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**The Determinants of Oral Health Related Quality of Life in Adults**

**A thesis submitted in the fulfilment of the requirement for the Degree of Doctor of Philosophy**

**Dr Ekta Gupta**

**Academic Unit of Dental Public Health**

**School of Clinical Dentistry**

**University of Sheffield**

**2014**ABSTRACT

**Objectives:** Weak and indirect relationships between oral clinical status and oral health related quality of life (OHQoL) suggest individual and environmental factors might intervene in this relationship. Therefore, the aim of this research was to identify clinical and psychosocial determinants of OHQoL in adults.

**Methods:** Prospective cohort study of 495 adult employees of an automobile parts manufacturer in India. Measures of OHQoL, general health perceptions, overall QoL, individual factors [sense of coherence, social support, stress, oral health beliefs, dental behaviours and subjective SES] and environmental factors [SES and social network] were collected at baseline and three month follow-up, together with a clinical examination at baseline. Analysis using lagged structural equation modelling (SEM) was guided by the Wilson and Cleary model linking clinical variables to quality of life.

**Results:** Participants’ mean age was 33.12 years (18-72), 96% were males and mean DMFT was 2.13. The final SEM model was an excellent fit to the data accounting for 10%, 26% and 24% of the variance (prospectively) in OHQoL, GHP and Overall QoL respectively. Clinical status (decayed teeth) at baseline (*β* = 0.14, p < 0.01**)** had a direct effect on OHQoL at follow-up. Baseline individual characteristics: social support (*β* = 0.12, p < 0.05**)**, SOC (*β* = 0.12, p < 0.05**)** and stress (*β* = 0.14, p < 0.01**)** had direct effects on OHQoL at follow-up. SES and social network indirectly predicted OHQoL through the individual characteristics.

**Conclusion:** The findings offer longitudinal evidence that clinical and psychosocial factors may determine OHQoL, GHP and overall QoL in adults and suggest routes by which environmental factors such as SES might influence them. These factors might provide avenues for health promotion interventions and should be accounted for when evaluating clinical treatment to improve OHQoL.

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# ABBREVIATIONS

|  |  |
| --- | --- |
| ART  CFI  CHS  CI  CPI  CPITN  CPQ11-14  CVD  DAI  DB  DMFS  DMFT  DT  MT  FT  GFI  GHP  GRRs  HRQoL  IADL  ICC  ICF  ICS-II  LSNS  SWSS  MSPSS  OHBQ  OHIP  OHIP-14  OHIPG-49  OHIPC-14  OHIP-J  OHIP- NHANNES  OHQoL  OIDP  PSS-4  QoL  RCT  RMSEA  SE  SEM  SES  SF-36  SHO  SOC  SPSS  SRMR  Subjective SES | Antiretroviral Therapy  Comparative Fit Index  Current Health Scale  Confidence Interval  Community Periodontal Index  The community periodontal index of treatment needs  Child Perception Questionnaire  Cardio-vascular Disease  Dental Aesthetics Index  Dental Behaviour  Decayed/Missing/Filled Surfaces  Decayed/Missing/Filled Teeth  Decayed Teeth  Missing Teeth  Filled Teeth  Goodness of Fit  General Health Perceptions  Generalised Resistance Resources  Health related quality of life  Instrumental Activity of Daily Living  Intra-class correlation coefficient  International Classification of Functioning  International Collaborative study of Oral Health Outcomes  Lubben’s Social Network Scale  Satisfaction with life Scale  Multidimensional Scale of Perceived Social Support  Oral Health Beliefs Questionnaire  Oral Health Impact Profile  OHIP-short version  OHIP-German long version  OHIP-Chinese short version  OHIP-Japanese  OHIP-National Health and Nutrition Examination Survey  Oral health related quality of life  Oral Impacts on Daily Performance  Perceived Stress Scale  Quality of Life  Randomised controlled Trail  Root Mean-Square Error of Approximation  Standard Error  Structural Equation Modelling  Socio-economic status  Short Form-36  Subjective Health Outcome  Sense of Coherence  Statistical Package for the Social Sciences  Standardised Root Mean Square Residual  Subjective Socio-economic Status |

## INTRODUCTION

Recent years have seen a shift in the focus of dentistry from valuing only clinical assessments to measuring subjective experiences of patients. This change in approach has led to the development of an important construct of ‘Oral health related quality of life (OHQoL)’. OHQoL is defined as “ *the impact of oral disease and disorders on aspects of everyday life that a patient or person values, that are of sufficient magnitude, in terms of frequency, severity or duration to affect their experience and perception of their life overall* ” ([Locker and Allen, 2007, p.409](#_ENREF_248)).

Researchers have often found weak and indirect relationships between clinical status (e.g. dental caries, xerostomia and fluorosis) and subjective assessments of oral disease (OHQoL) ([Baker, 2007](#_ENREF_28); [Baker *et al.*, 2010](#_ENREF_29); [Daly *et al.*, 2010](#_ENREF_104)). A possible explanation for this finding is that other factors intervene in the relationship between clinical status and OHQoL. Recently, oral health research has found several individual and environmental factors to be associated with OHQoL, for example factors such as sense of coherence, self-esteem and socio-economic status ([Savolainen *et al.*, 2005a](#_ENREF_380); [Baker, 2007](#_ENREF_28); [Baker *et al.*, 2010](#_ENREF_29); [Piovesan *et al.*, 2010](#_ENREF_342); [Nammontri *et al.*, 2013](#_ENREF_309)). These factors have been found to mediate relationships between clinical status and OHQoL ([Baker *et al.*, 2010](#_ENREF_29)).

