
- Double data entry, cleaning and validation.

4.12 Study time period

Data collection took approximately eight months (from March 2012 to October 2012), almost three months more than initially expected because of the difficult law and order situation in Karachi which resulted in cancellation of appointments and visits on several occasions. Data entry took approximately six weeks, hence the total time period of the study was approximately 10 months.

4.13 Statistical analysis

The software SPSS version 18.0 was used for statistical analysis. The overall analysis is divided into the following two categories; descriptive and inferential statistics.

4.13.1 Descriptive statistics

Overall response and questionnaire completion rate was calculated and reported for each academic year in all participating institutes. Response rate was calculated as the percentage of students who returned completed questionnaires, by the total number of students in that respective academic year and by institute. Questionnaire completion rate was calculated as the percentage of students who returned the completed questionnaires out of the total number of students who took questionnaires.

The distribution of continuous variables was assessed by plotting the data on histogram. Mean and standard deviation were reported for the continuous variables with normal distribution such as age, height, weight, BMI and the number of family members. It was plan to report median and inter-quartile ranges for the continuous variables with skewed distribution. The majority of the variables in the study were categorical. Frequencies and percentages were calculated and reported for the categorical variables such as degree programmes, year of study, ethnicity, parents' education, parents' occupation, birth order, and family characteristics.

Socio-economic status (SES) of participants was assessed by household items. Participants having both a car and air conditioner were labelled as of the high SES regardless of other household items. Similarly, participants having fridge, washing machine, television and computer were labelled as of the middle SES. This category may have either car or air conditioner but not both. In the low SES category participants may have radio, telephone, cycle, and motorcycle. This category may have fridge, television, computer or washing machine but not all of them. After categorization, frequency and percentage of participants in each SES category was reported.

Similarly, the percentage of participants in various categories in terms of knowledge of weight status, sources of weight knowledge and weight maintenance practices was presented. Also, the percentage who received weight related comments from family, friends, and colleagues was recorded. For questions such as 'Do your colleagues/friends point at you because of your body weight?', there were five response categories; never, sometimes, often, usually, and always. For reporting purposes, the first category was considered as 'No' whereas the last four categories were taken as 'Yes' and results are presented in the form of frequency and percentages accordingly. In similar way information for weight stigmatization was collected and reported. Information regarding participants' views about the factors influencing their perception of body weight were also collected on five different response categories; strongly disagree, disagree, neither agree nor disagree, agree and strongly agree. However, the findings are reported in terms of percentages in three categories; agree, disagree and neither agree nor disagree.

BMI of participants was calculated by using participants' actual measured weight (in kilograms) divided by height (in meter^2). BMI was given in four categories by using South Asian (SA) BMI cut-off points; underweight (BMI < 18.5), normal weight (BMI 18.50-22.99, overweight (BMI ≥23.0-24.99), obese (BMI ≥25.00) (Bhanji et al., 2011; Mahmood et al., 2013; Misra et al., 2009; Mozaffer et al., 2009). Also, BMI was given in four categories by using WHO cut-off points; underweight (BMI < 18.50), normal weight (BMI 18.50-24.99, overweight (BMI ≥25.0-29.99), and obese (BMI ≥30.00). Based on both criteria, results are reported in the form of frequencies and percentages for all four weight categories. Participants were also categorized into overweight and obese categories on the basis of waist circumference (men 90cm; women 80cm) and waist to hip ratio (men 0.88; women 0.81) (Misra et al., 2009). As per recommendation of the WHO (2008) and NICE (2013), additional information regarding overweight or obesity and associated risk of diseases among individuals is provided by combining the BMI and WC data by using the agreed cut-off points for the South Asian population (Misra et al., 2009).

The outcome variable (underestimation of body weight) was formed and reported by four different methods to check the differences between them: (1) cross-tabulation between self-reported weight status and actual weight status based on the SA BMI criterion; (2) cross-tabulation between self-reported weight status and actual weight status based on the WHO BMI criterion; (3) cross-tabulation between self-reported weight category on body images and actual weight status based on the SA BMI criterion; (4) cross-tabulation between self-reported weight category on body images and actual weight status based on the WHO BMI criterion. Percentages of participants with underestimation of body weight were reported for all four methods. Agreement between verbal response and response on body images were also presented in the form of Kappa statistics to show how accurately participants picked their weight status on body image compared with what they reported on questionnaire.

Cross-tabulation was also done to explore the descriptive statistics across various variables. Findings are presented in terms of frequencies, percentages and chi square statistics. For example participants' views on whether health professionals are a role model for the general population and with healthy body weight their health education will be more effective for patients were presented in terms of percentage by gender, degree programme, actual weight status and weight stigmatization status [sections 6.2 and 6.3].

Similarly, [sections 7.3] underestimation of body weight among participants was compared with participants' personal characteristics such as gender, year of study, degree programmes and birth order. The percentage of participants with underestimation of body weight was also compared with participants' sources of weight knowledge and weight management consultation and socio-economic characteristics [sections 7.4].

4.13.2 Inferential statistics

Logistic regression analysis was used to obtain the odds ratio and 95% confidence intervals (CI) by using the maximum likelihood estimates method to examine the association of demographic and other personal profile variables with (i) overweight and obesity (ii) underweight status and (iii) underestimation of body weight. For the purpose of inferential analysis, the outcome variable 'underestimation of body weight' was considered the one which was formed by cross-tabulation of self-reported weight status versus weight status on the South Asian BMI criteria.

The focus of the current study is on the underestimation of body weight, but the situation is better explained if issues of overweight and obesity and underweight status are taken into account.

Regression analysis was carried out in three steps; univariate, bivariate and multivariate analysis. Though regression analysis was carried out separately for all three conditions, the basic steps followed were the same. The following sections describe the steps of regression analysis in detail.

Univariate Analysis

In univariate analysis, the objective was to assess the (crude association) magnitude of effect of each independent variable and to regress it individually against the dependent (outcome) variable by considering cut-off point (p-value) of 0.25 for significance and to be considered for multivariate analysis (Bursac et al., 2008; Hosmer & Lameshow, 2000). This arbitrary cut-off point (p-value = 0.25) is based on the Wald test from logistic regression. The traditional cut-off point (p-value = 0.05) at uni-variate level can fail to identify important variables (Bursac et al., 2008; Hosmer & Lameshow, 2000).

The unadjusted odds ratio, their 95% confidence interval and the p-value were determined for each of the independent variables at this level. Variables found to be significant at univariate level were considered for further analysis.

Bivariate Analysis

It is important to check multicollinearity between independent variables before taking them into multivariate analysis. There is a statistical phenomenon in which two or more independent variables are highly correlated with each other in multiple regression models (Hosmer & Lameshow, 2000). For example one independent variable can linearly predict the other independent variable. This phenomenon may change the coefficient estimates erratically in a model (Gujarati, 2003). In order to avoid such a situation, multicollinearity between independent variables was checked in bivariate analysis by using Pearson's correlation test (among continuous variables), Phi & Cramer's V (among nominal variables), Eta (between continuous and nominal variables) and Kendall's tau B (among ordinal variables). A cut-off (r) value of > 0.8 was used to label correlation of variables as multicollinearity (Hosmer & Lameshow, 2000). In case multicollinearity was found between two variables, it was decided to drop less important variable (based on theoretical knowledge) from further analysis.

Multivariate Analysis

Multivariate analysis was carried out to adjust the simultaneous effect of the multiple independent variables on the dependent (outcome) variable. Independent variables which showed significant association at univariate level were considered for multivariate analysis. The "enter" method of analysis was used at this level. Variables were taken into model one by one on the basis of their significance. If a significant variable (in univariate analysis) become non-significant in multivariate analysis, it was removed from the main effect model after checking its confounding effect and biological plausible interactions. A variable was checked for confounding effect if fulfilled the following criteria (Rothman et al. 2008);

- ✓ It should be associated with the outcome variable
- ✓ It should be associated with the exposure variable
- ✓ It should not come in an intermediate pathway of the exposure and outcome variable

Confounding effect was assessed by dividing the difference of crude beta coefficient and adjusted beta coefficient with adjusted beta coefficient and multiplying it by 100. A variable was labelled as confounder and retained in the potential final model if the result was ≥ 10% (Hosmer & Lameshow, 2000). Similarly, biological plausible interactions of independent variables were looked for. A p-value of 0.05 was considered as significant for interactions and to retain the interaction term for further analysis in the potential final model.

For the final model a cut-off p-value of 0.05 was considered as significant to retain any variable in the model. The adjusted odds ratio with 95% confidence intervals was determined for each covariate adjusting for the effect of other covariates in the multivariate model.

First, statistical model was developed for overweight and obesity by using the South Asian BMI criterion. Sensitivity analysis was run to check the stability of model. For this purpose, analysis was repeated after defining overweight and obesity status by using (i) the WHO BMI criterion and (ii) waist circumference. Along with overweight and obesity, statistical model was also developed for factors associated with underweight status and the BMI cut-off points are same (<18.5) for the underweight status on the South Asian well as on the WHO criterion.

Thereafter, statistical model was developed for underestimation of body weight by using the South Asian BMI criterion. Similarly, sensitivity analysis was run to check the stability of model. For this purpose, underestimation of body weight was defined by using the WHO BMI criterion.

4.14 Ethical consideration

The study received ethical approval from the Ethics Review Committee (ERC) of the School of Health and Related Research (ScHARR), University of Sheffield **[Appendix 10]** and the Institutional Review Board (IRB) of DUHS **[Appendix 11]**. Permission was obtained from the pro vice chancellor of the DUHS for data collection **[Appendix 12]**. Similarly, consent was obtained from the head/principal of each participating institute. Short meetings were arranged with teaching faculty of each institute and permission for class room announcements was obtained.

Chapter 5: Descriptive characteristics of the study population

5.1 Introduction

It is important to present descriptive epidemiology of study population before inferential findings. This information is necessary for the determination of whether the individuals in a particular study are a representative sample of the target population for generalization purposes (Banerjee & Chaudhury, 2010). Thus, this chapter provides the readers with the descriptive characteristics of the study population.

5.2 Contribution and response rate of participating institutes

The following sections provide data collection information in terms of questionnaire distribution, completion and response rate from each participating institute which include SMC, DMC, IoN, DIKIOHS, DCOP, and COP.

5.2.1 Sindh Medical College (SMC)

SMC was the first institute approached for data collection. A total of 615 volunteered with a response rate of 27.1% to 39.1% across the 5 years. The exception was the 4th year (at only 16.6%) students who had more commitment on the hospital wards where it was not feasible to meet them. Also they had only one lecture a week where attendance was below 25%. However, the principal investigator was able to achieve a very good (82.4%) overall questionnaire completion rate. Table 5.1 shows the details of the number of questionnaires distributed and returned from the SMC students.

Table 5.1: Data collection from Sindh Medical College

Academic year	Total students (a)	Questionnaire taken (b)	Questionnaires returned (c)	Return (completion) rate [(c/b)x100]	Response rate [(c/a)x100]
1st year	350	114	95	83.3%	27.1%
2nd year	350	136	112	82.4%	32%
3rd year	350	153	137	89.5%	39.1%
4th year	350	77	58	75.3%	16.6%
5th year	350	135	105	77.8%	30%
Total	**1750**	**615**	**507**	**82.4%**	**29%**

5.2.2 Dow Medical College (DMC)

DMC was approached next for data collection. Initially data was collected from 2nd year to final year students as the 1st year students were on vacation. The response rate of students was similar to the response rate received in SMC. It ranged from 24.3% to 35% (except again the 4th year at 18.6%). On their return, the 1st year students' attendance was higher than the other years which increased the response rate to nearly 50%. Table 5.2 shows the details of number of questionnaires distributed and returned from the DMC students.

Table 5.2: Data collection from Dow Medical College

Academic year	Total students (a)	Questionnaire taken (b)	Questionnaires returned (c)	Return rate [(c/b)x100]	Response rate [(c/a)x100]
1st year	350	225	174	77.3%	49.7%
2nd year	350	157	124	79%	35.4%
3rd year	350	122	98	80%	28%
4th year	350	82	65	79.3%	18.6%
5th year	350	105	85	80.9%	24.3%
Total	**1750**	**691**	**546**	**79%**	**31.2%**

5.2.3 Institute of Nursing (IoN)

The Institute of Nursing was next studied and has two degree programmes; BSc. Nursing (four year programme) and Post RN (two year programme). The latter is the degree top-up programme for those nurses already registered. A total of 180 students volunteered and response rate ranged from 80% to 94.7% across the 3 academic years. Table 5.3 shows the details of number of questionnaires distributed and returned from the ION students.

Table 5.3: Data collection from Institute of Nursing

Academic year	Total students (a)	Questionnaire taken (b)	Questionnaires returned (c)	Return rate [(c/b)x100]	Response rate [(c/a)x100]
1st year	75	74	71	95.9%	94.7%
2nd year	75	72	66	91.6%	88%
3rd year	35	34	28	82.4%	80%
Total	**185**	**180**	**165**	**91.6%**	**89.2%**

5.2.4 Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences (DIKIOHS)

The Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences (DIKIOHS) was situated in a double storey building with two main lecture halls and four small laboratories. A total of 389 students volunteered and response rate ranged from 85% to 100% across the 4 academic years. The details of questionnaires distributed and returned from the DIKIOHS students are shown in Table 5.4.

Table 5.4: Data collection from students of DIKIOHS

Academic year	Total students (a)	Questionnaire taken (b)	Questionnaires returned (c)	Return rate [(c/b)x100]	Response rate [(c/a)x100]
1st year	100	96	85	88.5%	85%
2nd year	100	97	89	91.7%	89%
3rd year	100	96	88	92.6%	88%
4th year	100	100	100	100%	100%
Total	**400**	**389**	**362**	**93.3%**	**90.5%**

5.2.5 Dow College of Pharmacy (DCOP)

Dow College of Pharmacy was the next institute on the list for data collection. Table 5.5 shows the details of number of questionnaires distributed and returned from the DCOP students. A total of 432 students volunteered and response rate ranged from 63% to 90% across the 5 academic years. Response rate was less than IoN and DIKIOHS but better than the response from medical colleges.

Table 5.5: Data collection from Dow College of Pharmacy

Academic year	Total students (a)	Questionnaire taken (b)	Questionnaires returned (c)	Return rate [(c/b)x100]	Response rate [(c/a)x100]
1st year	100	92	74	80.4%	74%
2nd year	100	82	63	76.8%	63%
3rd year	100	87	71	81.6%	87%
4th year	100	90	75	83.3%	90%
5th year	100	81	68	83.9%	81%
Total	**500**	**432**	**351**	**81.2%**	**70.2%**

5.2.6 College of Physiotherapy (COP)

The College of Physiotherapy was the best institute in terms of students' response and participation. A total of 193 students volunteered and response rate ranged from 88% to 98% across the 4 academic years. Table 5.6 shows the details of data collection process from the students of COP.

Table 5.6: Data collection from College of Physiotherapy

Academic year	Total students (a)	Questionnaire taken (b)	Questionnaires returned (c)	Return rate [(c/b)x100]	Response rate [(c/a)x100]
1st year	50	49	49	100%	98%
2nd year	50	47	44	93.6%	88%
3rd year	50	49	46	92%	92%
4th year	50	48	44	93.8%	88%
Total	**200**	**193**	**183**	**95.3%**	**91.5%**

5.2.7 Overall contribution and response rate of participating institutes

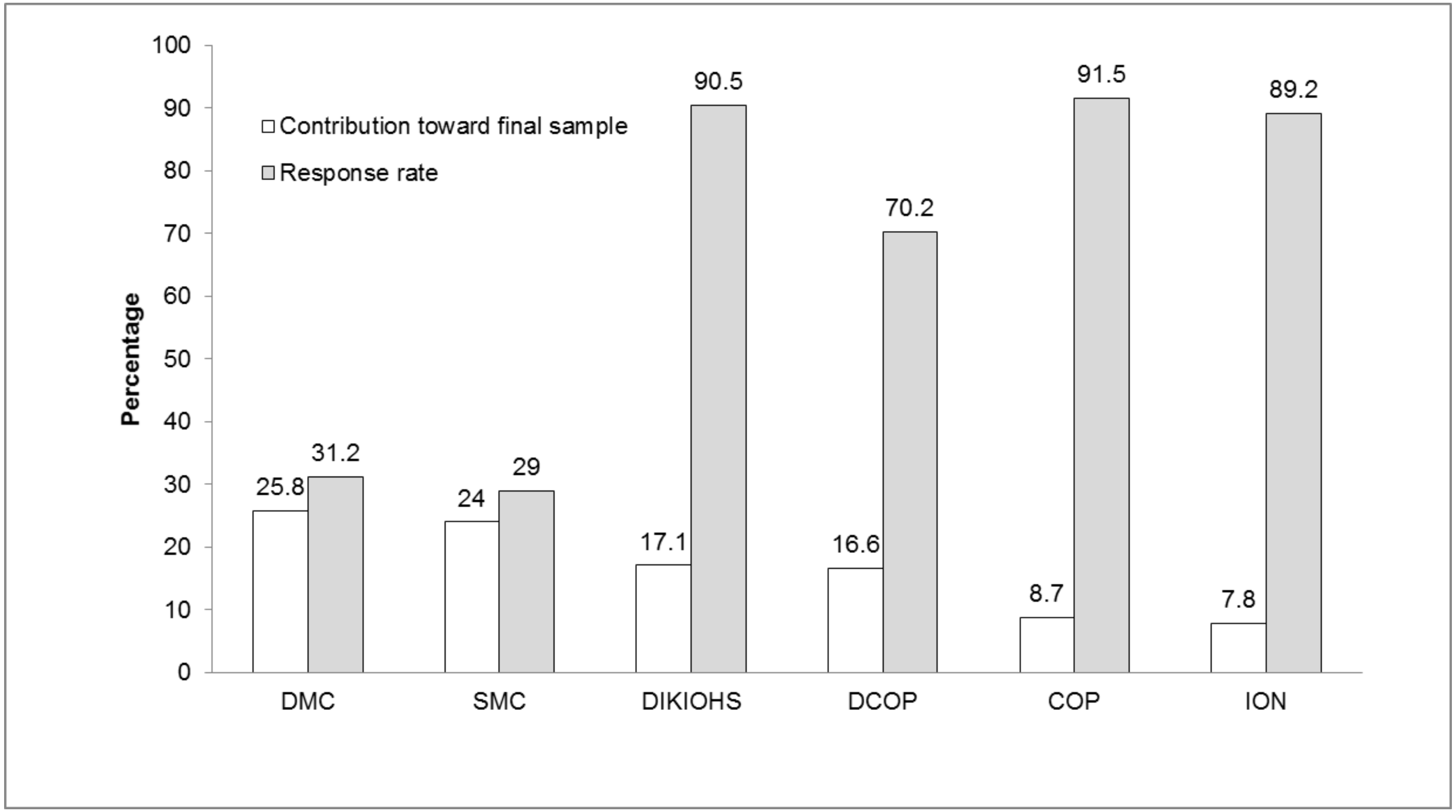
Overall, approximately 4785 students were invited to participate from six institutes. A total of 2500 questionnaires were distributed among interested students. The overall response rate was just below 45%. Similarly, the return rate was excellent (84.6%). Table 5.7 summarizes the overall picture.

Table 5.7: Summary of data collection from all institutes

Name of institutes	Total students (a)	Questionnaire taken (b)	Questionnaires returned (c)	Return rate [(c/b)x100]	Response rate [(c/a)x100]
SMC	1750	615	507	82.4%	29%
DMC	1750	691	546	79%	31.2%
DCOP	500	432	351	81.2%	70.2%
DIKIOHS	400	389	362	93.3%	90.5%
COP	200	193	183	95.3%	91.5%
ION	185	180	165	89.2%	89.2%
Total	**4785**	**2500**	**2114**	**84.6%**	**44.2%**

Graph 5.1 shows the individual contribution of each institute toward the final sample and the participants' response rate from each institute. Although the DMC (25.8%) and SMC (24%) contributed nearly half of the final sample, it is important to note that a much higher response rate was received from the DCOP, DIKIOHS, ION and COP as compared to the DMC and SMC.

Graph 5.1: Contribution of each institute toward the final sample & response rate in each institute



DMC: Dow Medical College SMC: Sindh Medical College DIKIOHS: Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences

DCOP: Dow College of Pharmacy COP: College of Physiotherapy IoN: Institute of Nursing

5.3 Gender

On the basis of information from the administrators of the six institutes, there were a total of 4785 students in the five degree programmes. The overall percentage of men and women was 17.8% (n=850) and 82.2% (n=3935) respectively.

Of the sample, 81.5% were women, similar to their percentage (82.2%) on the courses. Table 5.8 compares the gender of the actual and sampled population across all degree programmes. Further analysis also showed that each academic year has a similar percentage of men and women irrespective of degree programme.

Table 5.8: Gender (Enrolled vs. participated)

Speciality	*Total enrolled students			Students participated in study		
	Total	**Men n(%)**	**Women n(%)**	**Total**	**Men n(%)**	**Women n(%)**
Medicine	3500	593 (16.9)	2907 (83.1)	1053	152 (14.4)	901 (85.6)
Pharmacy	500	74 (14.8)	426 (85.2)	351	68 (19.4)	283 (80.6)
Nursing	185	68 (36.8)	117 (63.2)	165	66 (40.0)	99 (60.0)
Dentistry	400	57(14.3)	343 (85.7)	362	54 (14.9)	308 (85.1)
Physiotherapy	200	58 (29.0)	142 (71.0)	183	52 (28.4)	131 (71.6)
Overall	**4785**	**850 (17.8)**	**3935 (82.2)**	**2114**	**392 (18.5)**	**1722 (81.5)**

* Information from the administration of participating institutes

5.4 Socio-demographic characteristics

This section describes the demographic characteristics of the participants in terms of age, ethnicity, parents' education and occupation, type of family set-up, family size, birth order, and socio-economic status which are summarized in Table 5.9.

Table 5.9: Demographic characteristics of participants (n=2114]

Variables	n(%)
Age in years [Mean ± SD*]	20.6 ±2.4
Ethnicity	
Muhajirs	1436 (67.9)
Punjabis	251 (11.9)
Sindhis	180 (8.5)
Pashtum	60 (2.8)
Hazaraywaal	29 (1.4)
Seraikis	22 (1.0)
Memons	68 (3.2)
Others	68 (3.2)
Father's qualification	
Postgraduate (e.g. MA, MSc, PhD)	635 (30.0)
Graduate (e.g. BA, BSc, MBBS)	1036 (49.0)
Intermediate (grade 12)	225 (10.6)
Matric (grade 10)	123 (5.8)
Middle (between grade 5 to grade 8)	34 (1.6)
Primary (below grade 5)	22 (1.0)
No formal qualification	39 (1.8)
Mother's qualification	
Postgraduate (e.g. MA, MSc, PhD)	321 (15.2)
Graduate (e.g. BA, BSc, MBBS)	989 (42.5)
Intermediate (grade 12)	4.3 (19.1)
Matric (grade 10)	241 (11.4)
Middle (between grade 5 to grade 8)	75 (3.5)
Primary (below grade 5)	76 (3.6)
No formal qualification	100 (4.7)
Birth order	
Elder	700 (33.1)
Middle	920 (43.5)
Youngest	456 (21.6)
Only child	38 (1.8)
Socio-economic status (SES)	
High SES[1]	71 (3.4)
Middle SES[2]	1902 (90.0)
Low SES[3]	141 (6.7)

[1]High SES: Car and air conditioner *Standard deviation

[2]Middle SES: Fridge, television, computer, washing machine ± car or air conditioner

[3]Low SES: Radio, telephone, cycle, motorcycle ± fridge, television, computer or washing machine

The distribution of the variable 'age' was found to be normally distributed, as assessed by histogram. The mean age of participants was 20.6 years with a standard deviation of ±2.4 years. The minimum and maximum age of participants was 17 years and 44 years respectively. The higher mean age of students enrolled for nursing degree programme is due to many students over the age of 27 years in nursing practice wanting to top up their (diploma) qualification to bachelor degree level (Table 5.10).

Karachi is the most ethnically diverse city in Pakistan. The main ethnic groups are Muhajirs (Urdu speaking), Sindhis (Sindhi speaking), Balochis (Balochi speaking), Punjabis (Punjabi speaking), Pashtun (Pashto speaking), Hazaraywaal (Hindko speaking), Seraikis (Seraiki speaking) and Memons (Memmoni speaking). Of the sample, the majority (68%) of the participants were Urdu speaking followed by Punjabi (11.9%) and Sindhi speaking (8.5%) as shown in Table 5.9.

Table 5.10: Mean age of participants across degree programmes

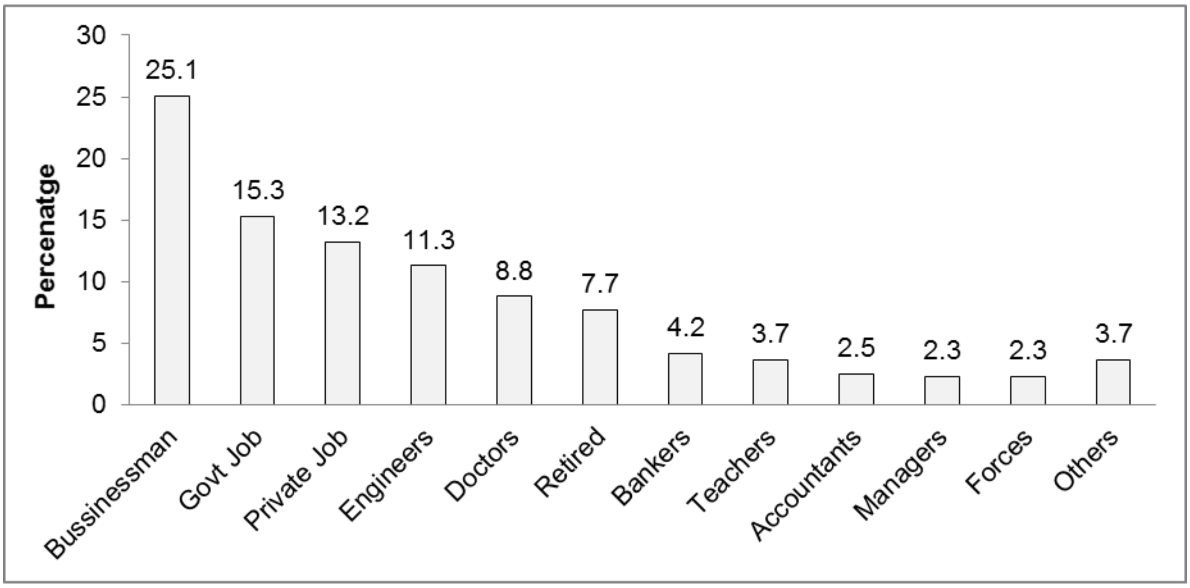
Degree programme	**Age in years** [Mean ± SD*]
Medicine	20.3 ± 1.6
Dentistry	20.3 ± 1.6
Physiotherapy	19.8 ± 1.5
Pharmacy	20.5 ± 1.6
Nursing	24.7 ± 5.1
Overall	20.6 ± 2.4

*SD: Standard Deviation

In terms of father's qualification, 49% reported graduate level qualifications whereas for mothers it was reported to be 42.5%. Similarly, 30% of participants reported father's qualification at postgraduate level as compared to 15.2% for mothers. At a qualification level of intermediate and below, the percentage of mothers in each category was higher than fathers. It was observed that 42.3% of mothers were educated up to intermediate level whereas the percentage of fathers at this level is half that of the mothers.