Studies using a theoretical framework such as the Wilson and Cleary model have shown that the individual and environmental factors affect OHQoL through symptom status, functional status and general health perceptions ([Baker *et al.*, 2010](#_ENREF_29)). Identifying the determinants of OHQoL is important for many reasons. First, such determinants may bring opportunities for routes for new oral health promotion strategies. Secondly, interventions which are solely clinical, not addressing patient experiences may not be fully effective. The aim of this research was to identify clinical and psychosocial determinants of OHQoL in adults.

This thesis is structured as follows:

**Chapter Two** is the narrative review of the literature on concepts of health; health related quality of life (HRQoL) and OHQoL. It then considers theoretical models applicable to OHQoL; ICF ([WHO, 1999](#_ENREF_458)) and Wilson and Cleary ([1995](#_ENREF_464)). The chapter further details the results of a systematic review on ‘determinants of OHQoL in adults’, which helped to identify variables for inclusion within the main study. A detailed description of individual (social support, sense of coherence, stress, oral health beliefs, dental behaviours and subjective socio-economic status) and environmental factors (socio-economic status and social network) mapped within the Wilson and Cleary model are described. Finally, the aim and objectives of the research are presented.

**Chapter Three** describes the methods and materials used within the research along with details of the statistical methods and the data analysis strategy for the study.

**Chapter Four** presents the research results including descriptive, bivariate and structural equation modelling findings.

**Chapter Five** discusses the research findings, limitations and strengths.

**Chapter Six** highlights the major conclusions and summarises recommendations for policy and research.

## LITERATURE REVIEW

### Health

The term "health" comes from the old English word ‘hoelth’ meaning "wholeness or being sound or well" ([Dolfman, 1973](#_ENREF_119)). Consistent with this, the World Health Organization ([WHO, 1946](#_ENREF_454)) defined health as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity”. In 1946, this definition was seen as a ground breaking formulation which widened the meaning of health to both psychological and social dimensions. However, with the changes in the pattern of illnesses and disease over the last 60 years this definition seems impractical. For example, people with chronic diseases such as diabetes cannot achieve a state of complete wellbeing but rather can adapt and cope with the challenges to lead a healthy life. Therefore, Huber and colleagues ([2011](#_ENREF_188)) suggest that the emphasis should be given towards the ability to adapt and self-manage oneself in the face of social, physical and emotional challenges.

The above conceptualisation of health also relates to the Ottawa charter for health promotion ([WHO, 1986](#_ENREF_455)) which states that, in order to be healthy, an individual or group must be able to identify and to realise aspirations, to satisfy needs, and to change or cope with the environment. In this way, health is seen as a resource or an asset that helps one to lead a normal everyday life. This idea is central to the concept of ‘health related quality of life’ (HRQoL) which reﬂects an individual’s subjective evaluation and reaction to health or illness. Further, it is suggested in the Ottawa charter that people cannot achieve their fullest health potential unless they are able to take control of those things which determine their health. To do this, it is important that people are provided with the necessary resources which enable them to achieve health. The resources specified in the Ottawa charter can be interpreted as factors related to the social, economic, and physical environment and, persons’ individual characteristics and behaviours; together referred to as the determinants of health ([WHO, 2008](#_ENREF_459)). Moreover, these determinants of health interact with each other to shape the health and well-being of a person and society as a whole ([WHO, 2008](#_ENREF_459)). Thus, differential availability of these resources in daily life can influence health, leading to inequalities in health among people and within societies. Hence, it is important to consider how the determinants of health affect general well-being and health.

This chapter will begin by conceptualising health within the Biomedical and the Bio-psychosocial models to show how the concept of health has evolved and led to the evolution of OHQoL.

#### Health within the Bio-medical model

The biomedical model of health (the disease model) came into existence in the 17th century with the discovery of the circulation of blood in human body by William Harvey and Rene Descartes in 1628 ([Hewa and Hetherington, 1995](#_ENREF_172)). Harvey stressed that the blood circulated in the body in a mechanical manner and thus gave birth to the notion of body being a machine. Harvey’s findings were reinforced by the ‘Cartesian Dualism’ ([Descartes, 1969](#_ENREF_112)), which recognised the human body to be analogous to a machine introducing the notion where the mind was seen separate from the body. This mechanistic view of the body was strengthened by discoveries in medicine which reinforced the idea that illnesses are a failure of mechanical functions of various parts of the body. This theory also sees medicine as a science with concrete answers to everything that goes wrong with the body. The advent of germ theory from Robert Koch, Louis Pasteur and other significant advancements in clinical medicine reinforced the idea that biochemical measures are the crux of medicine. Dubos ([1959](#_ENREF_122)) suggested that modern medicine was governed by the idea that the human body can be manipulated and cured by introducing chemical compounds or by replacing and repairing parts. This conforms perfectly with the view of Engel ([1977](#_ENREF_127)) that the biomedical model of health has no room for psychological and social dimensions of illness. This reductionist approach reduces aetiology of disease to biological causes with no appreciation of the social determinants of health. Health is merely seen as ‘absence of disease’ and patients become passive recipients in treatment.

Based upon the biomedical model of disease, dentistry has traditionally focused on measuring oral disease with clinical measures such as DMFT and CPITN which tell little about the functional and psychosocial impacts of oral disease on an individual ([Allen, 2003](#_ENREF_13)). Here, the mouth and oral diseases are seen as separate from the rest of the body. Similarly, prevention strategies in oral health primarily focus on changing the behaviours of the high risk individuals rather than emphasising the factors which lead to adoption of high risk behaviours ([Watt, 2007](#_ENREF_450)). For example, dentists often suggest people to stop smoking which is a risk factor for oral cancer, however, fail to address the issue why the individual smokes in the first instance. The uptake of smoking can be related to individual and environmental factors such as perceived stress and socio-economic status (SES). Thus, due to its narrow conceptualization, the biomedical model of health is unable to define the multidimensional concept of health within a broad social context.

#### Health within the Bio-psychosocial model

In contrast to the biomedical model, the bio-psychosocial model of health is a scientific model ([Engel, 1981](#_ENREF_129)) that incorporates the missing dimensions of the biomedical model; the psychological and environmental factors. This model embraces the systems approach ([Engel, 1980](#_ENREF_128)) where the person is seen as highest level of the organismic hierarchy and the lowest member of the social hierarchy.

Using this bio-psychosocial hierarchy approach, Engel ([1980](#_ENREF_128)) pointed out that the biomedical model describes only at the patient level while the bio-psychosocial model works both at the patient and environmental levels. Engel pointed out the need to study the subjective experiences of patients to complement the clinical biomedical data.

In oral health this model provides an important conceptual shift from the biomedical/behavioural ‘downstream approach’ to an upstream approach aimed at addressing the wider determinants of oral health or the causes of the causes ([Watt, 2007](#_ENREF_450)).

Within the biomedical model a cause of dental caries is ‘Streptococcus Mutans’. Although all individuals harbour these bacteria not everybody develops caries. This example highlights the limited scope of the biomedical model in explaining the process of dental caries. The bio-psychosocial model sees dental caries as a multifactorial process caused by the convergence of several factors; biological (e.g., genetics, presence of bacteria), psychological (e.g., stress) and social (e.g., socio-economic status, dietary factors, access to dental care and advice).

In clinical practice the bio-psychosocial model has important implications. For example, consider an old patient wanting complete denture prosthesis. A dentist with a biomedical approach may follow the usual procedures of and provide the patient with dentures which are clinically acceptable but from the patient’s perspective are not suitable. A dentist with the bio-psychosocial approach might explore further into why the patient wants the dentures in first instance (highest priority). For example, is it for fulfilling functional demands like mastication or aesthetics, together with what expectations the patient and his/her family have from these dentures. These insights into the psychological and the social expectations of the patient allow the dentist to tailor treatment to the patient’s individual needs, increasing the likelihood of success.

Thus, the bio-psychosocial model may help to shift the concern from treating disease to achieving health, from emphasising the biological factors to wider determinants of health and from using only clinical disease status measures to incorporating subjective health status measures.

#### Quality of life (QoL)

One such subjective perspective is quality of life (QoL) which came into existence following economic growth after World War II which resulted in an increase in people’s expectations of satisfaction, well-being and psychological fulfillment ([Awad and Voruganti, 2000](#_ENREF_24)). In 1964, American President Lyndon Johnson in his speech ‘Great Society’ used the phrase ‘Quality of life’ for the first time elaborating that there is more to life than being just financially secure ([Meeberg, 1993](#_ENREF_293)).

Although quality of life has intuitive appeal, it means different things to different people in varying situations and has been defined differently by different authors. Some define it in terms of fulfillment of need ([Hornquist, 1990](#_ENREF_180)), some state it in terms of satisfaction ([Campbell *et al.*, 1976](#_ENREF_67)) while others describe it in terms of fulfillment of life plans ([Goodinson and Singleton, 1989](#_ENREF_155)). However, these definitions are very vague and do not assist in interpreting what actually constitutes a person’s QoL. There is no universal definition for QoL, but, most authors agree that it is a multifaceted and complex construct ([Bowling, 2001](#_ENREF_50)).

A taxonomy of quality of life definitions was developed to organize existing definitions ([Farquhar, 1995](#_ENREF_137)) and divided the definitions in terms of origin into ‘expert’ or professional definitions and lay definitions.

Expert definitions can be divided into three types. First, global definitions are general definitions describing QoL in terms of satisfaction and throw no light on its components or how it can be operationalised. For example, Campbell and colleagues ([1976](#_ENREF_67)) described QoL in terms of individual’s own evaluation of their life experiences. Abrams ([1973](#_ENREF_1)) defined QoL as the degree of satisfaction or dissatisfaction felt by people with different aspects of their lives.

Second, component definitions divide quality of life into components or dimensions making them more applicable to empirical work. Patterson ([1975](#_ENREF_329)) described key quality of life dimensions as health, function, comfort, emotional response and economics. Primarily, describing QoL in terms of subjective and objective dimensions.