For mother's occupation, 78.2% of the participants reported housewife and 7.9% reported working women whereas 13.9% reported both. Graph 5.2 shows detailed breakdown of father's occupation status.

Graph 5.2: Father's occupation



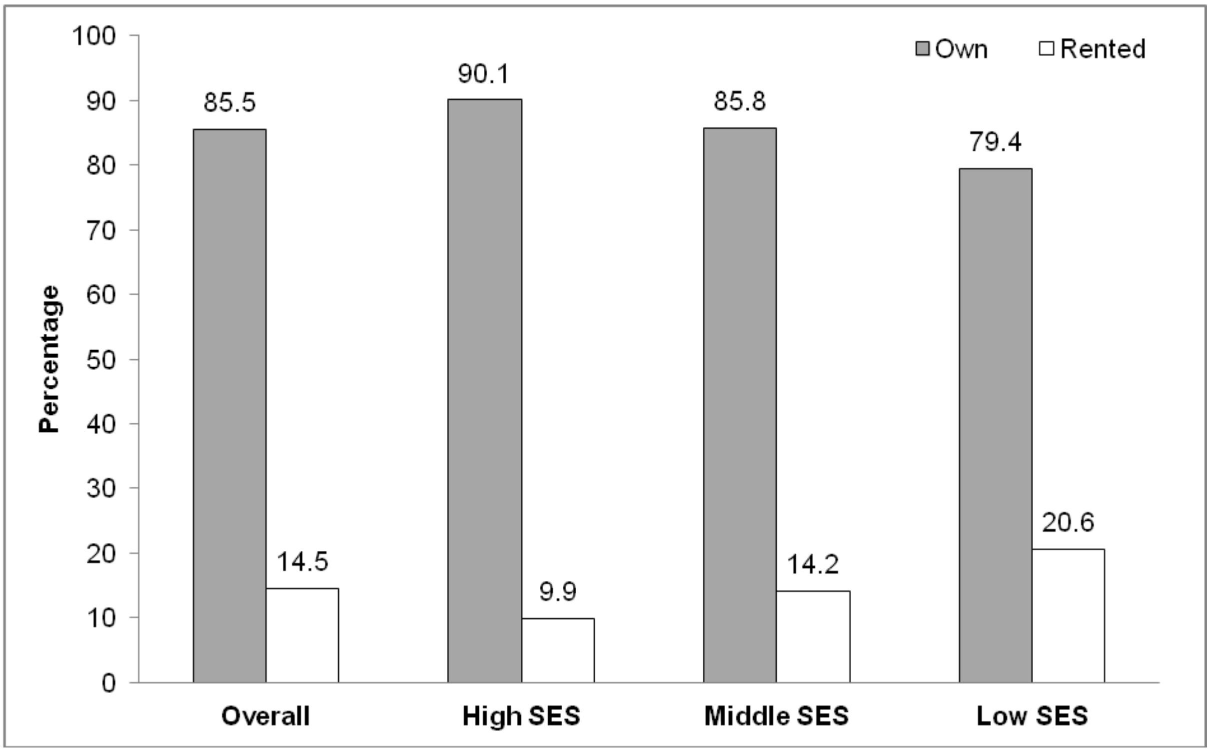
Business was the most frequently stated father's occupation (25.1%) followed by government work (15.3%), private jobs (13.2%), engineer (11.3%) and doctor (8.8%). This information was collected through open-ended question and participants reported a wide range of occupations, which were grouped together. However, these categories are not mutually exclusive such as those working in the capacity of doctor or engineer who might also fall into the private or government sector.

Of all participants, 77.6% reported living with parents and siblings, also known as a 'nuclear family set-up' whereas the rest reported living in an extended family set-up, with parents, siblings and grandparents, uncles, aunts, or cousins. The mean number of family members was 6.6 with a standard deviation (SD) of 3.3. The mean (±SD) number of brothers and sisters was 1.6(±1.2) and 1.6(±1.4) respectively. In response to the questions on birth order, the majority (43.5%) of the participants reported being a 'middle one' among siblings, followed by the 'eldest' and 'youngest'.

On the basis of household items, socio-economic status (SES) was categorized into three categories; high SES, middle SES and low SES as described earlier in [section 4.14.1]. In our sample, the majority (90%) of participants was found to be in the middle SES category.

Similarly, participants were asked whether they lived in rented property or one owned by themselves or their parents. Overall 85.5% of the participants reported living in a house owned by them or their parents. There was a clear trend in home ownership with the direction as expected, ownership was highest in the high SES group and lowest in the low SES group, with the middle group falling between these two [Graph 5.3].

Graph 5.3: Home ownership and socio-economic status



5.5 Difference between self-reported and measured height, weight and BMI and relation with body image and environmental influences

Paired t-test shows a significant difference (p-value <0.001) between self-reported and the measured height, weight and BMI of participants [Table 5.11]. The mean self-reported height, and weight were 161.99 cm, 54.51 kg whereas actual measured height and weight were 159.94cm and 55.01kg respectively. Thus, height was being over-reported by 2.05cm whereas weight by under-reported by 0.5 kg.

Table 5.11: Difference between self-reported and measured height, weight and BMI

	N	Self-reported Mean	Self-reported SD	Actual measured Mean	Actual measured SD	Mean Difference	95% Confidence Interval	p-value*
Height (cm)	2114	161.99	7.89	159.94	8.02	2.05	1.86 to 2.23	< 0.001
Weight (kg)	2114	54.51	10.95	55.01	11.72	-0.50	-0.31 to -0.69	< 0.001
BMI (kg/m^2)	523	20.65	3.73	21.58	3.40	-0.94	-0.73 to -1.14	< 0.001

*p-value from paired t-test

Table 5.12: Difference between self-reported and measured height, weight and BMI by gender

	N	Self-reported Mean	Self-reported SD	Actual Measured Mean	Actual Measured SD	Difference	Mean Difference	95% Confidence Interval [Mean difference]	p-value*
Height (cm)							-0.38	-0.85 to 0.09	0.109
Men	392	172.29	7.42	170.55	7.32	1.73			
Women	1722	159.64	5.85	157.52	5.94	2.11			
Weight (kg)							2.05	1.57 to 2.53	< 0.001
Men	392	63.50	12.18	65.06	13.04	-2.17			
Women	1722	52.45	9.54	52.58	9.90	-0.12			
BMI (kg/m^2)							-0.08	-0.60 to 0.44	0.768
Men	107	21.48	3.90	22.50	4.53	-0.98			
Women	416	20.44	3.70	21.35	3.42	-0.92			

*p-value for independent sample t-test

Table 5.12 shows findings of the independent sample t-test in terms of gender. It was revealed that men and women are equally over-reported their height and there is no significant difference (p-value 0.109) between them in this regard. However in term of weight, a significant difference was revealed (p-value <0.001) between self-reported and measured weight across gender. Men under-reported their weight by 2.17kg whereas women under-reported their weight by only 0.12kg.

Paired t-test [Table 5.11] also shows a significant difference (p-value <0.001) between self-reported and the measured BMI of participants. The mean self-reported BMI was 20.65 kg/m^2 whereas the measured BMI was 21.58 kg/m^2. Thus, BMI was under-reported by 0.94 kg/m^2. Again there was no significant difference (p-value 0.768) across gender in this regard [Table 5.12]. It is important to note that only 24.7% (n=523) of the participants reported their BMI value and in 43.8% (n=229) of those cases self-reported height and weight was not related to reported BMI. The margin of error allowed in BMI was ≤ ±1.5. Thus, participants were not able to accurately self-report their BMI, height and weight.

Similarly, there was a poor agreement (Kappa = 0.232, SE = 0.015) between BMI category based on self-reported height and weight data versus their identified weight category on body image. In over half (50.4%) of the cases, participants' reported height and weight was not correctly matched with their identified weight category on body images. Moreover, no significant difference was found in terms of reported height, weight and BMI among those who received weight related comments from parents and siblings and who did not.

5.6 Knowledge of weight status (body mass index)

It is interesting to find that more than three-quarter of the students did not know their body mass index (BMI) and even amongst the 25% (n=523) of the students who claimed to, 44.7% were incorrect in their assessment. The reported BMI was compared against actual BMI (calculated from the measured height and weight of participants) and a reported BMI difference of ≤ 1.5 (≤4 kg) was accepted as a correct estimation.

Regarding BMI measurement, of those who claimed to know their BMI, 18.4% had not measured it in the last six months. Table 5.13 summarizes the participants' information in this regard.

Table 5.13: Participants' knowledge of weight status (n = 2114)

Variables	n (%)
BMI knowledge	
Yes	523 (24.7)
No	1591 (75.3)
BMI measurement in last six months for those who reported knowing their BMI	
Yes	427 (81.6)
No	96 (18.4)
Status of self-reported BMI for those who reported knowing their BMI	
Accurate	289 (55.3)
Inaccurate	234 (44.7)

5.7 Source of weight knowledge

Self-measurement of body weight was reported by 56.6% of participants. Other sources of weight knowledge were reported as friends/colleagues, parents, siblings, doctors/nurse and multiple sources.

5.8 Weight maintenance practices

Of the 2114 participants, 44.2% (934) reported trying to modify their body weight in the past year. Two-thirds (66.8%) had tried to lose weight and one-third (33.2%) had tried to gain weight. Graph 5.4 shows weight maintenance practices among men and women.

To reduce weight, a combination of diet and exercise was the commonest method for men (44.6%) and women (52.2%). Weight reduction by exercise alone was more common among men (28.9%) than women (17.3%) whereas diet alone was equally practised by men and women. Equally, diet alone was the commonest method for gaining weight as 79.8% of women and 41.1% of men claimed, with the second commonest method being diet along with exercise, though this was more popular among men (44.9%) than women (17.7%).

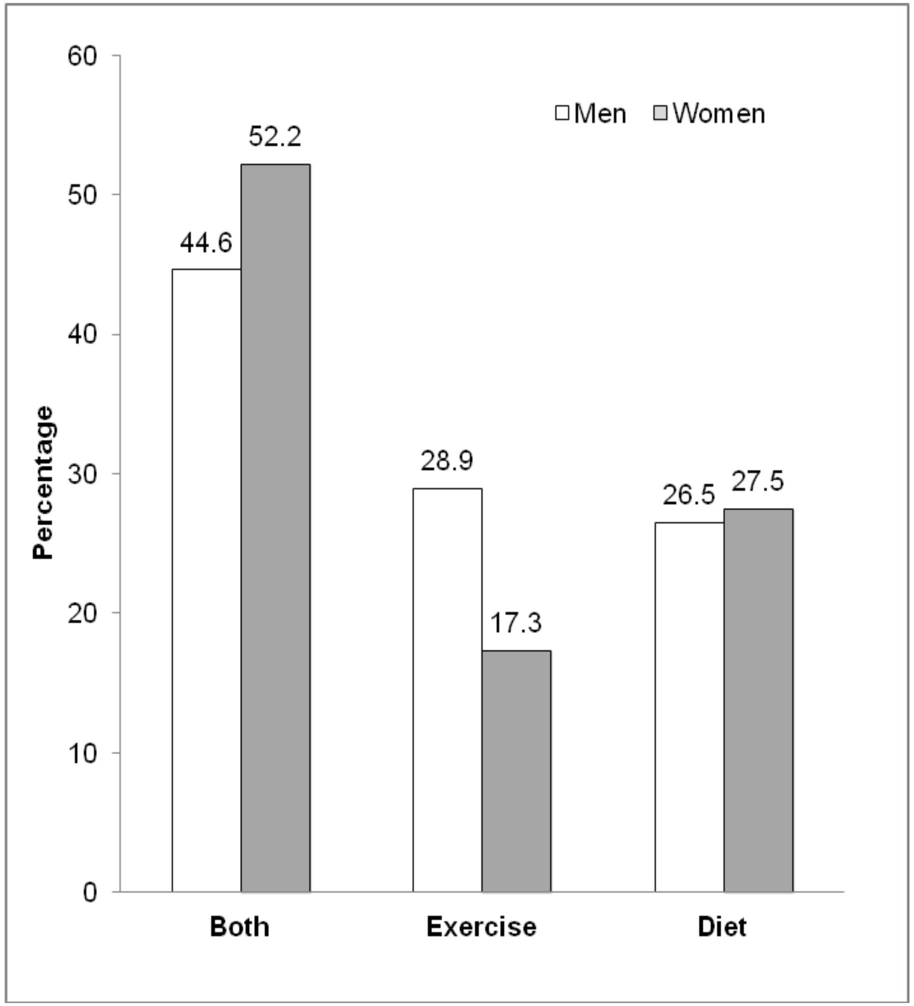
5.9 Weight management practices across weight categories

Table 5.14 summarizes the weight management practices across weight categories. Overall, 44.2% of the students had tried to modify their body weight in the past year. Among them 29.6% had tried to lose weight and 14.6% tried to gain weight.

Weight losing practices across weight categories (based on the South Asian BMI cut-off points) revealed that 55.7% of the overweight or obese participants tried to lose weight. It was also interesting to observe that 25.1% of participants in normal weight category and 5.5% of the participants in underweight category also tried to lose weight in the last year. On the other hand, weight gaining practices across weight categories found that 32.8% of the underweight participants tried to gain weight in the last year. Again interestingly, it was observed that 12.4% of normal weight participants and 3.8% of overweight or obese participants also tried to gain weight.

Among those who reported trying to lose weight 27.4% tried to control their diet and 18.9% tried to exercise, though the most (53.8%) common method remained a combination of both which was most commonly practiced by participants in overweight or obese (57.9%) and normal weight category (49.4%). On other hand, diet alone has been the most common weight gaining method across weight categories [Graph 5.4].

Graph 5.4 (a): Methods used for losing weight



Graph 5.4 (b): Methods used for gaining weight

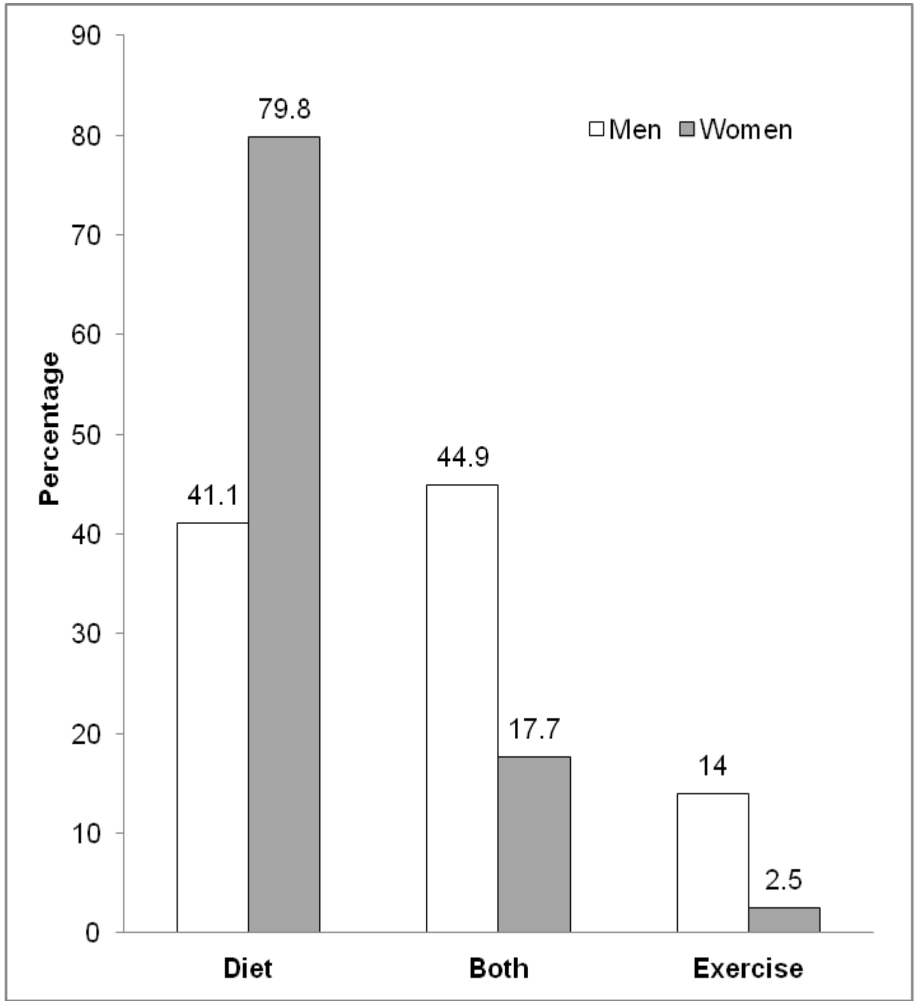


Table 5.14: Weight management practices across weight categories (n=2114)

Variables	Total		Normal weight		Underweight		Overweight or obese	
	N	(%)	N	(%)	N	(%)	N	(%)
Weight modification behaviour in last year								
Did not try to change weight	1180	(55.8)	621	(62.5)	305	(61.7)	254	(40.5)
Tried to lose weight	625	(29.6)	249	(25.1)	27	(5.5)	349	(55.7)
Tried to gain weight	309	(14.6)	123	(12.4)	162	(32.8)	24	(3.8)
Type of method used for losing weight								
Diet	171	(27.4)	70	(28.1)	11	(40.7)	90	(25.8)
Exercise	118	(18.9)	56	(22.5)	5	(18.5)	57	(16.3)
Both	336	(53.8)	123	(49.4)	11	(40.7)	202	(57.9)
Type of method used for gaining weight								
Diet	206	(66.5)	67	(54.5)	125	(77.2)	14	(56.0)
Exercise	20	(6.5)	8	(6.5)	8	(4.9)	04	(16.0)
Both	84	(27.1)	48	(39.0)	29	(17.9)	07	(28.0)

Underweight: BMI <18.5

Normal weight: BMI b/w 18.50 to 22.99

Overweight: BMI b/w 23.0 to 24.99

Obese: BMI ≥ 25.0

5.10 Weight status and impact of family, friends, colleagues and the media

Of all participants, 55.6% and 45.8% received weight related comments from parents and siblings respectively. Similarly, 59.5% participants reported that their colleagues or friends commented on their body weight. Although 27.1% reported feeling stigmatized by colleagues or friend, only 7.5% thought colleagues or friends did not like them because of body weight. However, 30.1% said their colleagues or friends would like them more if they could modify their body weight. Comparison of body weight with other colleagues or friends was also common (61.5%) among participants. The statistics are summarized in Table 5.15.

Table 5.15: Weight status and effect of surrounding people (n = 2114)

Variable	n(%)
Parents commented on body weight	
Yes	1178 (55.6)
No	938 (44.4)
Sibling commented on body weight	
Yes	968 (45.8)
No	1146 (54.2)
Colleagues/friends commented on body weight	
Yes	1258 (59.5)
No	856 (40.5)
Colleagues/friends make fun of your weight	
Yes	572 (27.1)
No	1542 (72.9)
Comparing your weight with colleagues/friends	
Yes	1300 (61.5)
No	814 (38.5)
Colleagues/friends do not like you because of weight	
Yes	159 (7.5)
No	1995 (92.5)
Colleagues/friends would like you more if you modify weight	
Yes	637 (30.1)
No	1477 (69.9)
Comparing your body with those on television/in a magazine	
Yes	1128 (53.4)
No	986 (47.6)

Regarding the role of the media, 53.4% of the participants reported that they compared their body weight with people on television or in magazines, more or so for women (55.2%) than for men (45.4%) [Table 5.16]. Similarly, 35.2% of the participants reported that they felt pressure from the television or magazines to modify (loss or gain) weight, this was the same for both men and women.

Table 5.16: Weight status and role of the media (n=2114)

Variables	Men		Women		p-value*
	N	(%)	N	(%)	
Comparing body with those on TV/ in a magazine					< 0.001
Yes	178	(45.4)	950	(55.2)	
No	214	(54.6)	772	(44.8)	
Feeling pressure to lose/gain weight					< 0.561
Yes	133	(33.9)	611	(35.5)	
No	259	(66.1)	1111	(64.5)	

*Pearson chi-square

5.11 Participants' opinions about factors influencing their perception of body weight

Regarding factors influencing their perception of weight, 45% participants agreed that parents influence their perception. For siblings, an equal proportion of participants agreed (38.9%) and disagreed (39.9%). Approximately 32% reported friends as an influencing factor whereas on the media a large proportion of participants disagreed (49%) as compared to 27.9% who agreed.

There was no significant difference between men and women in terms of their thoughts about the role of friends, parents, siblings and the media on how they perceive their weight. Table 5.17 shows a breakdown of participants' opinions of the influencing factors about body weight.

Table 5.17: Participants' opinions regarding factors influencing their perception regarding body weight by gender

	Overall n (%)	Men n (%)	Women n (%)	Pearson chi-square p-value
My friends influence how I perceive my body weight				0.160*
Agreed	671 (31.7)	139 (35.5)	532 (30.9)	
Disagreed	881 (41.7)	160 (40.8)	721 (41.9)	
Neither agreed nor disagreed	562 (26.6)	93 (23.7)	469 (27.2)	
My parents influence how I perceive my body weight				0.519*
Agreed	952 (45.0)	171 (43.6)	781 (45.4)	
Disagreed	742 (35.1)	135 (34.4)	607 (35.2)	
Neither agreed nor disagreed	420 (19.9)	86 (21.9)	334 (19.4)	
My siblings influence how I perceive my body weight				0.404*
Agreed	822 (38.9)	141 (36.0)	681 (39.5)	
Disagreed	844 (39.9)	166 (42.3)	678 (39.4)	
Neither agreed nor disagreed	448 (21.2)	85 (21.7)	363 (21.1)	
The media influence how I perceive my body weight				0.860*
Agreed	589 (27.9)	108 (27.6)	481 (27.9)	
Disagreed	1035 (49.0)	189 (48.2)	846 (49.1)	
Neither agreed nor disagreed	490 (23.2)	95 (24.2)	395 (22.9)	

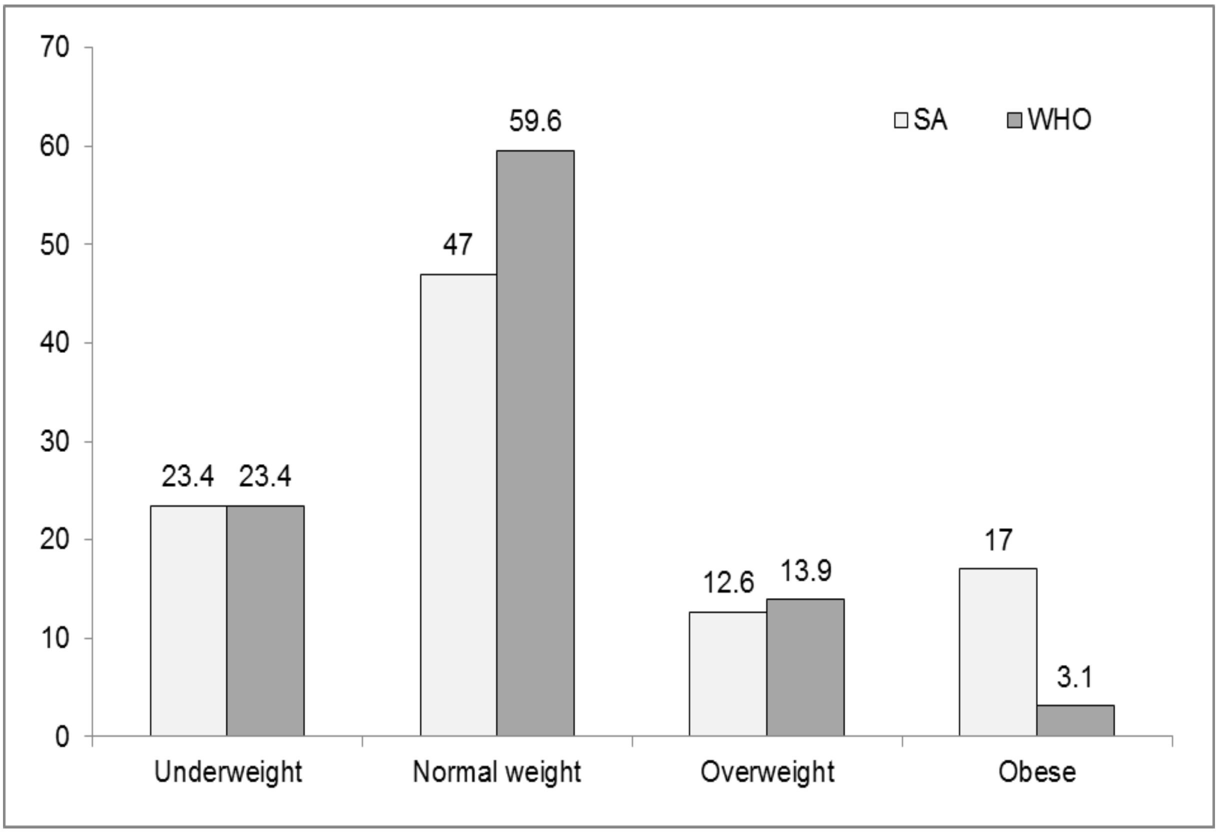
* Insignificant p value (>0.05) of Pearson chi square

5.12 Overall weight status

Graph 5.5 shows the overall weight status of participants based on the South Asian and the WHO BMI cut-off points. Difference in the percentage of participants was observed in all weight categories (except underweight) when weight assessment was compared on both BMI criteria. According to the SA BMI criterion, 47% of participants had normal body weight whereas 59.6% had normal body weight as per WHO BMI criterion.

It is important to note that nearly one quarter (23.4%) of the participants had body weight below the healthy limit which deserves equal attention while addressing the issue of overweight and obesity.

Graph 5.5: Weight status of participants based on the SA & WHO BMI cut-off points

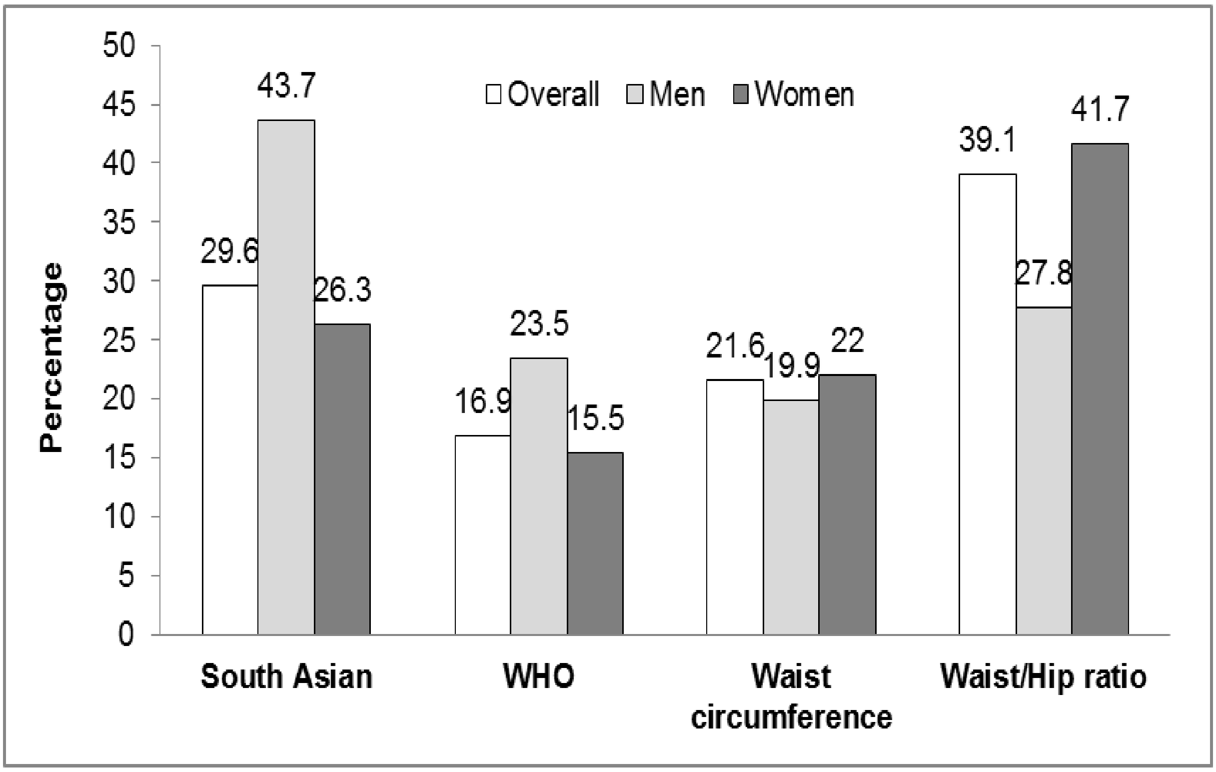


South Asian BMI criterion:	Underweight: BMI <18.50 Normal weight: BMI b/w 18.50 to 22.99 Overweight: BMI b/w 23.0 to 24.99 Obese: BMI ≥ 25.0
WHO BMI criterion:	Underweight: BMI <18.50 Normal weight: BMI b/w 18.50 to 24.99 Overweight: BMI b/w 25.0 to 29.99 Obese: BMI ≥ 30.0

5.13 Prevalence of overweight and obesity

In order to see variations, the prevalence of overweight and obesity among participants was also assessed by using waist circumference and waist to hip ratio, along with the South Asian and WHO BMI criteria. Graph 5.6 shows the overall and separate gender percentages of participants in the overweight and obese category based on above mention four criteria.

Graph 5.6: Prevalence of overweight and obesity across criteria by gender



5.13.1 South Asian BMI criterion

The South Asian BMI cut-off points (≥23.0) for overweight and obesity is lower than the WHO BMI cut-off points (≥25.0) and thus categorised more participants into overweight and obese category (Jafar et al., 2006; Misra et al., 2009). Results show that, of the 2114 participants, 29.6% were overweight or obese. A higher percentage (43.7%) of men was overweight or obese than women (26.3%).

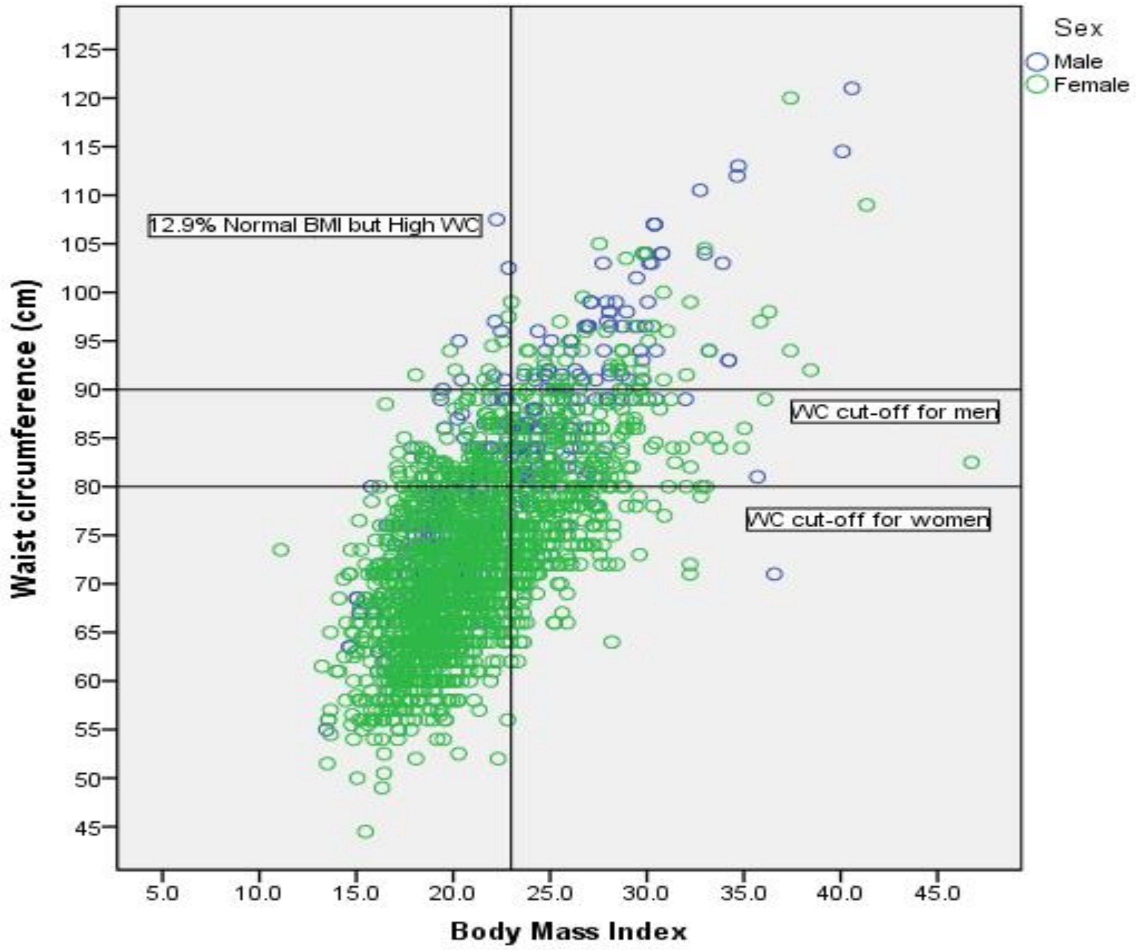
5.13.2 WHO BMI criterion

The WHO BMI criterion is the most widely used method for weight assessment among the White population. When applying this criterion on our sample, 16.9% of the participants were found to be overweight or obese (BMI≥25). Again a higher (23.5%) percentage of men were overweight or obese than women (15.5%) as in the previous (SA) criterion.

5.13.3 Waist circumference criterion

As compared to a Western population, Asians have a higher upper body adiposity and visceral fat at a given BMI (Jafar et al., 2006; Misra et al., 2009). Hence, it is important to assess their weight status on the basis of waist circumference (WC). The normal waist circumference cut-off values for men and women of the South Asian origin are 90cm and 80cm respectively (Misra et al., 2009; NICE, 2013). On this criterion, 21.6% of the participants were overweight or obese. Slightly higher percentage of women (22%) was overweight or obese than men (19.9%), but this difference was not significant (p-value 0.36). It is important to note that 12.9% of the participants in the normal BMI (BMI < 23) category had central adiposity and were classified as overweight or obese on WC criterion. It is shown in the left upper quadrant of Graph 5.7. It is also note that there is direct positive correlation between waist circumference and BMI.

Graph 5.7: Overweight and obesity based on the South Asian BMI and WC criteria



5.13.4 The combination of BMI and waist circumference data to assess the risk of chronic diseases

As per recommendations of the WHO and NICE, individuals' risk of chronic diseases was assessed by combining BMI and WC data (NICE, 2013; WHO, 2008). For this purpose, the South Asian BMI and WC cut-off points were used (Misra, et al., 2009). Findings are summarised in table 5.18. It was found that 12.9% of the normal weight participants have 'increased risk' for chronic diseases because of central obesity. Among the overweight participants, 28.8% with central obesity had 'high risk' for chronic diseases whereas 71.2% in the same weight category but without central obesity had 'increased risk'. Similarly, 48.7% of the participants in "Obese I category" with central obesity had 'very high risk' for chronic diseases whereas 51.3% in the same category but without central obesity had 'high risk'. If BMI is 27.5 or more (equivalent to BMI 35 or more for the White population), WC adds little to the absolute measure of risk provided by BMI (NICE, 2013).

Table 5.18: The combination of BMI and waist circumference data to assess the risk of chronic diseases* (The South Asian BMI and WC criteria)

Weight status	BMI cut-off points	Waist circumference: Men < 90cm Women < 80cm		Waist circumference: Men ≥ 90cm Women ≥ 80cm	
Normal weight	18.5 – 22.99	-		128 (12.9%)	Increased risk
Overweight	23.0 – 24.99	190 (71.2%)	Increased risk	77 (28.8%)	High risk
Obese I	25.0 – 27.49	98 (51.3%)	High risk	93 (48.7%)	Very high risk
Obese II	27.5 – 29.99	21 (20.4%)	Very high risk	82 (79.6%)	Very high risk
Obese III	≥ 30.0	10 (15.2%)	Extreme high risk	56 (84.8%)	Extreme high risk

Misra et al. 2009; NICE, 2013; WHO 2008

* type 2 diabetes, hypertension, and cardiovascular diseases

5.13.5 Waist to hip ratio

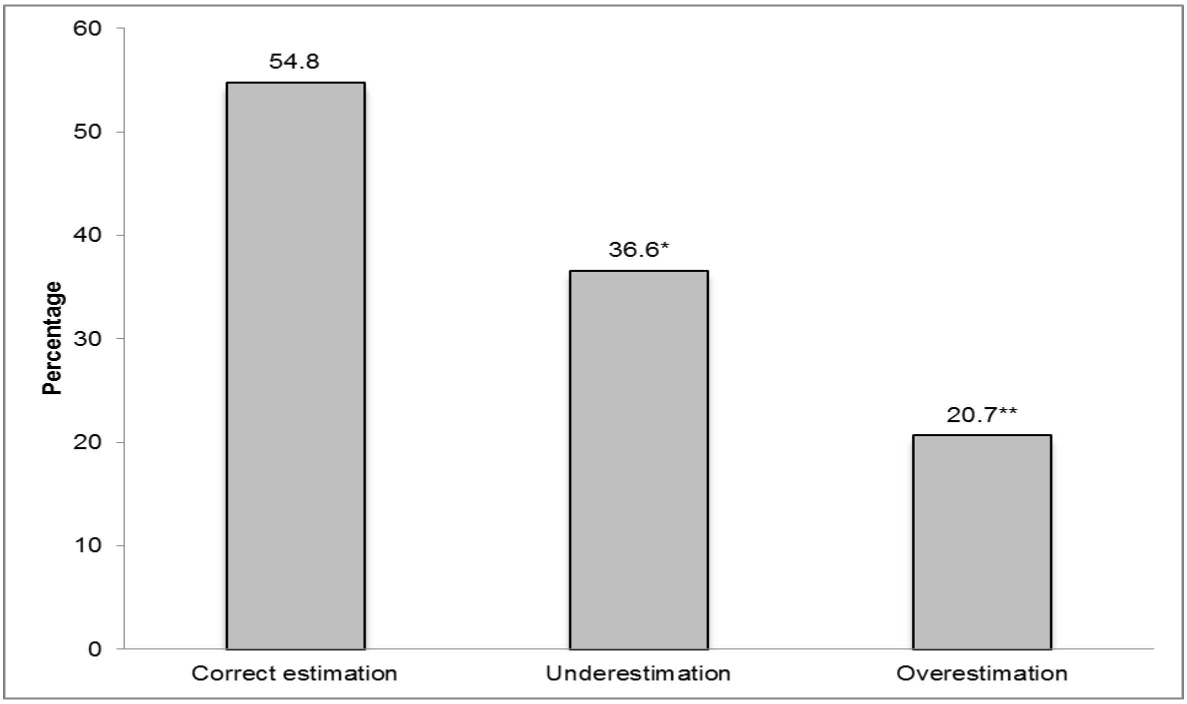
Waist to hip ratio [Men 0.88; women 0.81] is also used for categorization of individuals as overweight or obese (Misra et al., 2009; Snehalatha et al., 2003). In our sample population, 39.1% were overweight or obese based on waist to hip ratio criterion. A higher percentage (41.7%) of women was overweight or obese than men (27.8%).

5.14 Self estimation of body weight

There was poor agreement between the reported weight status of the students and their actual BMI (Kappa = 0.344, SE = 0.015, $p < 0.01$) category being calculated on the basis of their actual height and weight by using South Asian BMI cut-off points. The margin of error allowed in weight was ≤4 kg and in BMI ≤ 1.5.

Just over half, 54.8% (n=1158) correctly estimated their body weight category whereas 45.2% of the participants incorrectly estimated their weight category. Among them, 36.6% (n=592) of the participants underestimated their body weight and 20.7% (n=364) overestimated their weight category. Graph 5.8 shows participants' self-estimation of body weight.

Graph 5.8: Self-reported weight status versus actual weight status based on the South Asian BMI cut-off points (n=2114)



* 494 underweight participants excluded who technically cannot underestimate their weight

**360 obese weight participants excluded who technically cannot overestimate their weight

Underweight: BMI <18.5

Normal weight: BMI b/w 18.50 to 22.99

Overweight: BMI b/w 23.0 to 24.99

Obese: BMI ≥ 25.0

5.15 Summary

- Overall response and questionnaire return rates were 44.2% and 84.6% respectively.
- Approximately 81.5% of the participants were women
- The mean (±SD) age of participants was 20.6±2.4 years
- The majority of the participants were Urdu speaking
- Over 40% of the participants reported graduate level qualification for parents
- Business was the most frequently reported occupation for fathers whereas mothers mainly had responsibility as a housewife
- The nuclear family set-up was the most common family set-up
- Ninety percent of participants belonged to the middle SES
- Height was being over-reported by 2.05cm whereas weight by under-reported by 0.5 kg.
- Self-reported height and weight was not related to the reported BMI.
- More than 3/4 of the participants did not know their body mass index value
- Over 2/5 had tried to modify their body weight in the past year and weight management practices were common among participants irrespective of their actual weight status
- Weight related comments from colleagues, friends, siblings and parents were commonly received by participants
- Students acknowledge the role of colleagues, friends, siblings, parents and the media in influencing their own perception of their body weight
- Approximately ¼ of the participants were underweight
- More than a quarter of participants were found to be overweight or obese.
- Over a quarter (29.6%) of the participants were overweight or obese based on the South Asian BMI criterion which is conservative and more sensitive than WHO BMI criterion in identifying participants who are overweight and obesity
- The combination of BMI and waist circumference data provides additional information for risk assessment of chronic diseases especially those in ‘normal weight’, ‘overweight’ and ‘obese I’ categories
- Over 45% of participants have incorrect estimation about their body weight; 36.6% underestimated and 20.7% overestimated their body weight

Chapter 6: Unhealthy body weight (overweight, obesity and underweight) and its associated factors among trainee HCPs

6.1 Introduction

The aim of this chapter is to provide information about the issue of overweight and obesity among trainee HCPs along with taking into consideration those who are underweight.

We hypothesised:

- Irrespective of gender and actual weight status, participants believe that as HCPs they are role model for the general population
- Irrespective of gender, participants believe that as HCPs with healthy weight, their health education would be more effective
- Overweight and obesity is associated with underestimation of body, weight stigmatization, and incorrect BMI knowledge
- Being underweight is associated with incorrect personal BMI knowledge and weight stigmatization

6.2 HCPs are role models for the general population

Of the 2114, 64.3% of the participants agreed that as HCPs they are role models for the general population in terms of their body weight. We failed to reject the null hypothesis at 5% level of significance by using Chi square statistics and concluded that there was no significant difference in the views of participants in terms of gender (p-value 0.401) and their actual weight status (p-value 0.095) respectively [Table 6.1].

Similarly, participants were agreed that as HCPs they are role models irrespective of their experience of weight stigmatization (p-value 0.414).

However, there was a significant difference (p-value 0.008) in participants' view in terms of degree programme as higher proportion (76.4%) of nursing students agreed that as HCPs they are role models for the general population compared to (60.8% to 67.2%) students enrolled in other degree programmes. perspective

Table 6.1: HCPs are role models for the general population: Participants' perspective (n=2114)

Variable	Yes		No		Chi square	p value
	N	(%)	N	(%)		
Gender					0.705	0.401
Women	1115	(64.8)	607	(35.2)		
Men	245	(62.5)	147	(37.5)		
Degree programme					13.832	0.008
Medicine	664	(63.1)	389	(36.9)		
Dentistry	220	(60.8)	142	(39.2)		
Physiotherapy	123	(67.2)	60	(32.8)		
Pharmacy	227	(64.7)	124	(35.3)		
Nursing	126	(76.4)	39	(23.6)		
BMI weight categories					6.371	0.095
Underweight[1]	297	(60.1)	197	(39.1)		
Normal weight[2]	652	(65.7)	341	(34.3)		
Overweight[3]	182	(68.2)	85	(31.8)		
Obese[4]	229	(63.6)	131	(36.4)		
Experience of weight stigmatization					0.667	0.414
Yes	360	(62.9)	212	(37.1)		
No	1000	(64.9)	542	(35.1)		

[1] Underweight: BMI <18.5 [2] Normal weight: BMI 18.5 to 22.9
[3] Overweight: BMI 23.0 to 24.9 [4] Obese: BMI: ≥ 25.0

6.3 Healthy body weight and more effective health education for patients

Of the total 2114, 81.7% agreed that their education and counselling for diet and life style would be more effective if they had a healthy body weight. We failed to reject the null hypothesis at 5% level of significance by using Chi square statistics and concluded that there was no significant (p-value 0.098) difference between men and women in terms of their views [Table 6.2]. Similarly, over 80% of those with or without experience of weight stigmatization agreed that their education would be more effective for patients if they had a healthy body weight (p-value 0.573).

However a significantly (p-value <0.001) lower percentage (73.5%) of dentistry students agreed compared to (80.3% to 84.7%) students enrolled in other degree programmes. Similarly, examination of participants' views across weight categories revealed that fewer participants in the overweight and obese weight categories agreed with the views of those in the normal or underweight categories.

Table 6.2: Healthy body weight and more effective health education for patients: Participants' perspective (n=2114)

Variable	Yes		No		Chi square	p value
	N	(%)	N	(%)		
Gender					2.738	0.098
Women	1419	(82.4)	303	(17.6)		
Men	309	(78.8)	83	(21.2)		
Degree programme					22.997	< 0.001
Medicine	888	(84.3)	165	(15.7)		
Dentistry	266	(73.5)	96	(26.5)		
Physiotherapy	155	(84.7)	28	(15.3)		
Pharmacy	282	(80.3)	69	(19.7)		
Nursing	137	(83.0)	28	(17.0)		
BMI weight categories					9.189	0.027
Underweight[1]	417	(84.4)	77	(15.6)		
Normal weight[2]	821	(82.7)	172	(17.3)		
Overweight[3]	213	(79.8)	54	(20.2)		
Obese[4]	277	(76.9)	83	(23.1)		
Experience of weight stigmatization					0.317	0.573
Yes	472	(82.5)	100	(17.5)		
No	1256	(81.5)	286	(18.5)		

[1] Underweight: BMI <18.5 [2] Normal weight: BMI 18.5 to 22.9
[3] Overweight: BMI 23.0 to 24.9 [4] Obese: BMI: ≥ 25.0

6.4 Overweight, obesity and socio-demographic characteristics

Table 6.3 summarizes the association of overweight and obesity and the socio-demographic characteristics of participants.

A significant difference (p-value <0.001) was found between men and women in terms of weight status. A higher percentage of men (51.0%) were overweight or obese than women (35.5%). A significant mean difference (0.8 years) of age was found among participants in the overweight or obese group (21.3 years) than the normal weight group (20.5). When comparing them across degree programme, 34.2% to 41.5% of participants were overweight or obese in the medicine, dentistry, physiotherapy and pharmacy degree programme whereas higher (60.7%) percentage of overweight and obese participants was found in the nursing degree programme. Similarly, 68% of the only child in family was found to be overweight or obese as compared to 35.9% to 40.5% participants who were either elder, younger or middle one among siblings.

However, no weight difference was found among participants in terms of their academic year (p-value 0.661), SES (p-value 0.074), type of family set-up (p-value 0.493) and number of siblings (p-value 0.181). Thus, we concluded that there is no significant association of these variables with overweight and obesity.

Table 6.3 Association of overweight and obesity with socio-demographic characteristics (n=1620)

Variables	Total		Normal weight		Overweight or obese		Univariate OR (95% CI)	p-value
	N	(%)	N	(%)	N	(%)		
Gender								< 0.001
Women	1285	(79.3)	829	(64.5)	456	(35.5)		
Men	335	(20.7)	164	(49.0)	171	(51.0)	1.90 (1.49 to 2.42)	
Degree programme								< 0.001
Medicine	798	(49.3)	525	(65.8)	273	(34.2)		
Dentistry	272	(16.8)	159	(58.5)	113	(41.5)	1.37 (1.03 to 1.81)	
Physiotherapy	126	(7.8)	78	(61.9)	48	(38.1)	1.18 (0.80 to 1.75)	
Pharmacy	279	(17.2)	174	(17.5)	105	(37.6)	1.16 (0.87 to 1.54)	
Nursing	145	(9.0)	57	(39.3)	88	(60.7)	2.97 (2.06 to 4.27)	
Academic year								0.661
1st Year	426	(26.3)	254	(59.6)	172	(40.4)		
2nd Year	339	(20.9)	214	(63.1)	125	(36.9)	0.86 (0.64 to 1.16)	
3rd Year	352	(21.7)	218	(61.9)	134	(38.1)	0.91 (0.68 to 1.21)	
4th Year	278	(17.2)	176	(63.3)	102	(36.7)	0.86 (0.63 to 1.17)	
5th Year	225	(13.9)	131	(58.2)	94	(41.8)	1.06 (0.76 to 1.47)	
Socio-economic status (SES)								0.074
Low SES[1]	112	(6.9)	58	(51.8)	54	(48.2)		
Middle SES[2]	1455	(89.8)	905	(62.2)	550	(37.8)	0.65 (0.44 to 0.96)	
High SES[3]	53	(3.3)	30	(56.6)	23	(43.4)	0.82 (0.43 to 1.59)	
Birth order								0.017
Eldest	561	(34.6)	334	(59.5)	227	(40.5)		
Middle	691	(42.7)	431	(62.4)	260	(37.6)	0.89 (0.71 to 1.12)	
Youngest	343	(21.2)	220	(64.1)	123	(35.9)	0.82 (0.62 to 1.09)	
Only child	25	(1.5)	8	(32.0)	17	(68.0)	3.13 (1.33 to 7.37)	
Family set up								0.493
Nuclear*	1241	(76.6)	755	(60.8)	486	(39.2)		
Extended**	379	(23.4)	238	(62.8)	141	(37.2)	0.92 (0.73 to 1.18)	
Total number of siblings [Mean ± SD]				3.3 ± 1.9		3.2 ± 2.2	0.97 (0.92 to 1.02)	0.181
Age in years [Mean ± SD]				20.5 ± 2.0		21.3 ± 3.3	1.12 (1.08 to 1.17)	< 0.001

[1]Low SES: Radio, telephone, cycle, motorcycle ± fridge, television, computer or washing machine, [2]Middle SES: Fridge, television, computer, and washing machine± car or air conditioner, [3]High SES: Car and air conditioner ± other items;

*Nuclear (living with parents & siblings), **Extended (living with parents, siblings and grandparents/uncles/aunts/cousins)

Normal weight: BMI 18.5 - 22.99

Overweight or obese: BMI ≥ 23.0

6.5 Association of overweight and obesity with BMI knowledge, underestimation of body weight and weight stigmatization

The association of overweight and obesity with BMI knowledge, underestimation of body weight, and weight stigmatization is summarized in Table 6.4.

Of the 1620 participants, only 26% (n=421) claimed to know their BMI of whom 48.7% were incorrect. There was a significant association between correct BMI knowledge and overweight status. Among those who had correct BMI knowledge, 70.8% had normal weight whereas 29.3% were overweight or obese. Similarly, 28% (n=594) of the total participants underestimated their body weight. Exploration of underestimation of weight across weight categories revealed that 73.7% of the participants who underestimated their weight were overweight or obese whereas only 26.3% were normal weight.

Weight stigmatization also had a significant association with overweight status (p-value <0.001). Weight stigmatization was more prevalent (56.0%) among overweight and obese participants as compared to those with normal weight (44.0%).

6.6 Factors associated with overweight and obesity

6.6.1 Univariate logistic regression analysis

Association of the important independent variables was checked with overweight and obesity one by one. The revealed association is reported in the form of crude odds ratio, 95% confidence interval and p-value [Tables 6.3 & 6.4]. A variable with p-value of ≤ 0.25 was considered significant and a candidate for multivariate analysis. These variables include gender, age, degree programme, academic year of study, socio-economic status, birth order, correct knowledge of BMI, underestimation of body weight, weight stigmatization, and weight modification practices in the last year.

Multicollinearity was assessed among significant variables before taking them into multivariate analysis, and was found among none.

Table 6.4: Association of overweight and obesity with BMI knowledge, underestimation of weight and weight stigmatization (n=1620)

Variables	Total		Normal weight		Overweight or obese		Univariate OR (95% CI)	p-value
	N	(%)	N	(%)	N	(%)		
Knowledge of personal BMI								0.647
No	1199	(74.0)	731	(61.0)	468	(39.0)		
Yes	421	(26.0)	262	(62.2)	159	(37.8)	0.65 (0.84 to 1.33)	
Correct personal BMI knowledge								< 0.001
No	205	(48.7)	109	(53.2)	96	(46.8)		
Yes	216	(51.3)	153	(70.8)	63	(29.3)	0.47 (0.31 to 0.70)	
Underestimation of body weight								< 0.001
No	1026	(63.3)	837	(81.6)	189	(18.4)		
Yes	594	(36.7)	156	(26.3)	438	(73.7)	12.43 (9.97 to 15.83	
Weight stigmatization								< 0.001
No	1222	(75.4)	818	(66.9)	404	(33.1)		
Yes	398	(24.6)	175	(44.0)	223	(56.0)	2.58 (2.05 to 3.25)	

Normal weight: BMI 18.5 - 22.99
Overweight or obese: BMI ≥ 23.0

6.6.2 Multivariate logistic regression analysis

At multivariate level, we reject the null hypothesis at 5% level of significance and concluded that overweight and obesity is associated with underestimation of body, weight stigmatization, and incorrect BMI knowledge. Table 6.5 shows the magnitude of association of significant variables in the form of adjusted odds ratio, 95% confidence intervals and p-value. The final model was adjusted for confounding effects of the variables 'age', 'gender' and 'socio-economic status'.

Table 6.5: [Multivariate logistic regression] Adjusted odd ratios of factors associated with overweight and obesity (BMI ≥ 23) among trainee HCPs of public sector institutes in Karachi (n = 1620)

Variable	OR	95% C.I	p value
Underestimation of weight			< 0.001*
No	1		
Yes	9.02	5.52 to 14.71	
Experienced weight stigmatization			< 0.001*
No	1		
Yes	2.84	1.64 to 4.91	
Correct personal BMI knowledge			0.026*
No	1		
Yes	0.58	0.36 to 0.94	

Model adjusted for the effect of age, gender and socio-economic status
* Significant at p value ≤ 0.05

Participants who underestimated their body weight were more likely to be overweight and obese [OR=9.02 (95%C.I: 5.52 to 14.71)] as the odds of being overweight and obese was 9.02 times, that of the odds of being overweight and obese among those with correct estimation of weight. Similarly, the weight stigmatization was significantly contributing towards overweight and obesity (p-value < 0.001); individuals who experienced weight stigmatization were more likely to be overweight or obese [OR=2.84 (95%C.I: 1.64 to 4.91)] as compared to individuals who were not being stigmatized for weight.

Contrarily, overweight and obesity was less likely among participants with correct personal BMI information [OR=0.58 (95% C.I: 0.36 to 0.94)] as odds of being overweight and obese for participants with correct BMI information was 0.58 times the odds of being overweight and obese with incorrect BMI information.