Third, focused definitions describe one or a small number of the components of quality of life. For example, the definition of ‘health related quality of life’ describes quality of life in relation to one component that is health.

The World Health Organization ([WHO, 1995, p.1405](#_ENREF_456)) defined quality of life as an “ individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns”. The WHO definition mirrors the first and the second category of the taxonomy describing feelings and perceptions of life in relation to the dimensions of QoL. This definition describes QoL as a multidimensional concept, incorporating physical health, psychological state, social relationships, personal beliefs and their environment and highlights the view that quality of life is subjective.

Therefore, the concept of QoL consists of domains related both to health and non-health related facets such as political, cultural or societal. Advances in medicine and changes in the pattern of illnesses from infectious to chronic diseases has led to increase in life expectancy thereby shifting the focus of medicine towards improving quality of life. This narrower concept of quality of life related to health is known as ‘health related quality of life’ (HRQoL). HRQoL draws inspiration from the bio-psychosocial perspective on health and over the past two decades has formed an important part of modern medicine and practice ([Awad *et al.*, 1997](#_ENREF_25)). However, because people cannot be isolated from their environment both HRQoL and non-HRQoL overlap. For example, poor traffic regulation is a facet of non-HRQoL but can cause accidents leading to dental injuries resulting in impacts on HRQoL.

#### Health Related Quality of Life (HRQoL)

HRQoL operationalises concepts of health and provides a way to measure the people’s experience of their health and illness. In simple terms this concept helps to assess the impact of health conditions on everyday life of people taking into account person’s perspective.

Testa and Simonson ([1996, p.835](#_ENREF_422)) deﬁned HRQoL as the “physical, psychological and social domains of health, seen as distinct areas that are inﬂuenced by person’s experiences, beliefs, expectations and perceptions”. Bullinger and colleagues ([1993](#_ENREF_61)) saw health-related quality of life as being similar to subjective health status, because both are patient based, but the former focuses more on the impact of a perceived health state on the ability to live a fulfilling life. Kaplan and colleagues ([1984](#_ENREF_200)) defined HRQoL in terms of clinical outcome as the impact of disease and treatment on disability and daily functioning. The above definitions of HRQoL highlight that this concept is amorphous and multidimensional. Hence, HRQoL can also be described as a personal and a dynamic concept because as health status deteriorates perspectives on life, roles, relationships and experiences change ([Morris *et al.*, 1986](#_ENREF_300)).

Summarizing different perspectives and definitions of HRQoL, Bowling ([2001](#_ENREF_50)) described it as optimum levels of mental, physical, role (e.g. work, parent, carer, etc.) and social functioning, including relationships, and perceptions of health, fitness, life satisfaction and well-being. It should also include some assessment of the patient's level of satisfaction with treatment, outcome and health status and with future prospects. It is distinct from quality of life as a whole, which would also include adequacy of housing, income and perceptions of immediate environment.

#### Oral Health Related Quality of life (OHQoL)

Similar ideas were applied to oral health by Cohen and Jago ([1976](#_ENREF_79)) who advocated the development of socio-dental indicators to ameliorate the lack of data relating to the psychosocial impact of oral health problems on individuals. Reisine and Bailit ([1980](#_ENREF_350)) found that clinical criteria had limited relevance to an individual in judging their oral health status and suggested that there was a weak correlation between a person’s subjective assessment of their oral health and clinical indices. This suggested that subjective evaluations are affected by other factors. Such findings marked the transition of traditional dentistry focusing on disease to contemporary dentistry which acknowledges the impact of psychosocial factors on oral health and thus the need for measuring the subjective experiences of oral conditions.

The aim of contemporary dentistry is to obtain and maintain a functional, pain-free, aesthetically and socially acceptable dentition for the lifespan of most people ([Sheiham, 1992](#_ENREF_388)). In other words the goal of dentistry should be to improve quality of life ([Cohen and Jago, 1976](#_ENREF_79)). Consequently, it is important to account for the disruptions in physical, psychological and social functioning caused by oral conditions. Thus, OHQoL bridges the relationship between traditional clinical variables and person centred self-reported measures. In order to understand the concept of OHQoL, it will be first useful to define oral health.

##### What is Oral Heath?

Oral health was defined by the Department of Health ([1994, p.2](#_ENREF_111)) as the ‘standard of health of the oral and related tissues which enables an individual to eat, speak and socialize without active disease, discomfort or embarrassment and which contributes to general well-being'. Again this definition reflects the WHO definition of health and bio-psychosocial concepts of health. As it incorporates the ability to carry out the important everyday activities which affect overall well-being, measuring the ability to perform these activities and the impact of oral conditions on life overall is as important as identifying oral disease.

##### Definitions of OHQoL

As with HRQoL, OHQoL has multiple definitions. The definitions vary from very simple to complex. The meaning of OHQoL has evolved with the better understanding of the concept. Early attempts to define OHQoL were vague and restricted to the oral cavity in general. For example, Locker ([1989](#_ENREF_240)) defined OHQoL as ‘the functioning of the oral cavity and the person as a whole and with subjectively perceived symptoms such as pain and discomfort’. However the same author described it as ‘when talking about oral health, our focus is not on the oral cavity itself but on the individual and the way in which oral disorders, diseases and conditions threaten health, well-being and quality of life’ ([Locker, 1997, p.18](#_ENREF_244)). This latter definition emphasises the effect of oral problems on general health and well-being thus representing an evolution in the understanding of OHQoL. A more simple but comprehensive definition described OHQoL as ‘the extent to which oral disorders affect functioning and psychosocial well-being’ ([Locker *et al.*, 2000](#_ENREF_249)). Kressin ([1997](#_ENREF_215)) described it as the impact of oral conditions on daily functioning. The United States Surgeon General’s report ([2000, p.135](#_ENREF_430)) on oral health, defined OHQoL as “a multidimensional construct that reflects (among other things) people’s comfort when eating, sleeping, and engaging in social interaction; their self-esteem; and their satisfaction with respect to their oral health”. This is a very simple and general explanation of what OHQoL means.

Gift and Atchison ([1995](#_ENREF_153)) adapted Patrick and Erickson’s model ([1993](#_ENREF_328)) to explain the multidimensional nature and interrelated domains of OHQoL. According to that model, OHQoL incorporates survival (absence of oral cancer, presence of teeth); absence of impairment, disease or symptoms; appropriate physical functioning associated with chewing and swallowing and absence of discomfort and pain; emotional functioning associated with smiling. Importantly, it incorporated, social functioning associated with normal roles; perceptions of oral health; satisfaction with oral health; and absence of social or cultural disadvantage due to oral status.

Although the above definitions are closely related, Locker and Allen ([2007](#_ENREF_248)) draw a fine line between subjective oral health and OHQoL. Subjective health status provides a description of the person’s current health state, whereas OHQoL is a subjective evaluation of that status.

This thesis will use this most current definition throughout. OHQoL is “ *the impact of oral disease and disorders on aspects of everyday life that a patient or person values, that are of sufficient magnitude, in terms of frequency, severity or duration to affect their experience and perception of their life overall* ” ([Locker and Allen, 2007, p.409](#_ENREF_248)).

##### Applications of HRQoL and OHQoL

The potential applications of HRQoL or OHQoL have been highlighted by several authors ([Locker, 1996](#_ENREF_243); [Fayers and Machin, 2000](#_ENREF_138); [Khanna and Tsevat, 2007](#_ENREF_207)) and can be summarized in three broad categories; political, theoretical and practical (Table 2.1.1).

Politically, OHQoL helps to plan evidence based public health policies and indicates how resource allocation should be done ([Guyatt *et al.*, 1993](#_ENREF_162)). Clinically, it may assist in screening and monitoring for psychosocial problems ([Fitzpatrick *et al.*, 1992](#_ENREF_142)) and outcomes of care ([Fayers and Machin, 2000](#_ENREF_138)). Research can explore the outcomes of healthcare interventions and explore new and different pathways which affect health ([Locker, 1996](#_ENREF_243)). Public health applications describe illness in populations, plan and evaluate services and help in needs assessment and prioritization ([Gherunpong *et al.*, 2006](#_ENREF_152)).

Table 2.1.1 Potential uses of Oral Health Related Quality of Life measures

|  |  |
| --- | --- |
| Field of Work | Potential uses in health field/oral health related quality of life |
| Political | * Planning public health policy * Planning in resource allocation |
| Clinical Uses | * Communication tools * Commissioning program of care * Evaluating intervention * Assessing the outcomes of new treatment * Aid understanding of patient point of view * Screening purposes * Identifying and prioritizing patient problems and preferences * Monitoring and evaluating individual patient care * Identifying which patients might benefit most from treatment * Involving patients perspectives in decision making & self-care * To predict outcomes in order to provide appropriate care * Clinical Audit |
| Research | * Evaluating outcomes of health care interventions * Elucidating the relationships between different aspects of health |
| Public Health | * Describing and monitoring illness in population * Planning, monitoring and evaluating services * Needs assessment and prioritization * Encouraging greater lay participation in health care |
| Theoretical | * Exploring models of health * Describing factors influential to health |

Source: Robinson and colleagues ([2003](#_ENREF_356))

### Theoretical Models applicable to OHQoL

Theoretical models conceptualise the relationships between factors; for example between clinical variables, OHQoL and other factors which may potentially mediate this relationship. Multidimensional models such as those by Locker ([1988](#_ENREF_239)), ICF ([WHO, 1999](#_ENREF_458)) and Wilson and Cleary ([1995](#_ENREF_464)) distinguish and hypothesise relationships between conceptually distinct dimensions and antecedents of health and OHQoL. This review will focus on ICF ([WHO, 1999](#_ENREF_458)) and Wilson and Cleary ([1995](#_ENREF_464)) which link health to individual and environmental factors.

#### The International Classification of Functioning

The International Classification of Functioning, Disability and Health, known more commonly as ICF, provides a standard language and framework for the description of health, health related states, determinants and outcomes ([WHO, 1999](#_ENREF_458)) (Figure 2.2.1). It provides a framework to understand changes in body function and structure, what a person with a health condition can do in a standard environment (their level of capacity), as well as what they actually do in their usual environment (their level of performance). Thus it contains both health and health related domains. These domains are classified from body, individual and societal perspectives by means of two lists: a list of body functions and structure, and a list of domains of activity and participation. In ICF, the term functioning refers to all body functions, activities and participation, while disability is similarly an umbrella term for impairments, activity limitations and participation restrictions. ICF also lists environmental and personal factors that interact with all these components leading to a health condition.