6.6.3 Sensitivity analysis

In order to check the stability of the model-I which was based on the South Asian BMI cut off points; analysis was repeated to build (i) model-II by using the WHO cut-off points and (ii) model-III by using waist circumference criterion for classifying participants into overweight and obese weight status (Yes & No) categories.

In model-II, the same three variables (underestimation of weight, weight stigmatization and correct BMI knowledge) found to be associated with overweight and obesity which also showed significant association in model-I. According to model-II, participants who underestimated their body weight were more likely to be overweight and obese [OR=10.94 (95%C.I: 5.87 to 20.39)] as the odds of being overweight and obese was 10.94 times, that of the odds of being overweight and obese among those with correct estimation of weight. Similarly, the weight stigmatization was significantly contributing towards overweight and obesity (p-value 0.039); individuals who experienced weight stigmatization were more likely to be overweight or obese [OR=1.97 (95%C.I: 1.03 to 3.74)] as compared to individuals who were not being stigmatized for weight. Contrarily, overweight and obesity was less likely among participants with correct personal BMI information [OR=0.40 (95% C.I: 0.22 to 0.73)] as odds of being overweight and obese for participants with correct BMI information was 0.58 times the odds of being overweight and obese with incorrect BMI information. Similar to the model-I, age, gender and socio-economic status of participants did not show any significant association with overweight and obesity.

In model-III which was based on waist circumference criterion (men ≥90 cm; women ≥80 cm) for classifying participants into overweight and obese weight categories (Misra et al., 2009; NICE, 2013), only two variables (underestimation of weight, weight stigmatization) have significant association with overweight and obesity. Participants who underestimated their body weight were more likely to be overweight and obese [OR=1.67 (95%C.I: 1.08 to 2.61)] as the odds of being overweight and obese was 1.67 times, that of the odds of being overweight and obese among those with correct estimation of weight. Similarly, the weight stigmatization was significantly contributing towards overweight and obesity (p-value 0.009); individuals who experienced weight stigmatization were more likely to be overweight or obese [OR=1.81 (95%C.I: 1.16 to 2.83)] as compared to individuals who were not being stigmatized for weight. It is also important to note that previously significant variable ‘correct BMI knowledge’ in model-I and model-II was found to be insignificant in model-III. Similar to the model-I and model-II, variables age, gender and socio-economic status did not show any significant association with overweight and obesity. Summary of the sensitivity analysis is shown in [Table 6.6].

Table 6.6: [Multivariate logistic regression] Sensitivity Analysis: Adjusted odd ratios of factors associated with overweight and obesity among trainee HCPs of public sector institutes in Karachi (n = 1620)

Variable	Model-I			Model-II			Model-III		
	South Asian BMI criterion			WHO BMI criterion			Waist circumference		
	OR	95% C.I	p value	OR	95% C.I	p value	OR	95% C.I	p value
Underestimation of weight			< 0.001			< 0.001			0.022
No	1			1			1		
Yes	9.02	5.52 to 14.71		10.94	5.87 to 20.39		1.67	1.08 to 2.61	
Experienced weight stigmatization			< 0.001			0.039			0.009
No	1			1			1		
Yes	2.84	1.64 to 4.91		1.97	1.03 to 3.74		1.81	1.16 to 2.83	
Correct personal BMI information			0.026			0.003			
No	1			1				-	
Yes	0.58	0.36 to 0.94		0.40	0.22 to 0.73				

Model adjusted for the effect of age, gender and socio-economic status

South Asian BMI criterion**:** Underweight: BMI <18.50 Normal weight: BMI b/w 18.50 to 22.99
Overweight: BMI b/w 23.0 to 24.99 Obese: BMI ≥ 25.0

WHO BMI criterion: Underweight: BMI <18.50 Normal weight: BMI b/w 18.50 to 24.99
Overweight: BMI b/w 25.0 to 29.99 Obese: BMI ≥ 30.0

Waist circumference: Men ≥90 & women ≥80 (Misra et al., 2009; NICE, 2013)

6.7 Underweight and socio-demographic characteristics

It is equally important to note that approximately one quarter (23.4%) of the participants in our sample were underweight (BMI <18.5) and needs equal attention to address this issue along with problem of overweight and obesity.

Table 6.7 summarizes the association of underweight and the socio-demographic characteristics of participants. We found that underweight status is associated with female gender (p-value <0.001), being in earlier (1^{st} to 3^{rd}) academic years (p-value <0.001), being the only child in family (p-value <0.013), living in a nuclear family setup (p-value 0.032) and younger age (p-value <0.001).

A higher percentage of women (34.5%) was underweight than men (25.8%). When comparing prevalence of underweight across academic years, higher proportions (34.7% to 39.45%) of participants were found to be underweight in earlier academic years than 4^{th} (26.7%) and 5^{th} years (20.1%). Similarly, 61.9% of the only child in family was found to be underweight as compared to 29.4% to 34.7% participants who were either elder, younger or middle one among siblings. A significant mean difference of (0.5 years) age was found among participants in the underweight group (20.0 years) than the normal weight group (20.5 years).

However, no significant difference was found in underweight status of participants in terms of their degree programmes (p-value 0.051) and number of siblings (p-value 0.187). Overall, 90.9% of the participants belong to the middle SES whereas 6.9% and 3.2% participants were from the low and high SES respectively. Again there was no significant difference (p-value 0.814) in proportion of participants who were underweight across all SES (low SES 33.3%, middle SES 33.1%, high SES 37.5%) categories. Thus, we concluded that there is no significant association of these variables with underweight.

6.8 Association of underweight with BMI knowledge, overestimation of body weight and weight stigmatization

The association of underweight with BMI knowledge, overestimation of body weight, and weight stigmatization is summarized in Table 6.8.

Of the 1487 participants, only 24.5% (n=364) claimed to know their BMI of whom 37.9% were incorrect. There was a significant association (p-value 0.021) between incorrect BMI knowledge and underweight status. Among those who had correct BMI knowledge, 67.7% had normal weight whereas 32.3% were underweight. Similarly, 26.5% (n=353) of the total participants overestimated their body weight. Exploration of overestimation of weight across weight categories revealed that 55.8% of the participants who overestimated their weight were normal weight whereas 44.2% were underweight. Weight stigmatization also had a significant association with underweight status (p-value <0.001).

6.9 Factors associated with underweight

6.9.1 Univariate logistic regression analysis

Association of the important independent variables was checked with underweight one by one. The revealed association is reported in the form of crude odds ratio, 95% confidence interval and p-value [Tables 6.7 & 6.8]. A variable with p-value of ≤ 0.25 was considered significant and a candidate for multivariate analysis (Bursac et al., 2008; Hosmer & Lameshow, 2000). This is an arbitrary cut-off point (p-value = 0.25) and is based on the Wald test from logistic regression. According to Bursac et al. (2008) and Hosmer & Lameshow (2000) the traditional cut-off point (p-value = 0.05) at univariate level can fail to identify important variables.

These variables found to be significant at this level include gender, age, degree programme, academic year of study, birth order, family setup, number of siblings, correct knowledge of BMI, overestimation of body weight, and weight stigmatization. Multicollinearity was assessed among significant variables before taking them into multivariate analysis, and was found among none.

6.9.2 Multivariate logistic regression analysis

At multivariate level, we reject the null hypothesis at 5% level of significance and concluded that underweight status of participants was associated with incorrect BMI information and weight stigmatization. Table 6.9 shows the magnitude of association of significant variables in the form of adjusted odds ratio, 95% confidence intervals and p-value. The final model was adjusted for confounding effects of the variables ‘age’, ‘gender’ and ‘socio-economic status’.

Participants who do not have correct personal BMI knowledge were more likely to be underweight [OR=1.87 (95%C.I: 1.12 to 3.13)] as the odds of being underweight was 1.87 times, that of the odds of being underweight among those with correct personal BMI knowledge.

Similarly, the weight stigmatization was significantly contributing towards underweight status (p-value < 0.001); individuals who experienced weight stigmatization were more likely to be underweight [OR=3.56 (95%C.I: 2.08 to 6.10)] as compared to individuals who were not being stigmatized for weight.

Table 6.7 Association of underweight with socio-demographic characteristics (n=1487)

Variables	Total		Normal weight		Underweight		Univariate OR (95% CI)	p-value
	N	(%)	N	(%)	N	(%)		
Gender								0.011
Men	221	(14.9)	164	(74.2)	57	(25.8)		
Women	1266	(85.1)	829	(65.5)	437	(34.5)	1.52 (1.20 to 2.10)	
Degree programme								0.051
Medicine	780	(52.5)	525	(67.3)	255	(32.7)		
Dentistry	249	(16.7)	159	(63.9)	90	(36.1)	1.17 (0.86 to 1.57)	
Physiotherapy	135	(9.1)	78	(57.8)	57	(42.2)	1.51 (1.04 to 2.18)	
Pharmacy	246	(16.5)	174	(70.7)	72	(26.0)	0.85 (0.62 to 1.16)	
Nursing	77	(5.2)	57	(74.0)	20	(33.2)	0.72 (0.43 to1.23)	
Academic year								< 0.001
1st Year	396	(26.6)	254	(64.1)	142	(35.9)		
2nd Year	353	(23.7)	214	(60.6)	139	(39.4)	1.16 (0.86 to 1.56)	
3rd Year	334	(22.5)	218	(65.3)	116	(34.7)	0.95 (0.70 to 1.29)	
4th Year	240	(16.1)	176	(73.3)	64	(26.7)	0.65 (0.46 to 0.93)	
5th Year	164	(11.1)	131	(79.9)	33	(20.1)	0.45 (0.29 to 0.70)	
Socio-economic status (SES)								0.814
Low SES[1]	87	(6.9)	58	(66.7)	29	(33.3)		
Middle SES[2]	1352	(90.9)	905	(66.9)	447	(33.1)	0.99 (0.62 to 1.57)	
High SES[3]	48	(3.2)	30	(62.5)	18	(37.5)	1.20 (0.57 to 2.50)	
Birth order								0.013
Only child	21	(1.4)	8	(38.1)	13	(61.9)		
Eldest	473	(31.8)	334	(70.6)	139	(29.4)	0.26 (0.10 to 0.63)	
Middle	660	(44.4)	431	(65.3)	229	(34.7)	0.33 (0.13 to 0.80)	
Youngest	333	(22.4)	220	(66.1)	113	(33.9)	0.32 (0.13 to 0.79)	
Family set up								0.032
Nuclear*	1155	(77.7)	755	(65.4)	400	(34.6)		
Extended**	332	(22.3)	238	(71.7)	94	(28.3)	0.75 (0.57 to 0.97)	
Total number of siblings [Mean ± SD]				3.3 ± 1.9		3.2 ± 1.8	0.96 (0.90 to 1.02)	0.187
Age in years [Mean ± SD]				20.5 ± 2.0		20.0 ± 1.6	0.86 (0.81 to 0.92)	< 0.001

[1]Low SES: Radio, telephone, cycle, motorcycle ± fridge, television, computer or washing machine, [2]Middle SES: Fridge, television, computer, and washing machine± car or air conditioner, [3]High SES: Car and air conditioner ± other items;

*Nuclear (living with parents & siblings), **Extended (living with parents, siblings and grandparents/uncles/aunts/cousins)

South Asian BMI criterion**:** Underweight: BMI <18.50
Normal weight: BMI b/w 18.50 to 22.99

Table 6.8: Association of underweight with BMI knowledge, overestimation of weight and weight stigmatization (n=1487)

Variables	Total		Normal weight		Underweight		Univariate OR (95% CI)	p-value
	N	(%)	N	(%)	N	(%)		
Knowledge of personal BMI								0.016
No	1123	(75.5)	731	(65.1)	392	(34.9)		
Yes	364	(24.5)	262	(72.0)	102	(28.0)	0.73 (0.56 to 0.94)	
Correct personal BMI knowledge								0.021
No	138	(37.9)	109	(79.0)	29	(21.0)		
Yes	226	(62.1)	153	(67.7)	73	(32.3)	0.56 (0.34 to 0.92)	
Overestimation of body weight								0.001
No	978	(73.5)	640	(65.4)	338	(34.6)		
Yes	353	(26.5)	197	(55.8)	156	(44.2)	1.50 (1.17 to 1.92	
Weight stigmatization								< 0.001
No	1138	(76.5)	818	(71.9)	320	(28.1)		
Yes	349	(23.5)	175	(50.1)	174	(49.9)	2.54 (1.99 to 3.25)	

South Asian BMI criterion**:** Underweight: BMI <18.50
Normal weight: BMI b/w 18.50 to 22.99

Table 6.9: [Multivariate logistic regression] Adjusted odd ratios of factors associated with underweight status (BMI <18.50) among trainee HCPs (n =1487)

Variable	OR	95% C.I	p value
Correct personal BMI knowledge			0.017*
Yes	1		
No	1.87	1.12 to 3.13	
Experienced weight stigmatization			< 0.001*
No	1		
Yes	3.56	2.08 to 6.10	

Model adjusted for the effect of age, gender and socio-economic status
* Significant at p value ≤ 0.05

However, other variables which include gender, age, degree programme, academic year of study, birth order, family setup, number of siblings, and overestimation of body weight were insignificant at multivariate level.

6.10 Summary

- There is a large consensus among participants that people consider health professionals as a role model in terms of healthy weight regardless of gender, weight status and stigmatization of weight
- There is also a large consensus among participants that with a healthy body weight, health professionals can achieve a more positive change among their patients in terms of healthy diet and lifestyle.
- Overweight and obesity was more likely among those who underestimated their body weight, and experienced weight stigmatization
- Overweight and obesity was less likely among participants who had correct information of personal BMI
- Model-I (based on the SA BMI criterion) and model-II (based on the WHO BMI criterion) identified the same associated factors for overweight or obesity whereas model-III (based on waist circumference) could identify fewer associated factors of overweight or obesity than model-I and model-II.
- Participants who experienced weight stigmatization were more likely to be underweight
- Underweight status was less likely among participants who had correct information of personal BMI

Chapter 7: Underestimation of body weight and associated factors among trainee HCPs

7.1 Introduction

The aim of this chapter is to present findings regarding the extent to which trainee HCPs underestimate their body weight and their associated factors.

We hypothesised that:

- Underestimation of body weight is associated with gender and more common among men than women
- Underestimation of body weight is associated with BMI and more common among those who are overweight or obese than normal weight individuals

7.2 Prevalence of underestimation of body weight

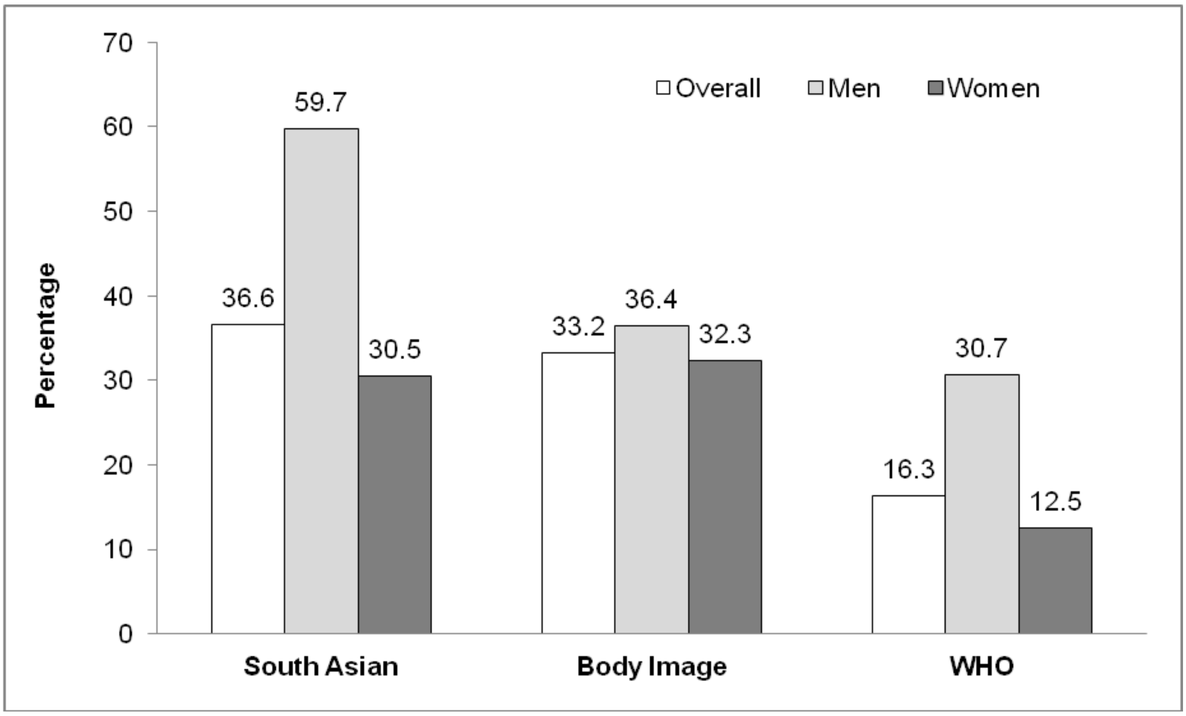
Of the 2114 participants, 1619 were considered for the analysis of underestimation of body weight, although those who were in the underweight category (n=495) and so technically could not underestimate their weight were excluded from this analysis.

Graph 7.1 shows the overall and gender based percentages of participants who underestimated their body weight by various criteria (the South Asian BMI criterion, the WHO BMI criterion, and body image).

7.2.1 Selected weight category (from the given options on questionnaire) versus actual weight category based on the SA BMI criterion

Of the eligible 1619 participants, 36.6% (n=592) underestimated their body weight when their selected weight category (from the given options on questionnaire) was compared with the measured BMI category based on the South Asian criterion**.** This is the outcome variable in this results section. Prevalence of underestimation among men (53.8%) was higher than that of women (38.4%).

Graph 7.1: Prevalence of underestimation of body weight by gender



7.2.2 Selected weight category (on image) versus actual weight category based on the SA BMI criterion

When participants' identified weight category on image was compared with the measured BMI category based on the South Asian BMI criterion, 33.2% (n=537) underestimated their weight. The prevalence of underestimation of body weight was slightly higher among men (36.4%) than women (32.3%).

7.2.3 Selected weight category (from the given options on questionnaire) versus actual weight category based on the WHO BMI criterion

When participants' selected weight category (from the given options on questionnaire) was compared with the measured BMI category based on the WHO BMI criterion, 16.3% (n=264) underestimated their weight. Underestimation was more than double among men (30.7%) than women (12.5%).

7.2.4 Selected weight category (on image) versus actual weight category based on the WHO BMI criterion

When participants' identified weight category on image was compared with the measured BMI category based on the WHO BMI criterion, 12.1% (n=197) underestimated their weight.

The prevalence of underestimation of body weight was slightly higher among women (12.7%) than men (10.2%).

7.2.5 Agreement between selected weight category from the given options on questionnaire and selected weight category on image

There was a fair agreement (Kappa = 0.337, SE = 0.017) between selected weight category from the given options on questionnaire and selected weight category on image (derived from the WHO cut-off points). Overall 58.14% (n=1229) participants correctly identified their weight category on body image when compared with their selected weight category from the given options on questionnaire. This agreement was better among women (60.45%) than men (47.96%) which show a higher validity of body image among women. A detailed breakdown of numbers of participants in different weight categories is shown in Table 7.1.

7.2.6 Agreement between selected weight category on body images versus actual weight category based on the WHO BMI criterion

There was a fair agreement (Kappa = 0.302, SE = 0.017) between selected weight category on image versus actual weight category on the WHO BMI criterion. Overall 58.46% (n=1236) participants correctly identified their weight category on body images when compared with their actual weight category based on the WHO BMI criterion. Again this agreement was better among women (59.75%) than men (52.80%) which show a higher validity of body image among women. A detailed breakdown of numbers of participants in different weight categories is shown in Table 7.2.

Table 7.1: % agreement between self-reported weight category versus weight status marked on body image (based on WHO BMI criterion)

Weight categories marked on images	Self-reported weight categories				
	Under weight	Normal weight	Over weight	Obese	n
Under weight	**182** (A)	69 (B)	5 (C)	0 (D)	256
Normal weight	303 (E)	**681** (F)	193 (G)	4 (H)	1181
Over weight	23 (I)	220 (J)	**353** (K)	60 (L)	656
Obese	00 (M)	03 (N)	05 (O)	**13** (P)	21
Total	508	973	556	77	2114

Percent Agreement (Overall)

= [A + F + K + P] * 100 / Total reading

= (1229/2114) x 100

= 58.14 %

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Weight categories marked on images	Self-reported weight categories				
	Under weight	Normal weight	Over weight	Obese	n
Under weight	**17** (A)	02 (B)	00 (C)	00 (D)	19
Normal weight	79 (E)	**94** (F)	04 (G)	00 (H)	177
Over weight	13 (I)	98 (J)	**74** (K)	04 (L)	189
Obese	00 (M)	03 (N)	01 (O)	**03** (P)	07
Total	109	197	79	07	2114

Percent Agreement (Men)

= [A + F + K + P] * 100 / Total reading

= 188/392 x 100

= 47.96 %

.

Weight categories marked on images	Self-reported weight categories				
	Under weight	Normal weight	Over weight	Obese	n
Under weight	**165** (A)	67 (B)	05 (C)	00 (D)	237
Normal weight	224 (E)	**587** (F)	189 (G)	04 (H)	1004
Over weight	10 (I)	122 (J)	**279** (K)	56 (L)	467
Obese	00 (M)	00 (N)	04 (O)	**10** (P)	14
Total	399	776	477	70	2114

Percent Agreement (Women)

= [A + F + K + P] * 100 / Total reading

= 1041/1722 x 100

= 60.45 %

Table 7.2: Percent agreement between selected weight category on body images versus actual weight category (WHO BMI criterion)

Weight categories marked on images	Weight status based on WHO BMI criterion				
	Under weight	Normal weight	Over weight	Obese	n
Under weight	**102 (A)**	75 (B)	01 (C)	0 (D)	178
Normal weight	286 (E)	**829 (F)**	62 (G)	4 (H)	1181
Over weight	28 (I)	353 (J)	**220 (K)**	55 (L)	656
Obese	00 (M)	03 (N)	11 (O)	**07 (P)**	21
Total	416	1260	294	66	2114

Percent Agreement (Overall)

$$= \frac{[A + F + K + P]}{\text{Total reading}} * 100$$

= (1236/2114) x 100

= 58.46 %

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Weight categories marked on images	Weight status based on WHO BMI criterion				
	Under weight	Normal weight	Over weight	Obese	n
Under weight	**14 (A)**	05 (B)	00 (C)	00 (D)	19
Normal weight	36 (E)	**131 (F)**	09 (G)	01 (H)	177
Over weight	07 (I)	104 (J)	**59 (K)**	19 (L)	189
Obese	00 (M)	03 (N)	01(O)	**03 (P)**	07
Total	57	243	69	23	392

Percent Agreement (Men)

$$= \frac{[A + F + K + P]}{\text{Total reading}} * 100$$

= 207/392 x 100

= 52.80 %

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Weight categories marked on images	Weight status based on WHO BMI criterion				
	Under weight	Normal weight	Over weight	Obese	n
Under weight	**166 (A)**	70 (B)	01 (C)	00 (D)	237
Normal weight	250 (E)	**698 (F)**	53 (G)	03 (H)	1004
Over weight	21 (I)	249 (J)	**161 (K)**	36 (L)	467
Obese	00 (M)	00 (N)	10 (O)	**04 (P)**	14
Total	437	1077	225	43	1722

Percent Agreement (Women)

$$= \frac{[A + F + K + P]}{\text{Total reading}} * 100$$

= 1029/1722 x 100

= 59.75 %

7.3 Underestimation of body weight and participants' personal characteristics

Table 7.3 summarizes the association of underestimation of body weight with personal characteristics of the participants. Those which had significant (p-value ≤ 0.05) association with underestimation of weight included gender, degree programme, academic year of participants and BMI status.

Underestimation of body weight was more prevalent among man (53.8%) than women (38.4%). There was also significant association between underestimation of body weight and type of degree programme participants enrolled on, with a higher (49.4%) percentage among those on the nursing degree programme than on other programmes (28.5% to 37.6%). Similarly, a significant association was found between underestimation of body weight and academic study year of participants, with a higher (43.6%) percentage among those on the 5th year than other years (29.9% to 34.4%). However, there was no significant association between underestimation of weight and birth order of participants. Participants underestimate their body weight regardless of their birth order.

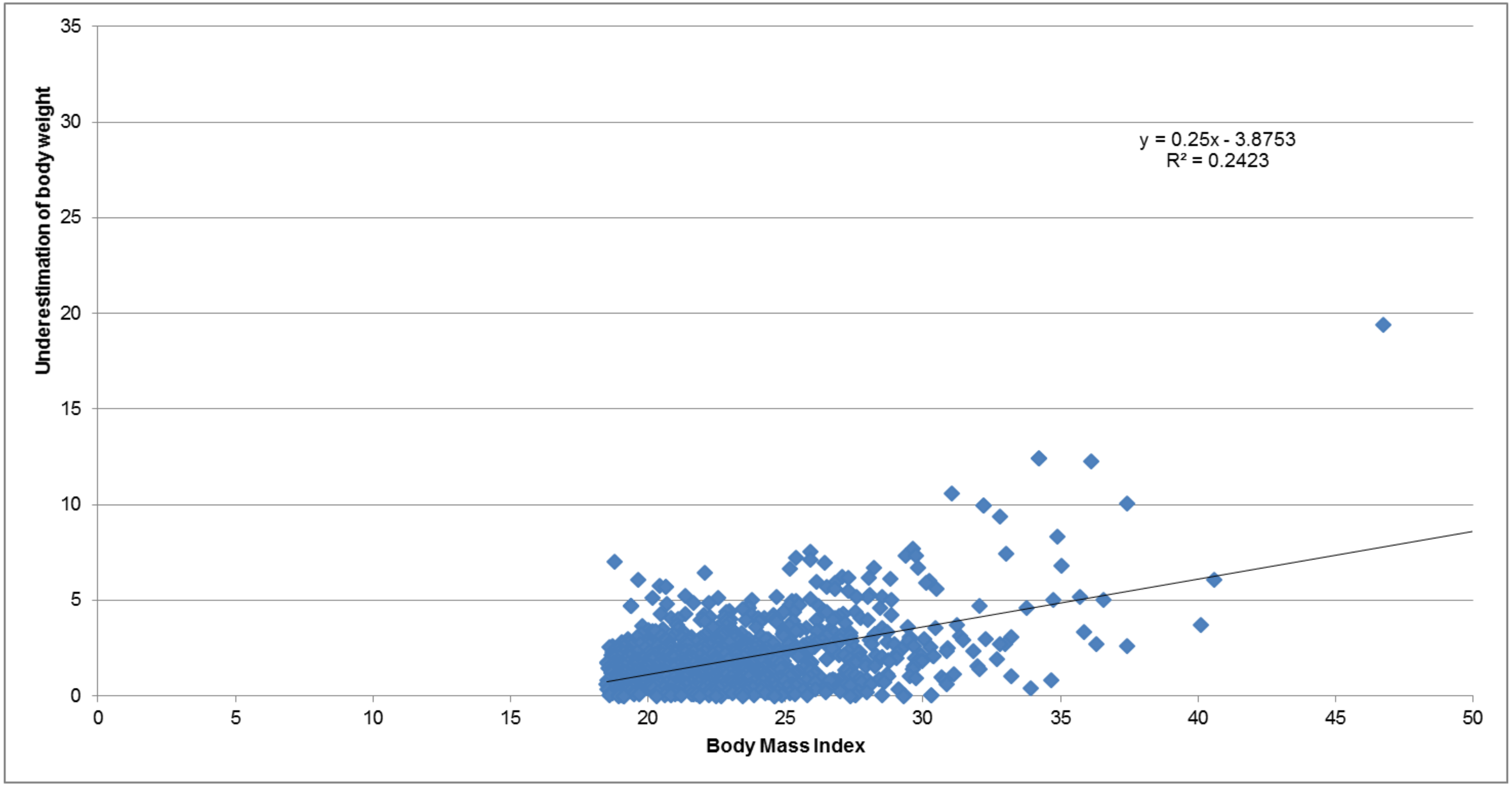
Underestimation of body weight when explored across weight categories was found more among overweight participants (55.4%) than normal weight (19.6%). Similarly, the percentage of underestimation was even higher (81.8%) among obese individuals than normal and overweight individuals. Further relationship between underestimation of body weight and BMI is shown in Graph 7.2. Although underestimation of body weight is spread across BMI ranges, it is evident that there is a positive correlation between BMI and underestimation of body weight. Magnitude of underestimation increases with increase in BMI.