In relation to oral health, body functions in the model would refer to the physiological functions of the oro-facial complex (including psychological functions). Body structures are anatomical parts of the mouth such as teeth, tongue and other components. Impairments are problems in oral function or structure such as a significant deviation or loss. Activity is the execution of a task such as chewing or swallowing by an individual. Participation is involvement in a life situation. Activity limitations are difficulties an individual may have in executing activities such speaking, mastication etc. Participation restrictions are problems in involvement in life situations such as not going out in public due to the loss of an anterior tooth. The environmental factors make up the physical, social and attitudinal environment in which people live. The personal factors include lifestyle, habits, social background, education, life events, race/ethnicity, sexual orientation and assets of the individual.

However, the ICF has been criticized for being vague about its conceptual origins and the theory that underpins it ([Imrie, 2004](#_ENREF_194)). It is currently being used primarily as taxonomy rather than an explanatory theory or model ([Bruyere *et al.*, 2005](#_ENREF_59)). Bruyère and colleagues ([2005](#_ENREF_59)) also suggest that the associations and causal links between the constructs in the model require investigation. The lack of clear distinction between the definitions of activity and participation, which is the confusion between capacity for action and the actual performance of that action, needs conceptual clarity ([Nordenfelt, 2003](#_ENREF_318)).

A review by Jelsma ([2009](#_ENREF_198)) on the type of use, aims and implementation issues involving ICF model reported several areas in which users identified difficulties with it including missing, and overlapping codes. The lack of clarity between the activities and participation components was the greatest challenge among researchers which lead to incorrect and non-standard applications. The classification does not elaborate on the personal factors.

Health Condition

(Disease or condition)

Body function & structure

(Impairment)

Activities

(Limitation)

Participation

(Restriction)

Environmental factors

Personal

Factors

**Contextual factors**

Figure 2.2.1 International Classification of Functioning, Disability and Health

Several writers have noted that the subjective dimension of functioning is missing in ICF, and dimensions such as life satisfaction should be integrated ([Ueda and Okawa, 2003](#_ENREF_434); [Wade and Halligan, 2003](#_ENREF_439)). Perenboom and Chorus ([2003](#_ENREF_337)) have raised the issue whether participation can be assessed without taking into account person-perceived participation. They again point to the lack of subjective appreciation within the model.

#### Wilson and Cleary Model

The Wilson and Cleary model ([1995](#_ENREF_464)) is a multidimensional model which relates clinical status to individual experience (Figure 2.2.2). It integrates the biomedical and the psychosocial perspectives on health as the relationship between clinical factors and HRQoL or OHQoL and subjective well-being. It also acknowledges the role of individual and environmental factors. The relationships are hypothesized between adjacent levels along with complex, direct, and indirect (mediated) relationships between non-adjacent levels. Individual and environmental factors may mediate these relationships. Wilson and Cleary emphasize that the arrows in the model indicate dominant relationships which does not imply that other relationships do not exist. The model was later revised by Ferrans and colleagues ([2005](#_ENREF_140)) who elaborated on what constitutes the environmental and the individual factors not discussed by Wilson and Cleary originally.

Wilson and Cleary described five main levels of variables arranged in a continuum left to right according to a pathway of biological, social and psychological complexity. The model links physiological variables to symptom status progressing to functional health, general health perceptions, and overall quality of life and helps to clarify the distinctions between them while acknowledging the complexity of their inter-relationship. Within the model, OHQoL is analogous to symptoms and functional status. Wilson and Cleary provided clear definitions for each variable in the model, which enables their separate measurement.

#### Variables in the Wilson and Cleary Model

**Biological and Physiological Variables**

Biological and Physiological variables include the functions of the cells, organs and organ systems in the body. Any alteration in biological functioning directly or indirectly affects all components of health, including symptoms, functional status, perceptions of health, and overall quality of life. For example, dental caries or xerostomia are variations in biological functioning.

**Symptoms**

When assessing symptoms the focus shifts from the cellular and organism level to the person. Symptoms are “a patient’s perception of an abnormal physical, emotional, or cognitive state,” which can be categorized as physical, psychological, or psychophysical.

Ferrans and colleagues ([2005](#_ENREF_140)) pointed out that the experience, evaluation, and interpretation of symptoms are influenced by individual and the environmental factors. For example, in a study by Locker and colleagues ([2000](#_ENREF_249)) older adults who rated their oral health as poor had lower morale, more life stress, and were less satisfied with their lives than those who rated their oral health favourably suggesting that stress can modify the perception of symptoms. Similarly experiencing a stressful life change had a significant effect on subjective oral dryness ([Locker, 1993](#_ENREF_242)). Such patients were more likely to report problems in chewing food, problems with eating and communication and were more likely to be dissatisfied with their oral health. The relationship between the biological and symptom levels is complex. A person may perceive symptoms as normal experiences at one point of time but with changes in circumstances such as loss of partner they can cause an alarm about the health state ([Mechanic, 1995](#_ENREF_291)). A person with temporomandibular disorder may have no clinically identifiable biological and physiological abnormalities. However, another person can have a carious lesion with no symptoms.

**Functional Status**

Wilson and Cleary ([1995](#_ENREF_464)) defined functional status broadly, as the ability to perform tasks in multiple domains such as physical function, social function, role function, and psychological function.

Many factors can affect functional status. It can be directly affected by biological function, symptoms, and characteristics of the individual and the environment. For example, in people with oral sub mucous fibrosis, functional capacity can be limited by stiffness of the oral mucosa causing inability to open the mouth and by symptoms of inability to speak or swallow. As the severity of the disease increases it might interfere with activities such as speaking, swallowing or chewing which can have both physiological (poor nutrition) and psychological influences. But the extent of the functional restriction could also depend on individual characteristics, such as will power, or environmental factors, such as social networks or availability of health care.

**General Health Perceptions**

General health perceptions integrate all the components that come earlier in the model, and are subjective in nature. This component is a synthesis of all the various aspects of health in an overall evaluation. Although general health perceptions are influenced by the earlier components, they are distinct ([Ferrans *et al.*, 2005](#_ENREF_140)).

Figure 2.2.2 Wilson and Cleary model

General

Health Perceptions

Biological and

Physiological

Variables

Symptom

Status

Functional

Status

Non-medical

Factors

Overall

Quality of

Life

Characteristics of

the Individual

Characteristics of

the Environment

Wilson and Cleary ([1995](#_ENREF_464))

Thus using the other components, such as functioning or symptoms, to assess general health perceptions is not appropriate. Instead, specific measures which explore general health perceptions should be used, such as a global question asking people to rate their health such as SF-36 Health Survey.

**Overall Quality Of Life**

Overall quality of life, the final component of the model is characterized as subjective well-being portraying how happy or satisfied someone is with life as a whole. Diener and colleagues ([1999](#_ENREF_114)) pointed out that subjective well-being does not represent a single construct as it includes pleasant and unpleasant affect, global judgments of life satisfaction, and satisfaction with individual domains of life. At a broad level these domains represent health and functioning, psychological and spiritual, family, social, and economic dimensions ([Ferrans, 1996](#_ENREF_139)). A person’s life satisfaction depends on their patient values and preferences, which change as circumstances and environment change. Wilson and Cleary (1995) also pointed out that the general measures of life satisfaction may not be related to objective circumstances. A decayed tooth may pose problems that do not affect overall quality of life whereas another person with a similar problem might experience considerable change in overall QoL. This variation is seen due to the differences in individual and environmental factors.

**Individual and the Environment Characteristics**

According to Wilson and Cleary ([1995](#_ENREF_464)), how a person responds to physiological and biological changes and evaluates HRQoL depends on their individual and environmental characteristics, which provide explanatory causal pathways at every level. Ferrans and colleagues ([2005](#_ENREF_140)) in the revised model explained the content of the individual and environmental factors which was not discussed in the original Wilson and Cleary model.

Individual characteristics are the traits or qualities that identify a human being ([Sousa *et al.*, 1999](#_ENREF_405)) (e.g. age, sex) whereas environmental characteristics are the conglomerate of external conditions that influence the life of human beings ([Sousa *et al.*, 1999](#_ENREF_405)) (e.g. socio-economic status).

Researchers have often found weak and indirect relationships between clinical status (e.g. dental caries, xerostomia and fluorosis) and subjective assessments of oral disease (OHQoL) ([Atchison and Dolan, 1990](#_ENREF_23); [Locker, 1992](#_ENREF_241); [Locker and Slade, 1994](#_ENREF_251); [Baker, 2007](#_ENREF_28); [Baker *et al.*, 2010](#_ENREF_29); [Daly *et al.*, 2010](#_ENREF_104)). The model explains this is because individual and environmental factors intervene in the relationship between clinical status and OHQoL. Hence, identifying these factors (determinants of OHQoL) is important for many reasons. First, such determinants may bring opportunities for routes for new oral health promotion strategies. Secondly, they may confound or mediate the relationship between clinical status and quality of life and thus may need to be accounted for when incorporating patient reported outcomes in evaluations of oral healthcare. Thirdly, interventions which are solely clinical not addressing patient experiences may not be fully effective.

**Applicability of Wilson and Cleary model in the current research**

This is a comprehensive model which identifies possible causal pathways linking biological factors and their functional and psychosocial outcomes with overall quality of life, mediated by individual and environmental factors. It defines types of variables clearly, which assists in choosing specific tools to measure them and has been previously tested in adults in relation to health conditions such as cardiovascular disease ([Janz *et al.*, 2001](#_ENREF_197)), HIV ([Sousa and Kwok, 2006](#_ENREF_404)) and renal disease ([Frank *et al.*, 2004](#_ENREF_145)). It has, until recently, been rather unexplored in relation to oral health. Its applicability has been tested in adults with xerostomia and elderly edentulous people ([Baker, 2007](#_ENREF_28); [Baker *et al.*, 2008](#_ENREF_30)). However these studies indicated the inclusion of the individual and environmental factors in future studies in order to capture more fully the variance in health outcomes. Recently, the model has been tested a priori in children to determine psychosocial factors which influence their well-being and oral health ([Baker *et al.*, 2010](#_ENREF_29)). The findings supported the main tenets of the model and, identified sense of coherence (an individual factor) as the strongest prospective predictor of OHQoL in children. This has been confirmed with experimental evidence in children ([Nammontri *et al.*, 2013](#_ENREF_309)). To date, the model has not been tested a priori in regard to oral health of adults, nor have studies examined several potential variables; clinical, individual and environmental simultaneously.