Table 7.3: Association of underestimation of body weight with personal characteristics (n=1750)

Variables	Total		Correct estimation		Underestimation		Univariate OR (95% CI)	p-value
	N	(%)	N	(%)	N	(%)		
Gender								< 0.001
Women	1378	(78.7)	986	(71.6)	392	(38.4)		
Men	372	(21.3)	172	(46.2)	200	(53.8)	2.93 (2.31 to 3.70)	
Degree programme								< 0.001
Medicine	838	(47.9)	578	(69.0)	260	(31.0)		
Dentistry	305	(17.4)	218	(71.5)	87	(28.5)	0.89 (0.67 to 1.18)	
Physiotherapy	151	(8.6)	96	(63.6)	55	(36.4)	1.27 (0.89 to 1.83)	
Pharmacy	298	(17.0)	186	(62.4)	112	(37.6)	1.34 (1.02 to 1.77)	
Nursing	158	(9.1)	80	(50.6)	78	(49.4)	2.17 (1.54 to 3.06)	
Academic year of study								0.015
1st Year	472	(27.0)	314	(66.5)	158	(33.5)		
2nd Year	379	(21.7)	261	(68.9)	118	(31.1)	0.90 (0.67 to 1.20)	
3rd Year	387	(22.1)	254	(65.6)	133	(34.4)	1.04 (0.78 to 1.38)	
4th Year	294	(16.8)	206	(70.1)	88	(29.9)	0.85 (0.62 to 1.16)	
5th Year	218	(12.4)	123	(56.4)	95	(43.6)	1.54 (1.11 to 2.13)	
Birth order								0.189
Eldest	584	(33.4)	371	(63.5)	213	(36.5)		
Middle	764	(43.6)	511	(66.9)	253	(33.1)	0.86 (0.69 to 1.08)	
Youngest	371	(21.2)	258	(69.5)	113	(30.5)	0.76 (0.58 to 1.01)	
Only child	31	(1.8)	18	(58.1)	13	(41.9)	1.26 (0.60 to 2.62)	
BMI status								< 0.001
Underweight[1]	338	(19.3)	338	(100)	00	(0.0)		
Normal weight[2]	796	(45.5)	640	(80.4)	156	(19.6)		
Overweight[3]	258	(14.7)	115	(44.6)	143	(55.4)	5.10 (3.77 to 6.90)	
Obese[4]	358	(20.5)	65	(18.2)	293	(81.8)	18.49 (13.42 to 25.49)	

Note: 364 participants with overestimation of body weight were excluded from analysis
[1]BMI: <18.5 [2]BMI: 18.5 to 22.9 [3]BMI: 23.0 to 24.9 [4]BMI: ≥ 25

Graph 7.2: Underestimation of body weight and body mass index



7.4 Underestimation of weight and socio-economic characteristics

The role of parents, siblings, friends, and economic status was assessed in the underestimation of weight, and is summarized in Table 7.4.

The percentage of underestimation of body weight was significantly higher among participants who received weight-related comments from parents (36.1%) versus those who did not (30.9%). Similarly, a higher (37.5%) percentage of participants found to underestimate their body weight who received weight related comments from friend versus those who did not (28.2%). Underestimation of body weight was also higher (38.9%) among those who experienced weight stigmatization than among those who did not (31.8%).

When explored across socio-economic status categories, it was found that underestimation was significantly higher (33.3%) among participants of middle than those of higher socio-economic status (25%). There was no significant difference between the high and low socio-economic groups. A positive association was also found between an increased number of siblings and underestimation of body weight whereas a marginal association (p-value 0.083) was revealed about receiving weight related comments from siblings. On the other hand, source of weight knowledge, consultation for weight management and number of sisters did not show significant association at this level.

7.5 Factors associated with the underestimation of body weight

7.5.1 Univariate logistic regression analysis

Association of identified independent variables on the basis of the literature search was checked with underestimation of weight one by one. Table 7.3 & 7.4 summarized the findings of univariate analysis in the form of crude odds ratio, 95% confidence interval and p-value. A variable with p-value of ≤ 0.25 was considered significant and a candidate for multivariate analysis. Significant variables when explored for multicollinearity, were found between BMI (in continuous form) and gender, SES, ethnicity, and degree programme. Hence, the variable 'BMI (in continuous form)' was dropped at this level to avoid its effect on other variables at multivariate level.

Table 7.4: Association of underestimation of body weight with social characteristics (n=1750)

Variables	Total		Correct estimation		Underestimation		Univariate OR (95% CI)	p-value
	N	(%)	N	(%)	N	(%)		
Source of weight knowledge								0.111
I checked it	1343	76.7	902	(67.2)	441	(32.8)		
Others told me	407	23.3	256	(62.9)	151	(37.1)	1.21 (0.96 to 1.52)	
Parents commented on body weight								0.022
No	761	43.5	526	(69.1)	235	(30.9)		
Yes	989	56.4	632	(63.9)	357	(36.1)	1.26 (1.03 to 1.55)	
Siblings commented on body weight								0.083
No	958	54.7	651	(68.0)	307	(32.0)		
Yes	792	45.3	507	(64.0)	285	(36.0)	1.19 (0.98 to 1.45)	
Friends commented on body weight								< 0.001
No	685	39.1	492	(71.8)	193	(28.2)		
Yes	1065	60.9	666	(62.5)	399	(37.5)	1.53 (1.24 to 1.88)	
Weight stigmatization								0.005
No	1256	71.7	856	(68.2)	400	(31.8)		
Yes	494	28.3	302	(61.1)	192	(38.9)	1.36 (1.07 to 1.69)	
Consultation for weight management								0.284
No	1537	87.8	1024	(66.6)	513	(33.4)		
Yes	213	12.2	134	(62.9)	79	(37.1)	0.85 (0.63 to 1.14)	
Socio-economic status (SES)								0.011
High SES[1]	60	(3.4)	45	(75.0)	15	(25.0)		
Middle SES[2]	1573	(89.9)	1049	(66.7)	524	(33.3)	2.48 (1.25 to 4.95)	
Low SES[3]	117	(6.7)	64	(54.7)	53	(45.3)	1.50 (0.83 to 2.71)	
Total number of siblings [Mean ± SD]	1750	(100)		3.2 ± 1.8		3.4 ± 2.2	1.05 (1.00 to 1.11)	0.037
Total number of sisters [Mean ± SD]	1750	(100)		1.6 ± 1.4		1.7 ± 1.5	1.04 (0.97 to 1.12)	0.250

[1]High SES: Car and air conditioner ± other items
[2]Middle SES: Fridge, television, computer, and washing machine ± car or air conditioner,
[3]Low SES: Radio, telephone, cycle, motorcycle ± fridge, television, computer or washing machine

7.5.2 Multivariate logistic regression analysis

At multivariate level, we reject the null hypothesis at 5% level of significance and concluded that underestimation of body weight was associated with male gender and higher BMI (overweight or obese). We also found that underestimation of body weight was associated with source of weight knowledge, weight related comments from parents, weight-related comments from friends, and total number of siblings. Table 7.5 shows the magnitude of association of significant variables in the form of adjusted odds ratio along with 95% confidence intervals and p-value.

The independent variables found to be non-significant were assessed for confounding effects before removal from the final model. None of the variables had a confounding effect.

Table 7.5: [Multivariate logistic regression] Adjusted odd ratios for factors associated with underestimation of body weight among trainee HCPs (n = 1412)

Variable	OR	95% C.I	p value
Gender			< 0.001*
Women	1		
Men	3.11	2.30 to 4.21	
BMI			< 0.001*
Normal weight[1]	1		
Overweight & Obese[2]	9.45	7.28 to 12.25	
Source of weight knowledge			0.039*
Self-assessment of weight	1		
Informed by someone	1.38	1.02 to 1.87	
Parents commented on body weight			0.001*
No	1		
Yes	1.56	1.19 to 2.03	
Friends commented on body weight			0.006*
No	1		
Yes	1.46	1.12 to 1.92	
Number of siblings	1.12	1.03 to 1.23	0.013*

[1]BMI 18.5 to 22.9 [2]BMI: ≥ 23.0 * Significant at p value ≤ 0.05

Note: 364 participants with overestimation of body weight and 207 participants in the underweight category who technically cannot underestimate their body weight were excluded from the final analysis.

Men were more likely to underestimate their body weight than women [OR=3.11 (95%C.I: 2.30 to 4.21)] as the odds of underestimation of weight among men were 3.11 times, the odds among women. Similarly, the measured BMI categories of participants were significantly associated with underestimation of body weight (p-value <0.001); compared to normal weight individuals, overweight and obese individuals were more likely to underestimate weight [OR=9.45 (95%C.I: 7.28 to 12.25)]. The odds of underestimation of body weight among overweight and obese participants were 9.45 times, the odds among normal weight participants.

Participants who relied on other people for their weight category were more likely to underestimate weight than those who decided for themselves [OR=1.38 (95%C.I: 1.02 to 1.87)]. The odds of underestimation among participants who relied on other people for their weight category was 1.38 times, the odds of underestimation of weight among those who self-measured weight and decided for themselves.

In particular, underestimation was more likely for participants who received weight-related comments from parents [OR=1.56 (95%C.I: 1.19 to 2.03)], the odds being 1.56 times more than for those who had not received such weight related comments. Similarly, underestimation was more likely for participants who had received weight-related comments from friends [OR=1.46 (95% C.I: 1.12 to 1.92)], the odds being 1.46 times more than for those who had not received such weight related comments.

Another variable which had significant association with underestimation of weight was number of siblings [OR=1.12 (95% C.I: 1.03 to 1.23)], the odds increasing by 1.12 times with each additional sibling. However, socio-economic status did not show significant association with underestimation of body weight.

7.5.3 Sensitivity analysis

In order to check the stability of the model-I (section 7.5.2) which was based on the South Asian BMI cut off points; analysis was repeated to build model-II by using the WHO cut-off points.

In model-II, five of variables (gender, BMI, weight related comments from parents, weight-related comments from friends, and total number of siblings) found to be associated with underestimation of body weight which also showed significant association in model-I. However, the variable ‘source of weight knowledge’ found to be insignificant in model-II which was significant in model-I.

According to model-II, men were more likely to underestimate their body weight than women [OR=2.31 (95%C.I: 1.59 to 3.35)] as the odds of underestimation of weight among men were 2.31 times, the odds among women. Similarly, the measured BMI categories of participants were significantly associated with underestimation of body weight (p-value 0.019); compared to normal weight individuals, overweight and obese individuals were more likely to underestimate weight [OR=1.56 (95%C.I: 1.07 to 2.27)]. The odds of underestimation of body weight among overweight and obese participants were 1.56 times, the odds among normal weight participants.

In particular, underestimation was more likely for participants who received weight-related comments from parents [OR=2.24 (95%C.I: 1.55 to 2.23)], the odds being 2.24 times more than for those who had not received such weight related comments. Similarly, underestimation was more likely for participants who had received weight-related comments from friends [OR=1.73 (95% C.I: 1.19 to 2.51)], the odds being 1.73 times more than for those who had not received such weight related comments. Another variable which had significant association with underestimation of weight was number of siblings [OR=1.08 (95% C.I: 1.00 to 1.17)], the odds increasing by 1.08 times with each additional sibling.

However the variable ‘source of weight knowldge’ which was significantly associated with underestimation of body weight in model-I, shown insignificant association with underestimation of body weight in model-II. According to model-II, participants who relied on other people for their weight category were more likely to underestimate their weight than those who decided for themselves [OR=1.09 (95%C.I: 0.77 to 1.53)]. The odds of underestimation among participants who relied on other people for their weight category was 1.09 times, the odds of underestimation of weight among those who self-measured weight and decided for themselves. The lower (0.77) and upper (1.53) of 95% confidence interval for this association capture ‘the value of 1’ in between, thus turned this association as insignificant. Similar to model-I, the variables age and socio-economic status did not show significant association with underestimation of body weight. Summary of the sensitivity analysis is shown in [Table 7.6].

Table 7.6: [Multivariate logistic regression] Sensitivity Analysis: Adjusted odd ratios for factors associated with underestimation of body weight among trainee HCPs

Variable	Model-I			Model-II		
	South Asian BMI criterion			WHO BMI criterion		
	OR	95% C.I	p-value	OR	95% C.I	p-value
Gender			<0.001*			< 0.001*
Women	1			1		
Men	3.11	2.30 to 4.21		2.31	1.59 to 3.35	
BMI			< 0.001*			0.019*
Normal weight[1]	1			1		
Overweight & Obese[2]	9.45	7.28 to 12.25		1.56	1.07 to 2.27	
Source of weight knowledge			0.039*			0.625
Self-assessment of weight	1			1		
Informed by someone	1.38	1.02 to 1.87		1.09	0.77 to 1.53	
Parents commented on body weight			0.001*			< 0.001*
No	1			1		
Yes	1.56	1.19 to 2.03		2.24	1.55 to 2.23	
Friends commented on body weight			0.006*			0.004*
No	1			1		
Yes	1.46	1.12 to 1.92		1.73	1.19 to 2.51	
Number of siblings	1.12	1.03 to 1.23	0.013*	1.08	1.00 to 1.17	0.042*

Model adjusted for the effect of age and socio-economic status

* Significant at p-value ≤ 0.05

South Asian BMI criterion: Normal weight: BMI b/w 18.50 to 22.99 Overweight & Obese: BMI ≥ 23.0

WHO BMI criterion: Normal weight: BMI b/w 18.50 to 24.99 Overweight & Obese: BMI ≥ 25.0

7.6 Summary

- Over one-third of participants underestimated their body weight
- The South Asian BMI criterion is conservative and more sensitive than the WHO BMI criterion for identifying participants with underestimation of body weight
- There was a fair agreement (Kappa = 0.337, SE = 0.017) between selected weight category from the given options on questionnaire and selected weight category on image (derived from the WHO cut-off points).
- There was also a fair agreement (Kappa = 0.302, SE = 0.017) between selected weight category on image versus actual weight category on the WHO BMI criterion.
- Model-I (based on the South Asian BMI criterion) and model-II (based on the WHO BMI criterion) identified the same associated factors for underestimation of body weight except one 'source of knowledge' which showed significant association only in model-I.
- There was a positive correlation between BMI and underestimation of body weight and magnitude of underestimation increases with increase in BMI
- Women were more likely to identify correct weight category based on image than men
- Underestimation was more likely among men who were overweight or obese or who relied on other people when deciding their weight category (model-I only)
- Underestimation was more likely among participants who received weight-related comments from parents and friends
- Increase in number of siblings also increased the likelihood of underestimation of body weight

Chapter 8: Discussion

8.1 Introduction

The aims of this thesis were to estimate the prevalence of the underestimation of body weight and to determine the factors associated with the underestimation of body weight among trainee HCPs. A cross-sectional analytical study was designed. We reported and compared the weight-based findings by using different BMI criteria; however, in the main discussion (especially for discussing associated factors of overweight, obesity and the underestimation of body weight) the South Asian BMI cut-off points were used.

Results show that over a quarter of participants were overweight or obese, but more than one-third of them did not consider themselves to be so. The underestimation of body weight was more likely among men (vs. women), and those who were overweight or obese (vs. normal weight). Participants who obtained their weight knowledge from others were more likely to underestimate their weight than those who self-measured their weight. Similarly, participants who received weight-related comments from their parents and friends were more likely to underestimate their weight than those who did not. An increased number of siblings also increased the likelihood of underestimation of body weight.

These findings with reference to the existing literature in the field are discussed in the following sections.

8.2 Characteristics of the study sample

It has been difficult for researchers to collect data in the busy environment of medical settings in Pakistan. The overall response rate of a recently published study was only 12.2% at this was conducted in two of the public sector institutes in Karachi (Mahmood et al., 2013). Similarly, a study conducted by Raza et al. (2010) in a public sector medical college received a response rate of 7.5%. The highest response rate a study has so far achieved was 45.3% with a 93.2% questionnaire completion rate by Minhas et al. (2010) who collected data from only one medical college. Other studies conducted in the area did not report the received response rate (Chaudhry et al., 2012; Mozaffer et al., 2009; Nighat et al., 2009). The overall response rate of the current study was approximately 45% which is excellent taking into consideration the fact that data collection was carried out in six different institutes. Also, the questionnaire completion rate was high (84.6%). High response and questionnaire completion rates were achieved by the cooperation of the heads of the participating institutes and of the faculty members who requested students' participation in classroom announcements. The involvement of class representatives and volunteers as the study advocates greatly helped in approaching groups of students in common rooms, cafeterias and corridors. The principal investigator's prior experience of collecting data from medical students also played a crucial role.

A representative sample of students was recruited from medicine, dentistry, pharmacy, physiotherapy and nursing degree courses. It is important to mention that the response rate was not constant across all participating institutes. A much higher response was received from COP (91.5%), DIKIOHS (90.5%), IoN (89.2%) and DCOP (70.2%) compared to the DMC (31.2%) and SMC (29%). The better response rate from these institutes was due to (i) the lower number of students enrolled in these institutes compared to the DMC and SMC, (ii) the small size of the buildings provided the research team with a better opportunity to approach the maximum number of students, (iii) the fact that a request for study participation was made by the principal of the institutes to the students and, (iv) the involvement of class representatives and volunteers as the study advocates in these institutes.

Also, the sample represents accurately the ratio of men to women students. In the sampled population, 81.5% of the participants were women, close to their actual representation (82.2%) in these institutes. This higher percentage of women is because of (i) the higher number of women applying for admission (ii) women demonstrate better academic performance than men in intermediate college exams and admission tests which are prerequisites for admission. A higher percentage of women over men was reported consistently in all previous studies (Chaudhry et al., 2012; Mahmood et al., 2013; Minhas et al., 2010; Mozaffer et al., 2009; Nighat et al., 2009; Raza et al., 2010).

The sample is also a true representative of participants in terms of ethnicity, as Karachi is a metropolitan city with multilinguistic communities. According to the last official census (Pakistan Bureau of Statistics, 1998), the main ethnic groups in the city were Urdu speaking (48.5%), Punjabi speaking (13.9%) and Sindhi speaking (7.2%). The sample contains 67.9% Urdu speaking participants (Muhajirs), 11.9% Punjabi speaking participants (Punjabis) and 8.5% Sindhi speaking participants (Sindhis). Earlier studies conducted in medical and dental settings in Karachi have shown similar representation. Raza et al. (2010) reported 75.4% and Nighat et al. (2009) reported 76.3% of the participants were Urdu speaking (Muhajirs) followed by Punjabi and Sindhi speakers. Thus, the sample of current study is representative of the population in terms of degree programmes, gender and ethnicity profiles.

8.3 Difference between self-reported and measured height, weight and BMI and relation with body image and environmental influences

It is interesting to mention that many of the participants were very keen to be measured as they did not know their height and weight and just filled in the information based on their best guess. In our sample, height was being over-reported by participants. The mean actual measured height was 159.9cm whereas the mean self-reported height was 161.9cm. It was revealed that men and women equally over-reported their height. Men estimated on average that they were 1.73cm taller than their actual measured height and women estimated on average that they were 2.11cm taller than their actual measured height. These findings are consistent with findings from the Health Survey for England (2012) in which men and women over-reported their height by 1.6cm and 1.0cm respectively. Although the direction of inaccuracy is same, it is important to note that the magnitude of over-reporting of height was higher in our study especially among women which possibly suggests important cultural differences between the two settings. In England people have more and better opportunities of physical measurements (e.g. GP surgery, gym and fitness centre etc.) than Pakistan which could contribute to the difference in knowledge. Similarly, the difference in cultural dress between the two settings could also be a contributory factor. For example, in Pakistan most of the women wear ‘shalwar and kamiz’ which does not required as accurate a measurement as is needed for ‘trouser and shirt’ in western society which could contribute towards the difference found in over-reporting of height between the two populations.

On the other hand, weight was under-reported by participants. The mean actual measured weight was 55.01kg whereas mean self-reported weight was 54.51kg. Men under-reported their weight to a greater degree than women. Men under-reported their weight by 2.17kg whereas women under-reported their weight by only 0.12kg. Overall under-reporting weight trends remained the same as those found in the Health Survey for England (2012) in which men under-reported their weight by 1.6kg and women by 2.4kg. The degree of under-reporting of weight among women in the HSE (2012) is higher than women in our study. This variation could be explained by the fact that women in the HSE are older than those participating in the current study and evidence suggests that underestimation of weight is associated with increasing age (Bhanji et al., 2011; Gregory et al., 2008; Tang et al., 2012). This difference could also suggest cultural differences as well as the overall difference of the prevalence of overweight and obesity (higher in England than Pakistan) which possibly contributes to weight bias especially in western society (Frances et al., 2013). Similar trends were also reported by earlier studies from France (Niedhammer et al., 2000), Switzerland (Faeh et al., 2008), Italy, the Netherlands and North America (Krul et al., 2010).

Similarly, BMI was under-reported by participants. An overall mean difference of 0.94 kg/m^2 was found between reported and actual measured BMI. No significant difference was found in terms of the under-reporting of BMI across gender, as men under-reported their BMI by 0.98 kg/m^2 and women by 0.92 kg/m^2. Again these findings are consistent with the findings from the Health Survey for England (2012) in which men and women under-reported their BMI by 1.0kg/m^2 cm and 1.1kg/m^2 respectively. These findings are also consistent with earlier literature (Faeh et al., 2008; Krul et al., 2010; Niedhammer et al., 2000). Interestingly, Frances and colleagues (2013) looked at the national representative (self-reported and measured) data of Ireland for height and weight collected from three waves of the Surveys of Lifestyle Attitudes and Nutrition (SLAN) over a period of ten years (1998 to 2007) and found that the self-reported height bias has remained stable over time, irrespective of age, gender, and weight whereas self-reported weight bias has increased over time in all age groups with no gender difference. Thus the researchers concluded that the widening gap between self-reported BMI and measured BMI is possibly attributable to an increased weight bias (Frances et al., 2013). Although we do not have supporting data over the period of time, this could be one of the likely explanations for our findings, which need waves of surveys over a period of time.

Statistically, over-reporting of height and under-reporting of weight and BMI result in the overall underestimation of body weight, which was more common among individuals who received weight-related comments from parents and friends than those who did not (further discussed in section 8.7.2). In the current study, the weight information of participants' parents, and friends was not gathered, thus it is difficult to infer that underestimation of body weight was more common only among the individuals whose parents and friends had a higher BMI or it was a common phenomenon among all. Future quantitative studies can explore this association in detail by gathering anthropometric measurements of parents and friends along with individuals and the association of the underestimation of individuals' weight can be assessed with the weight status of people around them.

Similarly, there was a poor agreement (Kappa = 0.232, SE = 0.015) between the BMI category based on self-reported height and weight data versus their identified weight category on body image. In over half (50.4%) of the cases, participants' reported height and weight was not correctly matched with their identified weight category on their body images. Moreover, no significant difference was found in terms of reported height, weight and BMI among those who received weight-related comments from parents and siblings and those who did not. This association can be better explored in future through qualitative studies by gathering detailed information regarding the nature, type and content of the comments from parents, siblings and friends as this level of information was not collected in our study because of its quantitative design.

8.4 Weight management practices across weight categories

According to Koplan and colleagues (2005) individuals adopt practices designed to maintain or modify their weight, sometimes known as weight management strategies. These have two main components; (i) a personal weight goal (ii) the use of varieties of behaviours or practices to achieve this personal weight goal. It is important to note that these personal weight goals can either match or mismatch with recommendations that a health professional might ask for achieving a healthy weight and similarly a variety of weight management practices used to achieve a personal weight goal can be healthy, or unhealthy (McCabe & Ricciardelli, 2006).

In our sample, approximately 44% of the participants reported that they had tried to modify their body weight in the past year. Among them 29.6% had tried to lose weight and 14.6% tried to gain weight. It was interesting to note that along with 55.7% overweight individuals, 25.1% of normal weight and 5.5% of the underweight individuals also tried to lose weight. As far as weight gaining practices are concerned, it was again interesting to note that along with 32.8% of underweight individuals, 12.4% of normal weight and 3.8% of the overweight or obese individuals tried to gain weight. Similar findings were reported by Roy and Gauvin (2010) from Canada who used a national representative population-based sample (n=2188) of adolescents from the Quebec Child and Adolescent Health and Social Survey and found 30.4% of the adolescents had mismatched personal goals and 49% were having mismatched weight management practices. Researchers think that body dissatisfaction can be one of the possible explanations for observed mismatched weight management practices as highlighted by earlier literature (McCabe & Ricciardelli, 2006; Polivy & Herman, 2002).

As far as our findings are concerned, there can be a number of possible explanations for these observed mismatched weight management practices. The first possible reason could be that participants were not aware of their actual weight status that is well supported by our data, which shows 75% of the participants did not know their BMI. When their reported weight status was compared with their actual measured weight status, 36.6% of individuals underestimated their weight and another 20.7% overestimated their weight. This incorrect perception of body weight could have contributed towards these inappropriate weight management practices. The second possible reason for the mismatched weight management practices could be the impact of family, friends and colleagues. Our data shows that a large proportion of participants received weight-related comments from parents (55.6%), siblings (45.8%) and colleagues (59.5%) whose assessment of weight for the participants is questionable. However, 30.1% of participants reported that their colleagues or friends would like them more if they could modify their body weight. The third possible reason could be the impact of the media. For example, 53.4% of the participants reported that they compared their body weight with people on television or in magazines and more importantly 35.2% acknowledged the fact that they felt pressure from television or magazines to modify (lose or gain) their weight. Our data quantitatively supports these possible reasons for mismatched weight management practices. However, it would be best if future research could explore the reasons behind weight management practices in detail through qualitative work where data can be collected with the help of in-depth interviews or FGDs.

8.5 Overweight, obesity and associated factors among trainee HCPs

8.5.1 Prevalence of overweight and obesity

Overweight and obesity continue to be a major public health problem worldwide (Jafar et al. 2006). Developing countries are especially susceptible to the epidemic of obesity which now affects populations regardless of age and gender (Friedrich, 2002). This is because of the extraordinary economic and societal changes accompanying what is known as 'nutritional transition'[19] (James et al., 2010). It has also been noted that compared to the populations in developed countries, those in developing countries are at greater risk of chronic diseases, such as cardiovascular disease and diabetes which is becoming the leading cause of morbidity and mortality in these countries (He et al., 2005; Reddy et al., 2004; Reddy & Yusuf, 1998). Data from the National Health Survey of Pakistan (1990-1994) suggested that a quarter of the general population of Pakistan is overweight or obese (Jafar et al., 2006).

In our sample, 12.6% of the participants were overweight and another 17% were obese according to the recommended South Asian BMI criterion. This finding is consistent with earlier studies conducted in public sector institutes of Pakistan (Chaudhry et al., 2012; Mahmood et al., 2013; Minhas et al., 2010; Raza et al., 2010). The study conducted by Mahmood and colleagues (2013) in a public sector medical institute in Karachi showed a 14.7% and a 12.4% prevalence of overweight and obesity according to the South Asian criterion (Mahmood et al., 2013). Another study conducted in the same setting reported a 17.4% prevalence of overweight and obesity (Raza et al., 2010).

Studies conducted in private medical settings of Pakistan reported 41.7% and 56.2% of participants in the overweight and obese categories respectively (Mozaffer et al., 2009; Nighat et al., 2009). The higher percentage of overweight and obesity recorded is due to the

[19] Change from diets high in cereal and fibre to diets high in sugars, fat, and animal-source food

fact that students in private medical institutes belong to the high SES. By contrast, the majority of the students in public sector institutes are from the middle SES, as was 90% of the current study sample.

Along with the use of the South Asian BMI criterion, this study also used the WHO BMI criterion to cross-check with studies which used the WHO criterion. According to the WHO criterion, in our sample the prevalence of overweight and obesity was 13.9% and 3.1% respectively. Two of the studies from Pakistan also used the WHO BMI criterion for the estimation of overweight and obesity (Chaudhry et al., 2012; Minhas et al., 2010). According to Chaudhry et al. (2012) the magnitude of overweight and obesity was 10.6% whereas Minhas et al. (2010) reported an 11.3% prevalence of overweight and obesity. Our findings are slightly higher than those reported by Chaudhry et al. (2012) and Minhas et al. (2010) from Pakistan. The larger sample size of our study gives us more confidence over the estimated scale of the problem. Future studies from Pakistan with a strong methodology especially in terms of a large justified sample size could provide a better comparison and it would be best if future research could report prevalence of overweight and obesity by using both BMI criteria.

Contrary to our findings (17%), a higher prevalence of overweight and obesity among students has been recorded among students from the US (42.7%), Canada (22.9%), the Central Eastern European countries (22.3%), and the United Arab Emirates (24%) who also used the WHO BMI criterion for weight assessment (Adderley-Kelly et al., 2007; Boo et al., 2010; Carter et al., 2003; Kolarzk et al., 2012; Perusse-Lachance et al., 2010; Sawsan & Elsadig, 2010). However, it is difficult to comment on definite causes of the observed obesity differences across countries due to the complex nature of obesity (Kolarzyk et al., 2012). According to Kolarzyk and colleagues (2012) differences in dietary intake (eating or not eating energy dense food such as burgers, chips, potatoes, noodles, confectionary and soft drinks etc.) across countries may be one of the possible factors. There are other factors such as nutritional environment, access to leisure and exercise facilities, cultural and social norms in which individuals live, all of which are likely to contribute to the causes of obesity (Vandenbroeck et al., 2007). Similarly, it is important to acknowledge that there is methodological heterogeneity across studies in terms of age, gender, sample size, sampling technique, and the nature of anthropometric data (measured or self-reported). For example the study conducted by Adderley-Kelly et al., (2007) had a small (n=151) convenient sample and that conducted by Perusse-Lachance and colleagues (2010) gathered self-reported data, which could give an underestimate as highlighted by Mongeau et al., (2005).

Regardless of country of origin, it is important that future research should be designed with a strong methodology especially in terms of sample size, sampling technique and gathering actual height and weight data instead of relying on self-reported data and wherever applicable ethnic-specific BMI cut-off points should be used. Additionally, adjustment for age and gender would help in comparison of obesity estimates across countries.

WHO (2008) has also suggested using the waist circumference and waist-hip ratio to assist in weight classification especially for the Asian population as they have increased risk of higher visceral and upper body adiposity for any given BMI, compared with the Western population. This upper body adiposity is responsible for the increased risk of diabetes, hypertension and dyslipidemia (Gomez-Ambrosi et al., 2007). The NICE also emphasised the importance of using waist circumference as a valid measure of abdominal fat mass and disease risk in individuals and recommended its use along with the BMI assessment (NICE, 2013). An assessment of overweight and obesity by using the waist circumference has also been carried out in the Health Survey for England (2011) which shows that a higher percentage (47%) of women were overweight or obese compared to men (34%).

The waist circumference cut-off values for overweight and obesity in men and women of South Asian origin are ≥90cm and ≥80cm respectively (Misra et al., 2009; NICE, 2013). By using these suggested cut-off points of waist circumference, 21.6% of the participants were found to be overweight or obese. Our findings suggest a lower percentage compared to an earlier study conducted in Pakistan, which reported that 39% of participants are overweight or obese based on waist circumference (Shaikh et al., 2011). This discrepancy over findings can be explained by the age difference in the sample population. Our population was younger (with a mean age of 20.6±2.4 years) than that of Shaikh et al. (2011), whose mean age was 27.5±5.7 years and it is evident that increasing age is one of the most likely risk factors for obesity in the Pakistani population (Jafar et al., 2006).

It is also important to note that in our sample, 12.9% of the participants with a normal BMI had central obesity[20] which increases the risk of diabetes, hypertension and cardiovascular disease (Misra et al., 2009; Snehalatha et al., 2003). Shaikh et al. (2011) also reported 17% of participants with normal BMI but with central obesity. Similarly, Meisinger et al. (2006) reported that 15% of the sample had central obesity despite a normal BMI in the National Health and Nutrition Examination Survey III (NHANES III). Both of these studies have reported a higher percentage of participants with central obesity than in our sample. The main reason again might be the difference in the sample age group which is younger in our case.

We have also assessed the magnitude of overweight and obesity by using a waist-to-hip ratio. According to this criterion, 39.1% of the participants were over the normal weight. Snehalatha et al. (2003) suggested the use of waist circumference for upper adiposity because of its higher sensitivity, rather than the waist-to-hip ratio, which has interaction with

[20] Men ≥ 90cm & Women ≥ 80cm

the BMI. Thus, we have provided the magnitude of overweight and obesity according to recommended criteria, which will help with comparing findings in future research.

Risk assessment of chronic diseases by combining BMI and WC data:

According to the recommendations of the WHO and NICE, individuals' risk of chronic diseases was also assessed by combining the BMI and WC data (NICE, 2013; WHO, 2008). For this purpose, the South Asian BMI and WC cut-off points were used (Misra, et al., 2009). This assessment highlights the impact of overweight and obesity on risk factors for developing long-term health problems e.g. heart diseases, diabetes, osteoarthritis, and many types of cancers. NICE (2013) advised HCPs that the risk of these co-morbidities should be identified using both BMI and WC as assessment tools in those with a BMI less than 35 (equivalent to less than 27.5 for the South Asian population).

It was interesting to find that 12.9% of the normal weight participants have 'increased risk' of chronic diseases because of central obesity. Among the overweight participants, 28.8% with central obesity had a 'high risk' of chronic diseases whereas 71.2% in the same weight category but without central obesity had an 'increased risk'. Similarly, 48.7% of the participants in the "Obese I category" with central obesity had a 'very high risk' of chronic diseases whereas 51.3% in the same category but without central obesity had a 'high risk'. If the BMI is 27.5 or more (equivalent to BMI 35 or more for the White population), WC adds little to the absolute measure of risk provided by BMI as risks are assumed to be very high with any WC (NICE, 2013). There is a lack of information from the developing countries especially in Pakistan regarding the risk assessment of individuals for chronic diseases by combining BMI and WC data and it would be very helpful if this gap be filled in future research.

However in HSE (2012), individuals were assessed for the risk of chronic diseases by combining BMI and WC data and findings are presented in terms of gender. According to HSE (2012) central obesity was more uncommon (2%) among men in the normal weight category than in our data (5.5%). Similarly 29% of overweight and 18% of those in the Obese-I category had an additional risk of chronic disease because of the central obesity. Our data shows 12.7% of overweight and 44.2% of those in the Obese-I category had additional risk which is different from the findings from HSE. While comparing data for women, the percentage of normal weight women with central obesity was similar in HSE and in our study. In HSE (2012) 13% of normal weight women had central obesity and an additional risk of chronic disease which is similar to the percentage (14.4%) in our data. On the other hand, our data showed a very high (50%) percentage of women in the Obese-I category with central obesity contrary to only 14% of those reported in HSE (2012).

It is observed that in almost all cases the central obesity was nearly similar or higher in our sample population than reported in HSE (2012), though our population was much younger than the population in HSE. Firstly, these findings support the existing literature which states that the South Asian population has a greater tendency towards central obesity and a greater risk of chronic diseases compared with the White Caucasian population (Jafar et al., 2006; Misra et al., 2006 & 2009; Mohan et al., 2007; Snehalatha et al., 2003). Secondly, lower BMI and WC cut-off points were used in the current study as supported by local data (Misra et al., 2009) as well as suggested by WHO (2008) and NICE (2013) for the South Asian population. HSE (2012) has used the European thresholds for all participants, regardless of ethnic group. It would be useful if future surveys could bridge this gap especially for the ethnic minority groups.

Overall, the risk assessment of chronic diseases by combining BMI and WC data provided additional useful information. It is essential for the HCPs to be aware of the importance of using the combined assessment tool (BMI and WC) for the prevention, identification and management of overweight and obesity especially among the high-risk population for chronic diseases (e.g. South Asian and other ethnic minorities). More importantly, HCPs should be aware of the difference of BMI and WC cut-off points recommended for the European, Asians and other ethnic minority groups so that they can be used accordingly.

8.5.2 Factors associated with overweight and obesity

Associated factors of overweight or obesity were explored by using three different criteria; (i) the South Asian (SA) BMI criterion (ii) the WHO BMI criterion (iii) waist circumference. The resulting models were labelled as model-I, model-II and model-III respectively. The purpose of comparison (sensitivity analysis) was to see the consistency of findings revealed by model-I across other models and secondly to provide information for future research for easy comparison regardless of the BMI criterion.

It was found that model-I based on the SA BMI criterion was found to be better than model-II and model-III. Model-I identified the same associated factors (the underestimation of body weight, weight stigmatisation and incorrect BMI knowledge) for overweight and obesity as those of model-II based on the WHO BMI criterion. The direction of the magnitude of association was also the same. However, results based on model-I (as compared to model-II) were more concise in terms of narrow confidence intervals and small p-values. On the other hand, model-III based on waist circumference could identify fewer risk factors for overweight and obesity as compared to model-I and model-II. Moreover, the magnitude of association was lower and p-values (chances of error) were higher than models based on SA and the WHO BMI criteria. Although model-III could not identify the same number of associated factors for overweight or obesity as those of the other models, the importance of model-III cannot be ignored in terms of its capability of predicting chronic diseases (e.g. cardiovascular diseases and diabetes) especially in the South Asian population (where central obesity is more common) (Nag & Ghosh, 2013), which was not the scope of the current analysis.

The following sections discuss the associated factors of overweight and obesity based on model-I (SA BMI criterion) which also covers factors revealed by model-II and model-III. These include underestimation of body weight, personal knowledge of BMI and experience of weight stigmatisation. However, age, gender and socio-economic status did not show significant relevance.

(i) Underestimation of body weight

In the current study, overweight and obesity were more likely among participants who underestimate their body weight as compared to those with a correct estimation of body weight. In our sample population, 53.6% of overweight participants said they were normal weight and 81.9% of obese participants said they were 'normal or a little overweight'. Even 15.7% of individuals in the normal weight category said they were 'underweight'. These findings are consistent with earlier research studies which also revealed links between the underestimation of body weight and obesity (Chhatwal et al., 2004; Gutierrez-Fisac et al., 2002; Halvarsson et al., 2002; Howard et al., 2008; Kuchler & Variyam, 2003; Paeratakul et al., 2002).

According to Kuchler & Variyam (2003) approximately 64% of the US population is overweight or obese, of whom 54.6% of men and 23.1% of women failed to recognise that they were overweight. Similarly, a study from Australia conducted in the north-west region of Adelaide reported that 65.4% of obese and 33.4% of overweight participants underestimated their body weight (Howard et al., 2008). Similar association between overweight and obesity and the underestimation of body weight were reported from Sweden, Spain and India (Chhatwal et al., 2004; Gutierrez-Fisac et al., 2002; Halvarsson et al., 2002).

It is important to understand that this is not just a slight misclassification of weight but these individuals are actually at higher risk of chronic disease of which they are unaware (Haffner, 2006). This association may be due to the fact that obesity is now widespread and so individuals are exposed to more overweight and obese people than previously (Jafar et al., 2006). Such continued exposure to overweight and obese people in their surroundings makes people less sensitive to the situation and also affects their perception (Christakis & Fowler, 2007). Also, it has been noted that in many cultures such as that in Pakistan, weight is assumed to be a sign of health and wealth (Bhanji et al., 2011; Cassidy, 1991). Undergraduate students in our study might be under this cultural misconception and have accepted their overweight and obese condition as a norm and this needs urgent attention. It would be best if in future research (especially from Pakistan and developing countries where information on the topic is limited) the issue of underestimation of weight among students as well as among their parents, siblings and friends could be explored through interview or focus group discussion which would provide detailed information and insight into the issue which would facilitate the interventions in process.

(ii) Knowledge of personal BMI

We found that overweight or obesity were inversely associated with personal BMI knowledge. Overweight and obesity were less likely among participants with accurate personal BMI knowledge as the odds of being overweight or obese for participants with correct BMI information were 0.52 times more than the odds for those with incorrect BMI information. It is important to have accurate information of personal BMI in order to maintain healthy body weight as evidence suggests that individuals who do not have accurate information of personal BMI are prone to overweight and obesity (Teresa et al., 2011). Wieck (2000) also stated that the health behaviour of individuals is influenced by their perception of body weight.

In the current sample 60% of the participants in the overweight and obese categories did not know their personal BMI. However, an earlier study conducted among medical students in Pakistan reported that 71% (n=88) of the participants were able to calculate their BMI (Raza et al., 2010). The study's small and non-representative sample suggests limited generalisability as it is possible students with a special interest in the area could have participated in the study and so might differ from other students. Similarly, the study did not report the percentage of participants in an overweight or obese category with the correct calculation of their BMI. However, our finding is consistent with another study conducted in a clinical setting in Pakistan, which reported that of the patients who did not know their current weight category, 66% were overweight or obese (Bhanji et al., 2011).

Similarly, there is also evidence from the developed countries suggesting a lack of personal BMI knowledge among individuals. A study conducted among US state (n=658) employees reported that 31% of the participants in the very obese weight category (BMI ≥ 40) did not know their BMI (Li et al., 2011). Another study conducted among the older population in Ireland (3%) and the US (7%) revealed an even lower percentage of participants with correct knowledge of personal BMI (Teresa et al., 2011). Inappropriate knowledge about personal BMI would also place individuals at risk of attempting mismatched weight management practices. Our data reflects this phenomenon and shows that 25.1% of normal weight and 5.5% of the underweight individuals unnecessarily tried to lose their weight. Another 12.4% of normal weight and 3.8% of the overweight or obese individuals tried to gain weight. Similar findings were also reported by earlier research studies (McCabe & Ricciardelli, 2006; Polivy & Herman, 2002; Roy & Gauvin, 2010). There is lack of information on the topic from Pakistan and other South Asian countries and it would be worthwhile to explore this in future research in light of the current study's findings that show that more than three-quarters of trainee HCPs did not know their BMI which is alarming.

(iii) Weight stigmatisation

Likewise, it was found that overweight or obesity was more likely among participants who had experienced weight stigmatisation in the last year compared to those who had not. This finding is consistent with earlier studies, which have demonstrated that weight stigmatisation is one of the barriers to obesity-related interventions (Ashmore et al., 2008; Friedman et al., 2008; Puhl & Latner, 2007; Schvey et al., 2011). One of the studies also suggests that individuals with weight stigmatisation adapt to cope with stigma by starting to eat more and refusing to diet (Puhl & Brownell, 2006). Another study reported the link between weight stigmatisation and a higher intake of calories and lower energy expenditure (Carels et al., 2009). It seems that weight stigmatisation makes individuals vulnerable to unhealthy eating habits which lead to overweight and obesity. Thus, it is quite an alarming situation requiring intervention.

Negative attitudes towards overweight or obese persons have been widely observed. Considering overweight and obese people to be lazy, unintelligent, unsuccessful, lacking self-discipline and resistant to doctors' advice has harmful effects (Puhl & Brownell, 2001; Puhl & Heuer, 2009). The main reason for the long-term social acceptance of weight stigma is the fact that people blame the obese individuals for their excess weight through assuming them to be responsible for their situation (Puhl & Brownell, 2003). People also believe that weight stigma is an effective tool to encourage obese individuals to adopt a healthy diet and lifestyle (Averett & Korenman, 1999; Hebl & Heatherton, 1998). However, research has revealed that weight stigma is not conducive to weight reduction or improving health. Instead, it negatively affects the physical and psychological health of individuals and is a barrier to obesity prevention efforts (Puhl & Heuer, 2010). The available evidence on the topic of weight stigmatization is from the developed countries, so far there is a lack of information in this regard in developing countries especially in Pakistan where obesity is a growing problem. Therefore, it is important to explore this issue in future research so that it can be addressed as a social issue and more importantly as a priority in public health intervention for obesity prevention.

(iv) Age

The prevalence of overweight and obesity increases among the older sections of the population. A population-based study from Pakistan reported a link between age and overweight and obesity (Jafar et al., 2006). According to the author, the prevalence of overweight and obesity was higher among older age ranges (35 to 54 years). However, we did not find any significant association of age with overweight or obesity since participants in our study were undergraduate students and the majority of them were aged between 18 and 23 years, thus the effect of age is difficult to observe. Our findings are consistent with earlier studies conducted among undergraduate students of medicine and dentistry which showed a non-significant association of age with obesity among participating students (Chaudhry et al., 2012; Mahmood et al., 2013; Minhas et al., 2010; Mozaffer et al., 2009; Nighat et al., 2009; Raza et al., 2010).

(v) Gender

Generally, among the adult population, women were more likely to be overweight or obese than men (WHO, 2013). Earlier studies conducted in our setting among undergraduate students of medicine and dentistry presented mixed results. Three of the studies reported a link between obesity and male gender (Chaudhry et al., 2012; Mahmood et al., 2013; Minhas et al., 2010) whereas another two studies conducted in private medical institutes reported a link between obesity and female gender. The conclusions of these studies are limited by their small and unjustified sample size. In our sample, we did not find a link between gender and obesity and this finding is in agreement with the earlier study conducted by Raza et al. (2010).

The possible explanation could be that participants in our study were young and it is difficult to observe such a difference at an early age. Our findings are also supported by the results of a large population-based study (n= 8972) by Jafar et al. (2006) who did not find any significant difference in overweight men and women of the age group (15-24 years) similar to our sample. However, Jafar et al. (2006) observed a gender difference in an older age group and reported the highest prevalence of overweight and obesity among women aged 35 to 54 years.

(vi) Socio-economic status

According to the National Health Survey of Pakistan, overweight and obesity is prevalent among those of a higher socio-economic status (Jafar et al., 2006). However, we did not find a significant difference in overweight and obesity in terms of SES. It may be because of the fact that 90% of participants were of the middle SES and there was no appropriate representation of students of the low and the high SES. Previous studies conducted in medical settings also did not report the association of SES with overweight and obesity (Chaudhry et al., 2012; Mahmood et al., 2013; Minhas et al., 2010; Mozaffer et al., 2009; Nighat et al., 2009; Raza et al., 2010). For example Mozaffer et al. (2009) and Nighat et al. (2009) conducted studies in private medical institutes where students are of high SES. On the other hand, studies conducted in public sector institutes have an overrepresentation of middle SES (Mahmood et al., 2013; Minhas et al., 2010; Raza et al., 2010).

However, the effects of SES on overweight and obesity can be seen indirectly by comparing the magnitude of the problem across studies. Studies from public sector institutes (predominantly middle SES) reported a lower (10-30%) prevalence of overweight and obesity (Mahmood et al., 2013; Minhas et al., 2010; Raza, et al., 2010) whereas studies from private institutes (predominantly high SES) reported a higher (41-56.2%) prevalence (Mozaffer et al., 2009; Nighat et al., 2009). These findings suggest the association of high SES with overweight and obesity among students as identified in the National Health Survey of Pakistan among the general population (Jafar et al., 2006). A systematic review conducted by Dinsa et al. (2012) which identified 42 surveys from 33 low- and middle-income countries conducted among the adult (≥15 years) population, also reported a positive association between SES and overweight and obesity; those with higher educational attainment and/or more affluence are more likely to be obese. Similarly Neuman et al. (2013) who reviewed national representative data from 38 low- and middle-income countries (LMICs) concluded that individual- and household-level SES measures were independently and positively associated with overweight and obesity. However, McLaren (2007) in his review of 333 published studies concluded that this positive association between SES and overweight and obesity turns into inverse association as one moves from low- and middle-income countries to high-income countries.

8.6 Underweight status and associated factors among trainee HCPs

While discussing the issue of overweight and obesity among participants, it is equally important to draw attention towards those who had body weight below the healthy limit.

8.6.1 Prevalence of underweight status

Like overweight and obesity, underweight status is also a risk factor for many chronic diseases such as osteoporosis, respiratory illnesses, diabetes and cardiovascular diseases (Gillespie & Haddad, 2003; Ly et al., 2013; Walls et al., 2009). In many low-to-middle-income countries, underweight remains a public health challenge along with an increasing prevalence of obesity, which is termed the ‘double burden of disease’ and has received considerable attention (Ke-You & Da-Wei, 2001; Popkin et al., 2012). According to recent statistics, approximately 17% of women and 13% of men were underweight in Asian countries whereas in OECD countries the prevalence of underweight was 4% and 2% among women and men respectively (OECD/WHO, 2014). Similarly, a study conducted among university students of 22 low-to-middle-income countries reported that 17.6% of women and 10.8% of men were underweight (Peltzer et al., 2014).

In our sample, approximately a quarter (23.4%) of the participants had body weight below the healthy limit (BMI <18.5) and were labelled as underweight regardless of the criteria being used, as the WHO and the South Asian criteria have the same BMI (<18.5) cut-off points for underweight. These findings about underweight status are consistent with an earlier study conducted among medical students of public sector institutes in Karachi, which reported 28% of students were underweight (Raza et al., 2010). Similar findings were reported by another study conducted among medical students of public sector institutes in Karachi which found 29.9% participants were underweight (Minhas et al., 2010). However, a study undertaken by Mozaffer and colleagues (2009) in private medical institutes showed a much lower (4.3%) burden of underweight than students from the public sector institutes (Minhas et al., 2010; Raza et al., 2010). This difference potentially can be explained by the difference of SES between students of public (low SES) and private (high SES) medical institutes as highlighted earlier by the OECD/WHO report which showed a higher (15%) underweight status among the adult population of low-to-middle-income countries than (3%) in the adult population of OECD countries.

8.6.2 Factors associated with underweight status

The factors which showed significant association with underweight status include incorrect BMI information and weight stigmatisation. The following sections further discuss these factors in detail.

(i) Knowledge of personal BMI

It was found that underweight status is inversely associated with personal BMI knowledge. Underweight status was more likely among participants with incorrect personal BMI knowledge [OR=1.87 (95%C.I: 1.12 to 3.13)] as the odds of being underweight for participants with the incorrect BMI information were 1.87 times more than the odds for those with the correct personal BMI information. In the current sample, of the participants with the correct personal BMI information only 32.3% were in the underweight category whereas 67.7% were in the normal weight category. Our findings are consistent with the recent study conducted by Ibrahim et al. (2014) among US high-school students containing a nationally representative (n=14,722) sample. According to Ibrahim and colleagues (2014) nearly one-third (33.9%) of the participants had inaccurate BMI information.

According to Teresa et al. (2011) accurate information of personal BMI is important in order to maintain a healthy body weight. It has also been stated that the health behaviour of individuals is influenced by their perception of body weight (Wieck et al., 2000). Inappropriate knowledge about personal BMI is likely to place individuals at risk of attempting mismatched weight management practices (Lemon et al., 2010). Our data reflects this phenomenon and shows that 25.1% of normal weight and 5.5% of the underweight individuals unnecessarily tried to lose weight. Similar findings were also reported by earlier research studies (McCabe & Ricciardelli, 2006; Polivy & Herman, 2002; Roy & Gauvin, 2010).

(ii) Weight stigmatisation

Weight stigmatisation was also found to be associated with underweight status (p-value < 0.001). Underweight status was more likely among participants who experienced weight stigmatisation [OR=3.56 (95%C.I: 2.08 to 6.10)] as the odds of being underweight for participants who experienced weight stigmatisation was 3.56 times more than the odds for those who did not experience weight stigmatisation. In the current sample, weight stigmatisation was very common among underweight participants. Approximately 35% of the underweight participants reported experiencing weight stigmatisation, contrary to only 17.6% with a normal weight.

It is interesting to note that the percentage (35.2%) of underweight participants who reported experiencing weight stigmatisation is similar to the percentage (35.6%) of the overweight and obese participants who reported experiencing weight stigmatisation. Existing bodies of literature report the role of weight stigmatisation among overweight and obese individuals and state that individuals with stigmatisation learn to cope with stigma and refuse to acknowledge overweight status (Ashmore et al., 2008; Friedman et al., 2008; Puhl & Latner, 2007; Schvey et al., 2011). However, there is a dearth of information regarding the association of weight stigmatisation and underweight status so far in existing literature. It is possible that underweight individuals might also have learnt to cope with weight stigmatisation like overweight and obese individuals. Similarly, it is possible that weight stigmatisation would have made them vulnerable to unhealthy eating and weight-maintaining practices as 5.5% of underweight individuals in our sample reported that they have tried to lose weight in the last year either by using dieting, exercise or a combination of both. Thus, it is highly important to explore the issue of weight stigmatisation among underweight individuals in terms of its magnitude, effects and contributing factors in future, and a mixed method research would be best to get information on these aspects through FGDs and in-depth interviews. There is a need to address the issue of weight stigmatisation as a social issue and more importantly as a complementary part in the public health intervention for obesity prevention as mentioned in the earlier section.

However, other variables which include gender, age, degree programme, academic year of study, birth order, family setup, number of siblings, and over-estimation of body weight were insignificant at multivariate levels in our data. It is important to mention that the available evidence on association of underweight status with knowledge of personal BMI and weight stigmatization is from the developed countries. There is a need to explore and highlight this issue in future research among the adult population of developing countries especially Pakistan so that underweight individuals should not be left out while designing interventions for prevention of overweight and obesity.

8.7 Underestimation of body weight and associated factors among trainee HCPs

8.7.1 Prevalence of the underestimation of body weight

A substantial percentage of individuals especially in the overweight and obese weight categories perceived their weight as lower than it actually was. Knowing overweight status plays an important role in weight loss attempts regardless of gender and actual BMI status (Lemon et al., 2009).

A higher percentage of the underestimation of body weight among the general population has been reported in earlier community-based studies (Gregory et al., 2008; Howard et al., 2008; Kuchler & Variyam, 2003). Studies conducted in clinical settings have reported even higher percentages of the underestimation of body weight among patients (Bhanji et al., 2011; Hemiup et al., 2005). However, there was a lack of information regarding the underestimation of body weight among trainee HCPs, which our study has highlighted as significant for future HCPs. Over one-third (36.6%) of participants were found to underestimate their body weight which has important public health implications. This underestimation of body weight is not only a risk for their own health but it might also affect their approach towards patients especially those who are overweight or obese (Barlow et al., 2002; O'Brienet et al., 2004).

The prevalence of the underestimation of body weight was assessed using four different criteria; (i) selected weight category (from the given options on the questionnaire) versus actual weight category based on the South Asian BMI criterion (36.6%), (ii) selected weight category (on image) versus actual weight category based on the South Asian BMI criterion (33.2%), (iii) selected weight category (from the given options on the questionnaire) versus actual weight category based on the WHO BMI criterion (16.3%) and (iv) selected weight category (on image) versus actual weight category based on the WHO BMI criterion (12.1%). Although it is recommended using South Asian criterion for an Asian population, the use of the WHO criterion simplifies a comparison across continents. It is important to note the difference in the prevalence of underestimation of body weight according to the South Asian (36.6%) and the WHO (16.3%) criteria. This suggests, care is needed in interpreting results of studies conducted in different settings with different criteria.

Four relevant studies were identified by the systematic review presented in the chapter 3, which were conducted in the US (Perrin et al., 2005), the UK (Zhu et al., 2013), Tonga (Kirk et al., 2008), and Mexico (Jimenez-Cruz & Bacardi-Gascon, 2006). The reported prevalence of underestimation of body weight ranged from 15% to 51%. The lowest (15%) prevalence was reported among nursing students in the study conducted by Zhu et al., (2013) who also reported 24.6% prevalence among qualified nurses in the UK. The highest (51%) prevalence was reported by Jimenez-Cruz & Bacardi-Gascon (2006) who conducted a study among physicians in Mexico. A similar prevalence (49%) was reported by Perrin et al. (2005) who conducted a study among paediatricians in the US. Kirk et al. (2008) have reported a lower (28%) prevalence of underestimation of body weight among Tongan nurses. All of these studies have used the WHO BMI criterion for the assessment of weight.

In our study, the prevalence of the underestimation of body weight is 16.3% when comparing individuals' selected weight category (from the given options on the questionnaire) with actual weight category based on the WHO BMI criterion. This is similar to the (15%) prevalence reported among nursing students (Zhu et al., 2013) but much lower than that reported among physicians (51%) and paediatricians (49%). While comparing results of studies, it is important to mention that three of the studies relied on self-reported height and weight data (Jimenez-Cruz & Bacardi-Gascon, 2006; Perrin et al., 2005; Zhu et al., 2013) whereas the one conducted among Tongan nurses measured the actual height and weight of participants (Kirk et al., 2008). Self-reported height and weight data is prone to give an underestimate of overweight and obesity and consequently lower estimates for underestimation of weight. Though Kirk and colleagues (2008) collected actual height and weight data, generalisability of their study is markedly limited by a very small (n=34) sample. Overall, the methodological quality of identified studies was not of a high standard and methodological heterogeneity makes it difficult to compare findings across studies. Our study reported prevalence of underestimation of body weight by using all possible methods of assessment for underestimation of body weight (e.g. WHO BMI criterion, SA BMI criterion, images) and has given baseline information and it would be easier for future research to compare findings with developed and developing countries.

Similarly, many studies conducted in this area also used body image for the assessment of weight perception (Bhuiyan et al., 2003; Holdsworth et al., 2008; Stunkard et al., 1983). The use of body image in our study in addition to self-reported weight category allowed us to compare differences in the underestimation of weight. A fair agreement (Kappa = 0.337, SE = 0.017) between participants' verbal response and responses given on body image suggests the potential use of image in future studies, although care is needed as the agreement was better among women than men.

It is worthwhile highlighting that western visual body images were based on the WHO BMI criterion, and it was interesting to get weight perception information in Pakistan. We found a fair agreement (Kappa = 0.302, SE = 0.017) between the selected weight category on image versus actual weight category on the WHO BMI criterion. Overall 58.46% (n=1236) participants correctly identified their weight category on body images when compared with their actual weight category based on the WHO BMI criterion. Again this agreement was better among women (59.75%) than men (52.80%). Although the use of these images can give very useful information on weight perception especially in situations where anthropometric measurements might not be feasible, it would be best if future research studies could assess the validity and reliability of these body images in our local setting.

The overall information on the topic of underestimation of body weight among HCPs is limited as revealed by systematic review in Chapter 3. The available evidence is from the developed countries. It would be beneficial if future research from developing countries and specifically from Pakistan could explore and highlight this issue among HCPs (including trainee HCPs) to give a better picture of the problem so that appropriate measures could be taken in terms of training needs. However, there is a need to design studies in this area with a sound methodology e.g. large justified sample, actual anthropometric measurements and use of ethnic-specific BMI cut-off points for weight assessment.

8.7.2 Factors associated with underestimation of body weight

Associated factors of the underestimation of body weight were explored by using two different criteria; (i) the South Asian BMI criterion (ii) the WHO BMI criterion. The resulting models were labelled as model-I and model-II respectively. The purpose of comparison (sensitivity analysis) was to see the consistency of findings revealed by model-I with model-II and secondly to provide information for future research for easy comparison regardless of the BMI criterion being used.

It was found that model-I was found to be better than model-II as model-I identified one additional factor (source of weight knowledge) associated with the underestimation of body weight. Model-I identified six factors associated with the underestimation of body weight whereas model-II identified five factors. The direction of the magnitude of the association of identified factors is the same in both models. However, results based on model-I (as compared to model-II) were more concise in terms of narrow confidence intervals and small p-value (chance of error).

The following sections discuss the associated factors of the underestimation of body weight based on model-I (the South Asian BMI criterion) which also covers factors revealed by model-II (the WHO BMI criterion). These include BMI status, gender, source of weight knowledge, weight-related comments from parents, weight-related comments from friends, and an increased number of siblings. The following sections further discuss these factors in detail.

(i) Overweight and obesity

In our sample, the underestimation of body weight was more prevalent among overweight (55.4%) and obese (81.8%) participants than those of normal weight (19.6%). We also explored and looked at the pattern of the underestimation of body weight across the BMI ranges to see the overall pattern of underestimation of body weight. It was interesting to note that the underestimation of body weight was spread across a (23.0 to 46.7) range of BMI. A positive correlation was revealed between BMI and the underestimation of body weight and magnitude of underestimation increases with an increase in BMI.

In an earlier section **[8.5.2]** we stated that overweight and obesity were more likely among participants who underestimate their body weight compared to those with a correct estimation of body weight. It is important to clarify that it is difficult to say whether individuals' underestimation of body weight leads to overweight and obesity or vice versa. The cross-sectional nature of this study, lack of baseline data and lack of prospective studies on the relationship between overweight, obesity and the underestimation of body weight limit our interpretation for causality. However, our findings regarding the association of the underestimation of body weight with overweight and obesity are consistent with studies conducted in Australia (Howard et al., 2008), Spain (Gutierrez-Fisac et al., 2002), Sweden (Halvarsson et al., 2002), the UK (Zhu et al., 2013), and the US (Kuchler & Variyam, 2003; Paeratakul et al., 2002).

Being overweight is a precursor of obesity. Although weight loss is often more successful for the overweight than for the obese, there is the additional problem that some cultures including Pakistan regard weight as a symbol of health, wealth and prosperity (Bhanji et al., 2011; Cassidy, 1991; Flynn & Fitzgibbon, 1998). Undergraduate students of medicine and allied health sciences are similarly influenced by their existing culture. This ultimately leads them to accept overweight or obesity as the norm and not to perceive it as a serious health risk. Thus, there is a strong need to educate students about what is a healthy body weight and to enable them to differentiate between cultural norms and healthy weight.

(ii) Gender

The underestimation of body weight was more prevalent among men than women in our sample population. Our results support the findings of previous work in this field (Bhanji et al., 2011; Flegal et al., 2010; Johnson et al., 2008; Linder et al., 2010; Paeratakul et al., 2002). This trend is equally prevalent in developed and developing countries (Flegal et al., 2010). The existing gender difference in incorrect perception could also be linked to social and cultural norms and values. Usually women are more likely to face pressure than men from family, friends and media to maintain an acceptable body weight which makes them conscious about weight and hence more accurately assess (or overestimate) their body weight than their counterparts (Flegal et al., 2010; Linder et al., 2010).

(iii) Source of weight knowledge

It is also important to note that the underestimation of body weight was associated with the source of weight knowledge. Participants who self-assessed their body weight were less likely to underestimate their body weight than those who relied on others for information about their weight. This finding is consistent with a study from Pakistan conducted in a clinical setting which stated that lack of knowledge about personal and healthy body weight leads to underestimation of body weight among patients (Bhanji et al., 2011). The author also reported that 78% of the participants (patients) did not receive weight-related advice from their health professionals. Of these 80% underestimated their body weight. Many studies have reported that doctors' advice on weight management is one of the strongest motivators of attempts at weight loss (Abid et al., 2005; Galuska et al., 1999). It is important to note that in our sample more than three-quarters of participants (future HCPs) did not know their BMI regardless of the sources of information available, which is likely to have practical implications. As HCPs in future, this underestimation may also affect their approach towards overweight and obese patients (Zhu et al., 2011).

(iv) Weight-related comments from parents

Interestingly participants who received weight-related comments from parents were more likely to underestimate their body weight than those who did not. Parents are usually over conscious about their children's health and cultural norms (such as weight as a sign of health) also influence them (Cassidy, 1991; Flynn & Fitzgibbon, 1998). Earlier studies have reported that a few parents of young overweight or obese children recognise them as overweight or obese (Ariza et al., 2004; Baughcum et al., 2000; Jain et al., 2001; Kathryn et al., 2006). Similarly, it has been found that there is an association between incorrect weight-related comments given by parents, friends and colleagues of an individual and the incorrect perception of body weight (Wing-Sze et al., 2009). Wing-Sze and colleagues (2009) reported that adolescents receiving incorrect weight-related comments were at increased risk of having incorrect weight perceptions irrespective of their actual weight status. According to researchers, even normal weight individuals receiving conflicting weight-related comments were found to be at risk of developing an underestimation of body weight (Wing-Sze et al., 2009). Thus, it could be hypothesised that children develop an underestimation of their body weight by getting incorrect weight-related comments from parents.

On the other hand, it is also important to accept the fact that we did not look at the parents' perception of their children's weight and so do not know whether the parents' perception was correct or they were underestimating or overestimating the weight of their children.

Therefore, it is essential to explore these pertinent findings in more detail in future through a qualitative research method. For example, future research can assess the perception of parents about their children's weight along with assessing the perception of respective individuals. Additional information regarding the type of weight-related comments received by individuals from parents would further facilitate an understanding of the topic. The best way of gathering information from the participants in this regard would be interview or focus group discussion.

(v) Weight-related comments from friends

Similarly, participants who received weight-related comments from friends were more likely to underestimate their body weight than those who did not. This finding is consistent with findings from the earlier study conducted among students in Hong Kong (Lo et al., 2009). According to Lo and colleagues (2009), students who received comments from others (peers and family members) were more likely to misperceive their body weight than those who did not. Similar findings are reported by Wing-Sze and colleagues (2009) who found that adolescents receiving incorrect weight-related comments were at increased risk of having an incorrect weight perception irrespective of their actual weight status. It is likely that the underestimation of body weight spreads in networks of friends and peers just like obesity and other phenomena (Christakis et al., 2007; Christakis et al., 2008). For example Christakis & Fowler (2008) who explored the relationship of social networking on giving up smoking found people do so in groups. Similarly, another study explored the relationship of social networking and the spread of obesity and revealed the spread of obesity in networks (Christakis et al., 2007).

In our sample population, the presence of a large number of individuals who underestimated their body weight may suggest that students exchange their ideas and views on various subjects including individual weight. In the presence of a large number of overweight and obese individuals, this underestimation of body weight may spread in social networks quickly like the above-mentioned phenomenon.

It is again important to accept the fact that we did not look at friends' perceptions of an individual's weight, so we do not know whether friends' perceptions were correct or they were underestimating or overestimating the weight of individuals. Therefore, it is essential to explore these pertinent findings in more detail in future through a qualitative research method. For example, future research can assess friends' perceptions of their friend's weight along with assessing the perception of respective individuals. Additional information regarding the type of weight-related comments received by individuals from their friends would further facilitate an understanding of the topic. The best way of gathering information from the participants in this regard would be interview or focus group discussion as suggested earlier for parents' perceptions of their children's weight.

(vi) Number of siblings

Another unanticipated finding was the association of an increased number of participants' siblings with the underestimation of body weight. This is a new finding and it appears that there is no study reporting this variable specifically in this context. However, this finding can be explained partly by social network mechanisms discussed earlier. Since siblings share the same social environment at home, studies show that parents' perceptions of their children's weight (as a symbol of health) made them fail to recognise the overweight and obese status of children (Ariza et al., 2004; Baughcum et al., 2000, Cassidy, 1991; Flynn & Fitzgibbon, 1998; Jain et al., 2001; Kathryn et al., 2006). Parents may transfer this incorrect perception (underestimation) of body weight to their children as suggested by our earlier revealed association between the underestimation of body weight among participants and the receiving of weight-related comments from their parents. It can be hypothesised that siblings of participants also receive the same message from parents which they consequently transfer to other siblings. Thus, an increasing number of siblings potentially means an individual may get the same incorrect message repeatedly which further increases an individual's chance of the underestimation of body weight.

Similarly, it is possible that participants are surrounded by siblings with the same (overweight) weight status as them which might have created a social norm and individuals might feel their overweight status is 'normal'. This phenomenon has also been reported by Mackey & Annette (2008) who stated that individuals assess their body weight by looking at people around themselves, instead of using the recommended BMI classification. Brown and colleagues (2010) also found that being in such an environment where other people around an individual are above average weight, makes him/her underestimate his/her body weight. In the current study, the weight information of participants' siblings was not gathered, thus it is difficult to infer whether the underestimation of body weight was more common only among the individuals whose siblings had a higher BMI or if it was a common phenomenon even among individuals whose siblings had a normal BMI. Therefore, it is also important to acknowledge that future quantitative studies could collect anthropometric measurements of parents/siblings/friends along with individuals in order to explore the association of the underestimation of individuals' weight status with the weight status of people living around these individuals.

(vii) Socio-economic status

However, socio-economic status did not show any link with the underestimation of body weight, in contrast to earlier studies (Gutierrez-Fisac et al., 2002; Johnson-Taylor et al., 2008; O'Dea & Caputi, 2001; Story et al., 1995). There are several possible explanations for this finding; (i) in our sample population, approximately 90% of the participants were of the middle SES which could have diluted the potential effect of SES on the underestimation of body weight (ii) our assessment procedure (on the basis of household items) is different from developed countries, where direct income is assessed (O'Dea & Caputi, 2001) (iii) we assessed SES on the basis of household items reported by students (as a proxy measure for SES). We could not obtain the direct income of households as people in a South Asian setting are reluctant to provide such information and the way SES was assessed for our study may be prone to reporting bias. It is possible to hypothesise that a similar association is less likely to occur if the sample was equally representative of all SES and some more direct methods could be used to measure income.

(viii) Age

Earlier studies have shown that increasing age increases individuals' likelihood to underestimate body weight. According to one study, a higher percentage of underestimation was found among individuals of 40 and over than in the under 40s (Bhanji et al., 2011). Blokstra et al. (1999) looked at the perception and dieting behaviour among a Dutch group and also reported a positive association between increasing age and the underestimation of body weight. Various other studies in the field have reported similar findings (Gregory et al., 2008; Tang et al., 2012). The possible explanation may be that there is a greater acceptance of weight gain in older people than the young. Evidence of a high prevalence of overweight and obesity among the older population and individuals' tendency to compare their weight status with their peers possibly explains this situation (Grundy, 1998). However, no age effect was observed on the underestimation of body weight in our sample population. It may be because of the fact that participants in our study were undergraduate students; the majority of them had a smaller age range (17-25 years) which was not enough to observe any significant difference.

8.8 Healthy body weight and its impact on the general population as a role model: Participants' perspectives

8.8.1 Health professionals are a role model for the general population: Participants' perspectives

It is well documented that physicians, nurses and other HCPs have a weight bias (weight-based discrimination) towards overweight and obese patients in healthcare settings (Brown, 2006; Huizinga et al., 2009; Huizinga et al., 2010; Puhl & Brownell, 2006; Schwartz et al., 2003). On the other hand, research has also illustrated the weight bias among patients towards overweight and obese physicians (Puhl et al., 2013). Puhl and colleagues (2013) stated that physicians' being overweight negatively affects patients' levels of trust, inclination to follow medical advice and even credibility. Being future health professionals, it is essential for undergraduate students to recognise that they are role models for the general population in terms of body weight.

In our sample, nearly two-thirds (64.3%, n=1360) of the participants believed that as health professionals they will be the role models for the general population in terms of healthy body weight; as Watts (1990) found, physicians are role models for giving up smoking. Men and women equally appreciated this notion regardless of their actual weight and experience of weight stigmatisation. However, a higher proportion (three-quarters) of participants from a nursing programme had this view compared with those (two-thirds) on the other degree programmes. Possibly, this may be because the majority of the participants on the nursing degree programme were already in nursing practice; the practical experience of dealing with patients made their belief stronger.

Thus, future healthcare professionals need to recognise the importance of healthy weight in the provider-patient relationship as a positive step towards the prevention of overweight and obesity among both healthcare professionals and their patients.

8.8.2 Health education by health professionals having a healthy body weight: Participants' perspectives

Approximately, four-fifths of the participants (81.7%, n=1728) in this study reported that their education and counselling of patients for a healthy diet and lifestyle would be more effective if they had a healthy body weight. Men and women equally appreciated this notion regardless of their experience of weight stigmatisation. Participants' views support the findings of earlier studies which illustrated the importance of health behaviours of healthcare providers (Bleich et al., 2012; Feller & Hatch, 2004; Hash et al., 2003; Pipe et al., 2009; Puhl et al., 2013; Rogers et al., 2005; Zhu et al., 2011). It is evident from research that physicians who do not smoke, more effectively counsel their patients on giving up smoking than those who smoke (Pipe et al., 2009). Equally, physicians with lower resting heart rates, more effectively counsel their patients about exercise (Rogers et al., 2005). Similarly, it has been observed that health professionals with a healthy body weight are more confident in weight management practices and outcomes for their patients (Zhu et al., 2011). According to one study, physicians with a normal body weight are better at providing health advice than overweight or obese physicians (Hash et al., 2003). It has also been found that patients' acceptance of the health advice from non-obese physicians was better than from obese physicians (Feller & Hatch, 2004).

However, a lower percentage of participants in dentistry degree programmes (compared to other degree programmes) believe in the maintenance of their own healthy body weight for the effective education of patients. It may be because of the fact that dentistry students may think that the majority of health conditions related to obesity such as cardiovascular diseases and diabetes are not associated with dentistry. However, many dental conditions are particularly common among obese individuals (Cinar et al., 2011; Levine, 2012). Thus as dentists, they are as responsible for maintaining health body weight as physicians, nurses, pharmacists and physiotherapists.

It is important to note that compared to participants in normal or underweight categories, participants in overweight and obese categories are less likely to acknowledge the importance of a healthy body weight for the health education of patients. This finding is not consistent with earlier studies (Bleich et al., 2012; Puhl et al., 2013). As reported by one of the research studies, healthcare providers' body weight affects patients' attitudes and following of medical advice (Puhl et al., 2013). Puhl and colleagues (2013) also stated that patients view the weight of healthcare providers as a proxy measure for their professional credibility.

8.9 Reflection upon the fieldwork and challenges

This section reflects upon the fieldwork and discusses the field practicalities such as barriers and facilitators faced during the course of the study.

8.9.1 Ethics

Generally, students who collect data overseas are also required to get ethical approval from the governing body where the study will be conducted, along with approval from the ethics review committee of ScHARR. The governing body in our case was the Institutional Review Board (IRB) of the Dow University of Health Sciences (DUHS), Karachi, Pakistan.

An application was submitted to the ethics review committee of ScHARR. Any queries were answered in face-to-face session with the committee and their feedback was noted. Finally, the study received ethical approval which took approximately eight weeks. Thereafter, a separate application was submitted to the IRB of DUHS through email who was advised to appear (face-to-face) in front of the panel. The meeting was arranged and attended accordingly. The study received ethical approval from the IRB of DUHS after the incorporation of given feedback, which took another four weeks. Thus in future research, it is important to keep in mind the expected time frame required for this process.

8.9.2 Permission from the head of institutes

The vice chancellor (VC) of the university was the head of all the institutes affiliated with DUHS. The researcher was not able to make an appointment with him as he was away with no confirmed date for his return. In his absence, the pro-vice chancellor acting head of the university, was based in another campus but he was not in his office during his visiting hours. Several visits were made throughout one week but without result. Thereafter, the personal assistant of the pro-vice chancellor as a favour contacted the researcher and asked for a quick visit. Although the researcher was at quite some distance from the campus, this led to a successful visit. The lack of an appointment system made it an unnecessarily difficult, time and energy-consuming process to obtain permission for data collection, but it was eventually obtained.

8.9.3 Personal relationships with university faculties and staff

In university-based studies, a researcher's personal relationship with the university faculties and staff plays an important role. SMC was the institute from which the researcher had graduated seven years previously and therefore he knew the faculty and the head of all the departments. It was very easy to communicate, coordinate and schedule research activities in SMC. Similarly, the researcher is a faculty member in the DMC and knew other faculty members especially the heads of department who offered their full cooperation. As far as the other institutes such as COP and SON were concerned, the researcher was referred by the head of his own department at DUHS to approach the principal and faculty members of the respective institutes. Both institutes facilitated the conduct of the study especially the principal of COP who herself had completed her Ph.D. degree recently and was aware of the fieldwork. She arranged the meeting with her faculty members which saved a lot of time.

However, in the Institute of Nursing (IoN) the researcher did not know any faculty members beforehand. The personal assistant to the principal of the institute had known the researcher for the last 12 years from SMC as he used to be a member of the clerical staff. After permission from the principal, he introduced the researcher to all of the faculty members who gave a positive response. He also provided all the required administrative information. After receiving an overwhelming response from the institute, the importance of personal relationships even at a very low (such as clerical and administrative) level was realised.

Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences (DIKIOHS) was the only institute where the researcher faced resistance from some of the faculty members for the conduct of the study. There were a total of four academic coordinators; one for each academic year.

Following advice from the principal, the first-year coordinator was contacted and he provided all the required administrative information. Additionally, each academic year had a class representative whose contact information was also provided by the first-year coordinator. All class representatives were contacted and in light of their suggestions the field activities were scheduled. However, the academic coordinators for the third year did not like receiving a request for information from the first-year coordinator. He not only withheld research activities from the third year, but also convinced the fourth-year coordinator to follow suit. In order to resolve any misunderstanding, the researcher tried to arrange meetings with both of them. They allowed me to carry out data collection after filling in unnecessary paperwork which took nearly a week. Patience and determination were the keys to dealing with those presenting a clash of personality or status issue in order to maintain the focus on the research work.

8.9.4 Poor law and order situation

Above all, the most devastating thing to affect research activity was the poor law and order situation in Karachi at the time. Karachi is the biggest city in Pakistan and is one of the economic hubs of the country. It is also the revenue-generating engine of the country. Different political parties attempt to maintain their dominance of the city, with the use of their armed groups. This places the people of Karachi at risk of violence and terrorist activities. As a result of this, the city suffers many strikes. Violence and strikes were at their peak during the period of my data collection. There were clashes occurring between two big political parties on a daily basis. Armed wings of the political parties become active on the previous night or very early in the morning of the threatened strike day and perpetrate target killings to create fear and terror and deter people from leaving their homes for routine activities. As a result, on average ten people were being killed daily in different parts of the city. The year 2012 in which my field activities were carried out was the most violent year in Karachi in the last two decades. According to the Additional Inspector General (IG) of Sindh police 2300 people were killed in the city (Dawn News, 2012).

On a number of occasions, the research team was caught in the middle of traffic jams because of the difficult law and order situation. These situations clearly threatened the security of the research team and research activities were disrupted on many occasions, and it was very difficult for the researcher and administrators of the respective institutes to reschedule them. The consequently low attendance of students also lengthened the data collection period.

During the fieldwork, the researcher used to leave home at 7:30am every morning. Data collectors were collected from their respective bus stops. On one notable morning, when travelling towards the university, we met a traffic jam with a couple of vehicles travelling in the wrong direction, whose drivers were shouting “Go back, go back, buses are being burnt”. Smoke from the burnt vehicles was visible so I decided to use an alternate route but 500 metres from the university, the road was again blocked and police were asking drivers to take a U-turn and go back. It was decided to cancel the field activity for the day but on the way back roads were blocked so that we were stuck in a traffic jam. It was astonishing to see such a situation in the early morning (8:00am). I decided to seek refuge at my in-laws’ home until the evening when police and law enforcement forces took over the situation. On that day, 37 buses had been burnt and more than fifteen people were killed in different parts of the city. Next day, there was a strike and on the following day the other political party exacted revenge and killed supporters of the opposition party. This led to yet more strikes.

In violent cities such as Karachi, it was very difficult to manage research activities under these circumstances. Therefore in future research, it is important to think about such law and order issues under certain circumstances, with the added consideration of personal and group safety as well as the time constraints over field activities.

8.10 Strengths of the thesis

This section discusses the six major strengths of the current research: the broad target population, high response and questionnaire completion rate, minimisation of measurement bias, consideration and addressing cultural barriers, the use of body image and sensitivity analysis. The following paragraphs discuss these strengths in detail.

8.10.1 The broad target population

Earlier studies conducted on the topic were limited to only physicians (Jimenez-Cruz & Bacardi-Gascon, 2006; Perrin et al., 2008) and nurses (Kirk et al., 2008; Zhu et al., 2013). Moreover, the methodological heterogeneity of those studies made it difficult to compare findings with each other. However, the current study was not restricted in terms of target population. Instead, the study included undergraduate students of dentistry, pharmacy, physiotherapy and nursing along with students of medicine. Findings regarding overweight and obesity and the underestimation of body weight across different groups of trainee HCPs are comparable and there is no concern regarding methodological heterogeneity.

Inclusion of different groups of trainee HCPs also takes into account the equal importance of dentists, pharmacists, physiotherapists and nurses with physicians as providers of health services to the general population and the importance of their role as health educators. It may thus be possible to target messages to correct the perception of weight among a wider identified population. If successful, this wider population of health professionals would be able to correct the weight perceptions of the general population more speedily in order to tackle the obesity epidemic.

8.10.2 High response and questionnaire completion rate

The original sample size of 752 was necessary to meet the study's objectives. On the basis of the findings in the literature, a 30% response rate was anticipated and a total of 2500 questionnaires were distributed. However, the researcher identified and applied effective data collection techniques from earlier studies to enhance students' participation response. Equally, during the data collection, the researcher evaluated and reflected on various techniques and modified them accordingly. The researcher's prior personal experience of data collection from a medical setting for earlier studies also helped greatly in this regard. Additionally, for better management of the field activities, data was collected from one institute at a time and within each institute by academic year. Voluntary participation of class representatives as the study advocates, and approaching students in corridors, canteens and common rooms along with class invitations enhanced students' participation. This enabled us to achieve an overall 45% response rate and an 85% questionnaire completion rate which was excellent taking into consideration the fact that data collection was carried out from six different institutes. Data collection from three times the original sample size increased the power of the study significantly.

8.10.3 Minimisation of measurement bias

Measurement bias (which is also known as observation or information bias) is a systematic (non-random) error in classifying study participants with respect to outcome (disease) or exposure (risk factors) status (Rothman et al., 2008). At times, it may occur because of inaccurate measurements. Differential and non-differential misclassification results in measurement bias (Porta, 2008). Recall bias is a common type of measurement bias commonly seen in case control studies but also observed in cross-sectional studies when participants are asked about specific information.

According to Jurek and colleagues (2005) if the extent of misclassification is different between study groups, it is known as differential misclassification. In our study, men and women might have recalled and reported their height and weight differently. Similarly, participants across the different weight categories (normal weight, overweight, obese) might have recalled and reported their weight differently. This recall bias could have resulted in differential misclassification and ultimately could have led to under- or over-estimation of the association between exposure and outcome. Though bias cannot be removed completely, it was minimised by taking the actual anthropometric measurements of participants rather than relying on reported measurements.

On the other hand, if the extent of misclassification between study groups is uniform, it is known as non-differential misclassification (Porta, 2008). In our study, anthropometric measurements were taken by different research officers and a margin of human error during measurements may have occurred. These errors are expected among participants regardless of their gender and weight and could have led to non-differential misclassification. It is important to note that non-differential misclassification dilutes the association between exposure and outcome. To minimise this, we provided the same training for all research officers. Secondly, the same measurement tools (weight machines) were used for all participants. Moreover, weight machines were calibrated on a daily basis in order to reduce errors that otherwise would have affected the internal validity of the study.

8.10.4 Consideration and addressing cultural barriers

In our setting, women do not like to be measured by men and vice versa. Measurement of women by men would have significantly reduced the overall response rate of the study. In consideration of cultural norms and values, male and female research officers were trained to take the measurements of men and women respectively. This helped in building the confidence of women participants. It is important to mention that all of the study advocates were female students who encouraged their colleagues to participate in the study. All these efforts increased the overall study response rate.

One may argue that the use of only female advocates may have affected the male-to-female ratio of the participants. However the resulting male-to-female ratio (1:4.4) in the study sample is not significantly different than their actual male-to-female ratio (1:4.6) in the study population, which shows that the use of only female advocates did not affect students' participation in terms of gender.

8.10.5 Use of body image for weight perception

Body image was also used to assess the weight perception of participants in our study in addition to asking participants to report their weight category verbally. The introduction of body image in the current study provided a direction for future research in this area. This allowed us to see the difference in the results over the underestimation of weight. A fair agreement between participants' verbal response and responses given on body image suggests the potential use of image in future studies. However, this agreement was better among women than men suggesting more applicability of image among women than men. It would be interesting to see the results in future studies, if investigators could modify the image in such a way that would show men and women in their cultural forms of dress.

8.10.6 Sensitivity analysis

Data analysis in terms of weight assessment was carried out by using the WHO BMI cut-off points (used internationally) as well as the South Asian BMI cut-off points. Similarly, weight assessment was also carried out by using waist circumference as well as waist-to-hip ratio criteria. Factors associated with overweight and obesity and the underestimation of body weight were determined by using all the mentioned criteria which were missing from earlier published studies in the area (Jimenez-Cruz & Bacardi-Gascon, 2006; Kirk et al., 2008; Perrin et al., 2008; Zhu et al., 2013) and provided information that would be helpful in future research to compare their findings across countries.

8.11 Limitations of the thesis

Our study has certain limitations. These results therefore need to be interpreted with caution. This section discusses the main limitations of the current study which included use of non-probability sampling, selection bias, lack of privacy during questionnaire completion, use of proxy measures for SES, lack of information on diet and physical activities and lack of temporality. The following paragraphs discuss the study's limitations in detail.

8.11.1 Non-probability sampling technique

Probability sampling techniques such as simple random sampling are desirable in a survey to ensure the generalisability of the study's findings. The availability of a complete list of potential participants is one of the prerequisites for this type of sampling technique. In the current study, in order to use a simple random sampling technique, we would have had a complete list of all students with the necessary information (name, registration number) from each academic year of the respective (six) institutes. The ethics committee and university administration had their concerns in this regard. Thus, it was not possible to pursue probability sampling without enough information. Even with such a list, it would have been difficult to identify students from a given class considering that there is less than 50% attendance in certain academic years. In the case of a student's absence, the researcher would have needed to find an alternative student for participation. A participant's refusal would have made such a situation worse and we would have ended up with students who are present in the institutes and more importantly willing to participate. None of the earlier studies conducted in this academic setting had used simple random sampling.

Due to the unavailability of a complete list of participants and to save time and energy, the researcher used a census sampling technique. All students present during the study period were approached and invited to participate. Secondly, the sample size was inflated by multiplying (x 2) for a design effect to adjust for the potential loss of variability in the sample due to the non-probability sampling technique. A further sample size inflation was done to adjust for the anticipated participation rate. More importantly, data collection from participants three times the original sample size ensured that the non-probability sampling technique did not affect our study.

8.11.2 Lack of privacy during questionnaire completion

This study was conducted in institutes where complete privacy could not be provided for students during the completion of the questionnaires which may have affected the results. In this setting, participants may have shared their questionnaires with each other, so their responses might bias the results in either direction. It is likely that they would have responded differently if provided with privacy, which was not practical in our case.

8.11.3 Use of proxy measures for socio-economic status

Direct assessment of socio-economic status from household income as in developed countries was difficult in our setting (O'Dea & Caputi, 2001). Participants are prone to over- or under-report their household income especially when filling in study questionnaires in a class or group setting. Therefore, we assessed the SES of participants on the basis of household items as reported by participants (as a proxy measure of SES). Though this proxy measure has also been used in the National Health Survey of Pakistan, there is still a margin of error for reporting bias.

8.11.4 Lack of information on diet and physical activities

We developed a statistical model which is to show the association of overweight and obesity with other variables such as age, gender, socio-economic status, and weight knowledge. We also collected information on weight management behaviours (diet and physical activity) but did not find any significant correlation with the weight status of participants. However, we did not collect information from participants in our study regarding detailed diet and physical activities by using food frequency questionnaires or physical activity questionnaires because (i) the main focus of the study was on the underestimation of body weight (ii) diet and physical activities are complex variables in epidemiology which need extensive information to be measured accurately. A limited amount of collected information on diet and physical activities in any study might cloud the interpretation of the results.

8.11.5 Lack of temporality

The main objective of a cross-sectional study design is to provide estimates of the magnitude (burden) of the problem under consideration. It also provides the link between the dependent and independent variables. Claiming a cause and effect relationship between variables is beyond the scope of this design. Prospective studies such as cohort and clinical trial studies are preferable to gauge causal inference. Thus, one of the limitations of a cross-sectional study design is lack of temporality.

Our statistical models on overweight and obesity and the underestimation of body weight suggested the association of these dependent variables with independent variables such as gender, weight status, correct knowledge of BMI, and source of weight knowledge. However, these are associations, not causation and any interpretation of causality should be made with caution. For example, in our study the unavailability of baseline data made it difficult to claim whether the underestimation of weight is responsible for overweight and obesity or being overweight and obese makes participants underestimate their body weight. Hence, this study highlighted the association between variables and prospective studies would answer these questions in terms of causal inference.

Chapter 9: Conclusion

This chapter presents the summary of the main findings and provides implications of the study in terms of policy, practice and future research.

9.1 Main findings of study

This study aimed to estimate the prevalence of the underestimation of body weight and to determine the factors associated with the underestimation of body weight among trainee HCPs. According to the TTM of change, the appropriate identification of a problem is the first step in enabling the individual to address the problem which in turn will increase the impact of any obesity-related intervention which requires changing behaviours.

In order to address the research question, a cross-sectional analytical study was conducted among trainee HCPs. Data was collected from the six different public sector institutes of Karachi through self-administered questionnaires followed by anthropometric measurements.

Study found that overweight and obesity was prevalent among over a quarter of the study population. It was more likely among those who underestimated their body weight and experienced weight stigmatisation from friends or colleagues, whereas it was less likely among participants who had the correct information about their personal BMI. It was also found that more than one-third of the student population underestimated their body weight. The underestimation of body weight was more likely among male students who were overweight or obese, and those who relied on other people for deciding their weight category. Receiving weight-related comments from parents and friends and an increase in the number of siblings also increased the likelihood of underestimating body weight. The study also revealed that over a quarter of the study population experienced weight stigmatisation.

Thus, the findings of the study show that a large proportion of trainee HCPs were overweight or obese and underestimated their body weight. The issue of weight stigmatisation among the trainee HCPs made the situation even worse. Being a cross-sectional study, (the temporal association of the underestimation of body weight with identified variables cannot be claimed), the findings suggest an association between the underestimation of body weight, overweight and obesity, and weight stigmatisation.

This study contributes to the public health area of the underestimation of body weight and overweight and obesity in two ways; (i) implications for policy and practice (iii) implications for future research.

9.2 Recommendations for policy and practice

The Nuffield Council on Bioethics (2007) has devised a stepwise process for policy and practice known as an 'intervention ladder' which assists in thinking about the acceptability and justification of different policy initiatives in order to improve public health. The main steps of the ladder include (i) at least monitor the situation, (ii) provide information, (iii) enable choices, (iv) guide choices through changing default policy, (v) guide choices through incentives, (vi) guide choices through disincentives, (vii) restrict choices and, (viii) eliminate choices. A stronger justification is required regarding the effectiveness of policy implications to move to a higher rung on the intervention ladder. The following sections present the main recommendations for policy and practice in the light of this intervention ladder and additionally include counselling services and targeted training and collaboration among all HCPs.

9.2.1 Monitor the situation

Based on our study's findings the least intrusive step on the ladder is to conduct similar types of surveys on an annual basis among trainee healthcare professionals especially at the beginning of each academic year. These surveys should have a strong methodology in terms of representative sample size, better sampling technique (e.g. multistage cluster or stratified sampling technique than just relying on convenient sampling), actual anthropometric measurements, and be reported using international and ethnic specific BMI and WC cut-off points. This will enable monitoring of the level of weight awareness among students. This is equally important and applicable for developing and developed countries.

9.2.2 Provide information

Modifications in routine academic curriculum

Risk denial and risk perception are important factors, which affect the health behaviour of individuals as is evident from the earlier studies on the awareness levels of drinking and willingness to quit smoking (Peretti-Watel et al., 2007; Williams et al., 2011). Thus, addressing the issue of risk denial and risk perception is essential for the correction of the underestimation of body weight. The provision of information on healthy weight and the consequences of unhealthy weight would help individuals to move from the pre-contemplative to a contemplative stage of TTM of change. This is the second step on the Nuffield intervention ladder.

Our data analysis revealed that height was on average over-reported by 2.05cm, weight was under-reported by 0.5 kg and self-reported height and weight were not related to the reported BMI. More than three-quarters of the participants did not know their body mass index value. Over two-fifths had tried to modify their body weight in the past year and weight management practices were common among participants irrespective of their actual weight status. In light of these findings it is recommended that healthcare professional bodies such as Pakistan Medical and Dental Council (PMDC), Pakistan Nursing Council (PNC), Pharmacy Council of Pakistan (PCP), and Pakistan Physical Therapy Association (PPTA) (and the equivalent bodies elsewhere) should incorporate specific sections on body weight in the routine academic curriculum of their respective degree programmes. This section should contain information on the weight categorisation of an individual's body and various criteria used for weight categorisation such as BMI, skin fold thickness, waist circumference, waist-to-hip ratio and total body composition measurements including the strengths and weaknesses of each criterion. This would enable students to correctly identify their personal weight status and to provide them with an environment to promote 'healthy weight' rather than just 'thin physique'. There is also a need to make sure 'underweight' individuals are equally focused on in these programmes.

In this regard, the guidelines of the Royal College of Physicians (2013) for undergraduate training would be very useful as a starting point to develop guidelines in this area for the professional bodies in Pakistan (e.g. PMDC, PNC, PCP) and other countries who have yet to develop such policies. According to RCP, students should understand the importance of regular exercise and maintaining good nutrition in daily life and this can be facilitated by engaging students in problem-based learning to investigate and solve clinically-based scenarios in small groups. Clinical assessment of patients' nutritional status should be part of a routine examination and be included as a core skill and clinical training should allow the refinement of students' skills to explore and recognise specific factors (e.g. weight history, family history of obesity and related diseases, diet and drug history) during clinical assessment. Additionally, we would recommend that anthropometric (height, weight, waist circumference) measurements should be part of the routine physical examination of patients. Students' knowledge and required skills should be assessed at all levels of undergraduate training as well as be part of the preregistration training especially their knowledge regarding the difference of BMI and WC cut-off points recommended for Europeans, Asians and other ethnic minority groups and its practical implications. This is equally applicable for developing and developed countries.

It is important to mention that the existing guidelines for the management of overweight and obesity (Jensen et al., 2014; Misra et al., 2009; Moyer, 2012; NHMRC, 2013; NICE, 2014; RCP, 2013; Tsigos et al., 2008) do not have the components to address the issue of the underestimation of body weight. Secondly, these guidelines are for the general population and do not specifically target HCPs. Our data suggests that more than one-third of the trainee HCPs underestimated their body weight, therefore the incorporation of the underestimation of body weight components in future obesity management guidelines would be an important step in bridging the gap in existing guidance. Similarly, making this guidance more specific for HCPs would be essential for the effective management of obesity.

9.2.3 Enable choices

Workshops and training sessions

Short educational intervention programmes have a proven effectiveness among medical students in improving their beliefs and stereotypes regarding overweight and obese patients (Poustchi et al., 2013; Wiese et al., 1992). It would be worthwhile to design some optional short and concise training modules, workshops and sessions regarding healthy weight for undergraduate students from the first academic year, something which is currently missing in the academic curriculum of developing and developed countries. Along with awareness, these sessions would increase students' belief that genetic and environmental factors play a major role in the development of obesity which would help reduce weight bias and the issue of weight stigmatisation among students. These training sessions would be more productive especially for the final year students. After graduation, they are about to start clinical practice and training sessions would help in reducing their weight bias towards obese patients which is crucial for effective interventions about obesity among the general population.

The Royal College of Physicians, UK has also highlighted the need for a subspeciality of obesity medicine for physicians (RCP, 2013). It would be very useful if professional bodies such as the Pakistan Medical and Dental Council (PMDC) and College of Physicians and Surgeons of Pakistan (and the equivalent bodies elsewhere) would design core curriculum and relevant experience for sub-speciality accreditation. This would help in future to provide leadership in the planning, provision and delivery of obesity interventions especially in developing countries where political factors matter in explaining under- and overweight outcomes (Fumagalli et al., 2013).

9.2.4 Guide choices through changing the default policy

Regular measurement of body weight

We are embedded in social networks and influenced by the behaviours and appearance of colleagues, friends and those around us (Koehly & Loscalzo, 2009). For example earlier health promotion programmes for skin protection found that the use of sun protection was the result of parental influence, parental and peer sun protection behaviour (Murray & Turner, 2004). Similarly, it is possible to make it a social norm to know your actual body weight and this could be achieved by introducing a system at university level where anthropometric measurements of students at admission could be recorded. Also, this measurement could be repeated on a yearly basis which would enable students to monitor their weight status over a period of time. The American Academy of Paediatrics' practical guidance for the HCPs also recommended calculating and plotting the BMI of children and adolescents once a year to aid early recognition of obesity. In our sample, as many of the participants did not know their height and weight and were very keen to be measured, offering this service is quite fundamental. The Royal College of Physicians UK (2013) recommended that occupational health departments have a responsibility to diagnose obesity in new employees and wherever employees make contacts with healthcare professionals e.g. when receiving influenza vaccinations. In a similar way, it would be worthwhile if undergraduate students of medicine and allied health sciences at the time of admission could be assessed for weight and risk of chronic disease while being assessed for their general fitness (e.g. vision, physical disability). In this regard, the combined tool (BMI and WC) would provide additional information as current data shows that even 12.9% of the normal weight participants have an 'increased risk' of chronic diseases because of central obesity. It is also essential to use an appropriate BMI and WC cut-off point for the identification and assessment of overweight and obesity and associated risks of chronic diseases (Misra et al., 2009; NICE, 2013).

Knowledge of healthy weight through the academic curriculum and about their current body weight through a routine measurement system could provide students with enough information to have an ongoing awareness of their actual weight, rather than relying on their peers and friends for the judgement of their body weight. Annual weight measurement programmes at school level are much appreciated by parents (Kubik et al., 2006). It has been found that school children were happy to be measured (Kalich et al., 2008). Acceptance of similar programme is highly likely among trainee HCPs in developing and developed countries.

Privacy and confidentiality should be at the core of these programmes to avoid issues such as weight stigmatisation. This can also be achieved by providing students with online tools for assessing their body weight as provided by the 'Healthy Weight' campaign in the US by the National Heart, Lung, and Blood Institute (NHLBI) (NHLBI, 2012). The existing generic NHS on-line resources might also be useful (NHS, 2015) after tailoring them according to local needs to be more appropriate. For example, the South Asian BMI cut-off points, and gender specific waist and hip circumference could be provided for weight classification of students and associated risks of chronic diseases. Similarly, practical weight loss advice could include information about commonly used dietary dishes (such as chapatti, biryani, korma etc.) in terms of size, content and number of calories.

9.2.5 Guide choices through incentives and disincentives

Giving priority in internship training

The next step on the intervention ladder is to guide choices through incentives and disincentives. Students who attended training modules, workshops and sessions regarding healthy weight could be given priority in internship training for the selection of clinical (speciality) training according to their own choices. Although taxes and penalties are not practical in this case, not being given priority for the selection of the clinical speciality of their choice could serve as a disincentive for those who did not attend optional modules.

Similarly these training modules, workshops and sessions could be awarded continuing professional development (CPD) points, which are essential for the appraisal and revalidation of professional registration with governing bodies such as GMC and NMC in the UK. In Pakistan, PMDC and equivalent governing bodies have yet to develop a similar mechanism for the appraisal and revalidation of registered professionals and these CPD points could be evidence of continuing career development, acquiring new skills and self-motivation.

9.2.6 Restrictions and elimination of choices

The last two higher rungs on the intervention ladder are to restrict and eliminate choices. It is not justifiable to recommend a higher rung on the intervention ladder, without a stronger justification regarding the effectiveness of a suggested intervention. So far we do not have research evidence regarding the effectiveness of suggested interventions (section 9.2.1-9.2.5), however the monitoring and evaluation of early suggested interventions on an annual basis would enable decisions on the future of these interventions in a better way.

After presenting the main recommendations for policy and practice in the light of the Nuffield intervention ladder, the following sections (9.2.7-9.2.9) present additional recommendations to enhance the effectiveness of earlier suggested recommendations (sections 9.2.1-9.2.6).

9.2.7 Counselling and weight management services

Although interventions such as education and behaviour change programmes are not invasive and unlikely to cause any harm, evidence suggests that some may do so, as seen in a bicycle safety training programme for children in Australia (Macintyre & Petticrew, 2000). Thus, it is not good enough to simply assume interventions are beneficial, there is a duty on those introducing such measures to monitor their actual impact over appropriate timeframes.

An increase in the prevalence of stigma and discrimination on the basis of weight is steadily increasing with the rise of overweight and obesity. There is the possibility that raising awareness of body weight will cause discomfort especially among those who discover that they are overweight or obese. As evident from the smoking example, a 'happy smoker' (pre-contemplation) becomes an 'unhappy smoker' (contemplation) as a result of an awareness campaign (Prochaska & Velicer, 1997). The same would be true of a weight awareness campaign but this discomfort may ultimately elicit positive behaviour change by enabling students to be open to such weight stigmatising messages. Counselling services could help equip students with the skills necessary to cope with issues raised.

It is equally important to have weight management services in place especially for students who have been diagnosed as underweight, overweight or obese. Our data suggests that over half of the students had an unhealthy weight (underweight 23%; overweight or obese 30%) and they were found to be involved in weight modification (losing or gaining weight) practices irrespective of their weight status which is alarming. For example 25.1% of normal weight and 5.5% of underweight individuals tried to lose weight which is possibly indicative of eating disorders. An appropriate referral system should also be part of weight management services especially where there is a suspicion of individuals being involved in unhealthy weight management practices and the same is true for those with an overweight status. Equally, this programme would facilitate normal weight students to maintain their healthy weight.

9.2.8 Targeted training and collaboration among all HCPs

According to the recommendations of the Academy of Medical Royal Colleges, there is a need for targeted training programmes for healthcare professionals who are already practising in the field including physicians, nurses, dentists, pharmacists and physiotherapists to ensure "making every contact count"[21] becomes a reality. These are the

[21] A concept introduced by NHS in healthcare settings which expects every HCP to use every contact with an individual to maintain or improve their mental and physical health and wellbeing where

most influential role models for patients' behaviour. It would be useful if PMDC and equivalent governing bodies in Pakistan and other developing countries could introduce similar programmes in their healthcare system to ensure collaborative efforts by all healthcare professionals to convey the same message to the general population to intervene in the epidemic of obesity.

9.2.9 Weight awareness among the general population

Along with healthcare professionals, it is important to raise awareness among the general population. Parents and families play an important role in developing their children's weight perception. Weight awareness among the general population can be achieved by the following methods;

(i) Lectures and awareness session

Lectures and awareness sessions regarding body weight can be arranged for parents and families in institutes of medicine and allied health sciences especially on open days to raise awareness among them about healthy weight and the importance of having the correct estimation of body weight. This is important as our findings showed that the underestimation of body weight was more common among those who received weight-related comments from parents, and friends. Family and friends are the main source of weight information for individuals. Incorrect information is likely to spread in social networks, thus it is important to be addressed as part of an obesity prevention which is currently missing from the existing obesity management guidance (Moyer, 2012; Tsigos et al., 2008). Policy makers and stakeholders of the medical institutions in Pakistan should take the lead in this regard and set an example to be followed at regional and international levels.

(ii) Use of the media

Similarly, print and electronic media can play an important role in raising awareness among the general population. Expert discussion and talk shows on radio and television can spread the message to a wider audience. Unfortunately, programmes on obesity so far have blamed individuals for their overweight status (De Brun et al., 2013). Therefore, it is important to acknowledge genetic and environmental factors as causes of obesity to minimise feelings of stigmatisation and blame in future weight awareness campaigns through the media.

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possible, in particular targeting the four main lifestyle risk factors: diet, physical activity, alcohol and tobacco – whatever their specialty or the purpose of the contact.

(iii) Regular weight measurement in schools

There is a need for implementing weight screening programmes in schools. On the one hand, this would identify children of overweight or obese status, at the same time this would raise healthy weight awareness among parents about their own weight. It is evident that parents appreciate weight-screening programmes and can identify the fact that obesity is becoming a norm in such a way that we are not aware of our own weight (Johnson et al., 2009).

While implementing weight screening programme in schools, it is also essential to have weight management programmes or at least an appropriate referral system in place at school level so that individuals screened as underweight, overweight or obese can be referred accordingly in a timely manner.

(iv) Regular weight measurement in primary healthcare settings

The extent to which HCPs deliver weight management interventions in their routine practice and the overall effectiveness of these interventions is uncertain so far. According to a Cochrane review conducted by Flodgren and colleagues (2010), it is difficult to draw any firm conclusion regarding the effectiveness of these interventions because of heterogeneity among studies in terms of settings, participants, interventions and outcomes. Meta-analysis of three of the trials (out of a total of six) revealed that, compared to standard care, such educational interventions targeted at HCPs helped in reducing patients' weight (mean1.2kg, 95% CI: −0.4 to 2.8kg) in one year, though moderate unexplained heterogeneity (I^2 = 41%) between these trials limited the generalisability of findings (Cohen, et al., 1991; Martin, et al., 2006; Moore, et al., 2003). Thus there is a need for further investigations.

Meanwhile, it would be better to have regular weight measurement as a norm in primary healthcare settings as recommended by obesity management guidelines in the US, UK and Australia (Moyer, 2012; NHMRC, 2013; NICE, 2014). This would at least help in raising awareness among the general population and would enable them to keep a track record of their weight. Regular weight measurement would also provide healthcare professionals with an opportunity to discuss achieving healthy body weight and its significance. Research has shown that prompts from healthcare professionals regarding healthy eating brought positive behaviour change among patients (*Safe*food, 2012). It is also important for South Asian countries like Pakistan, India and Bangladesh to develop clinical practice guidelines for obesity management in order to establish a basis for a more uniform approach across Asia as developed by EASO for the European countries (Tsigos et al., 2008).

Although the initial consensus committee from India (Misra et al., 2009) developed Asian Indian-specific guidelines for defining and managing overweight and obesity and proposed the use of lower BMI and WC cut-off points for the Indian population, there is a need for more collaborative efforts from regional countries. For example, it would be more effective if experts in the field of obesity from Pakistan, Bangladesh, and Sri Lanka gave their input in the formulation of obesity management guidelines. Similarly, well-defined objective criteria for the screening and evaluation of obesity should be defined in a consensus regarding who needs to be screened and when to be screened instead of relying on HCPs' estimation of patients' weight as is the case with the existing guidance (Moyer, 2012; NICE, 2014; Tsigos et al., 2008). More importantly, future guidelines should have a component to address the issue of the underestimation of body weight among overweight and obese individuals which is currently missing from all existing guidelines.

9.3 Direction for future research

There are various research areas which have emerged from the findings of this study and which need to be explored in future research.

- It would be useful if future research from Pakistan and other South Asian countries could use and report their findings regarding overweight and obesity by using international as well as ethnic-specific BMI and WC cut-off points. This would facilitate easy comparison of the findings across studies.
- It would be worthwhile if future HSEs use ethnic-specific BMI and WC cut-off points for weight assessment especially for the South Asian and other ethnic minority groups along with international criteria.
- Our study assessed problems associated with being overweight (the underestimation of body weight, obesity, weight stigmatisation) among students of public sector institutes where the majority of the students were of middle socio-economic status. There is a need to conduct similar studies in private sector institutes to compare the scale of the problems among students of high socio-economic status. This would enable the assessment of the possible role of SES in this regard.
- It would be worthwhile to evaluate the effectiveness of suggested interventions (provision of healthy weight information, training modules and workshops) for the prevention of the underestimation of weight among healthcare professionals.
- There is a need to assess the underestimation of body weight among the general population including children so that interventions such as counselling services can be designed and offered to high-risk groups in GP clinics and schools.
- Our study found that participants who received weight related comments from parents and friends were more likely to underestimate their body weight. However, we did not look at the perception of parents or friends of respective individuals so do

not know whether their (parents, friends) perception was correct or they were underestimating or overestimating the weight of those individuals. Therefore, it is essential to explore the perceptions of parents about their children's weight in more detail through a qualitative research method. Additional information regarding the types of weight-related comments received by individuals from parents would further facilitate the understanding of the topic. The best way of gathering information from the participants in this regard would be interview or focus group discussion. Similarly, it is equally important to explore this (perception of body weight) issue among friends and colleagues of participating individuals through qualitative work.

- Although the use of these images (Stunkard et al., 1983) can give very useful information on weight perception especially in situations where anthropometric measurements might not be feasible, it would be best if future research studies could assess the validity and reliability of these body images in our local setting. Reassuring results would enable the use of these body images in future for improving the perception of body weight.
- An exploration of body dissatisfaction, binge eating and eating disorders among students needs to be carried out so that these issues can be incorporated into future intervention programmes in our setting as current data found unhealthy weight modification practices among students irrespective of their weight status.
- Our study revealed a high magnitude of weight stigmatisation. It would be worthwhile to explore the confronting and coping mechanisms associated with weight stigma, its psychological effects and effects on exercise motivation.
- Similarly, it is important to explore the issue of weight stigmatisation among underweight individuals in terms of its magnitude, effects and contributing factors in future research and a mixed method research again would be best to get information on these aspects through FGDs and in-depth interviews.
- The role of family and social interactions should be explored in alleviating the negative psychosocial effects of overweight and obesity, the underestimation of body weight and weight stigmatisation.
- The effectiveness of counselling services for those behaviours related to the underestimation of body weight and weight stigmatisation in this setting needs to be evaluated.

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