### Determinants of Oral Health Related Quality of Life in Adults

Characteristics of

The Environment

Many studies have considered factors associated with OHQoL. In order to determine individual and environmental factors associated with OHQoL, a systematic review of the current literature on OHQoL and its possible predictors was conducted. The systematic review focused on identifying predictors of OHQoL in adults using an adaptation of the Wilson and Cleary model. The search attempted to identify all the relevant available studies, whether longitudinal or cross-sectional.

Sheiham and Spencer ([1997](#_ENREF_392)) identified criteria for selecting an OHQoL measure. It should be: brief, easy to use with an appropriate scoring system and supported by a relevant theoretical model. Of measures used in adults only OIDP and OHIP and their derivatives relate to an underlying model (in both cases the Locker ([1989](#_ENREF_240)) model of oral health). Therefore the review was limited to those studies that have used either of these two measures and their derivatives to measure OHQoL. Studies using these measures were identified and were hand searched for all the variables that they had considered.

Although RCT’s provide the highest level of evidence, this study design in most cases is not feasible for testing the impact of oral diseases on aspects of everyday life. Therefore, data from observational studies, including cross-sectional and cohort studies were also included in this review along with experimental evidence ([Stroup *et al.*, 2000](#_ENREF_411)). Reference lists of the eventually included papers were hand-searched to identify additional relevant studies and possible false exclusions, until no new applicable titles appeared. The full search profile is presented in Figure 2.3.1.

The terms used to search all the available studies on OHQoL are Oral Health Impact Profile, OHIP, OHIP\*, Oral Impacts on Daily Performance, OIDP and OIDP\*. The references of all primary studies identified via Medline (Ovid) 1950- June 2011, Pubmed, Embase, Cochrane library and Scopus were also searched for relevant articles upto June 2011.

The inclusion criteria were studies that used Oral Health Impact Profile (OHIP) or Oral Impacts on Daily Performance (OIDP) and their different forms, as a measure of OHQoL, studies that compared OHIP/OIDP against possible predictors or consequences, studies in adults over 18 years and studies which were conducted in any country but were published in the English language.

The exclusion criteria included studies in children and teenagers under 18 years (where it is not possible to analyse data for adults only), studies published in languages other than English and studies using other measures of OHQoL. A record was kept of the studies that could not be obtained.

Data were extracted by 8 reviewers from different dental specialities. The team included two Paediatric dentists, one Orthodontist, three Dental Public Health specialists and two Psychologists to ensure consistency between reviewers. Ten abstracts were retrieved and all authors extracted the data. Later all authors compared the decisions about included and extracted data. Similarly, ten full text articles were also retrieved and all authors extracted the data. Later all authors compared their decisions about included and extracted data. These processes were iterative and were repeated until the authors reached an adequate level of calibration.

A preliminary screening of abstracts and titles identified potentially relevant studies. All the titles which seemed to be doubtful were also included at this stage. This screening was conducted double blind and simply considered whether the studies should be included or not. The 404 study titles were equally divided among 4 pairs of reviewers. Each reviewer screened 101 titles and abstracts independently and then discussed the results in their respective pairs. Disagreements were settled by discussion between the reviewers or by recourse to other members of the review team.

Figure 2.3.1Number of studies according to the processes of searching, selection and evaluation of literature

Titles identified by electronic search and hand searching

(n=1204)

Screening of titles and abstracts

(n=404)

Duplicates removed

(n=800)

N=800

Studies excluded (based on abstract data extraction rules)

(n=115)

N=800

Final screening by full text reading

(n=289)

Studies selected to screen variables

(n=228)

Studies excluded (n=61)

* 19 studies in < 18 year olds
* 25 studies not comparing OHIP/OIDP against possible predictors or consequences
* 2 full text articles not retrievable
* 2 studies using other measures of OHQoL
* 13 studies reporting same data as other studies

165 Cross-sectional Studies

44 Longitudinal studies

19 Experimental Studies

#### Variables identified from the systematic review

##### Relationship between environmental factors and OHQoL

Less than half of the studies (n=22) supported the association between environmental factors and OHQoL (Table 2.3.1). Nine out of twenty-three studies examining the links between education and OHQoL suggested that more education was associated with better OHQoL. Three out of seven studies reported that higher job status was associated with better OHQoL. Eight out of eighteen studies provided support for the association between income and OHQoL, indicating higher income was related to better OHQoL. Two out of seven studies suggested that being single or divorced was related to worse OHQoL.

##### Relationship between individual factors and OHQoL

Out of thirty one studies, six suggested that being younger was associated with better OHQoL while two studies reported vice-versa (Table 2.3.2). Out of forty-two studies, 12 suggested that males had better OHQoL while two suggested otherwise.

All the three studies supported the association between social support and OHQoL suggesting low social support led to worse OHQoL. Two studies were identified which explored the relationship between SOC and OHQoL in adults. One supported the relationship while the other did not. All the three studies identified suggested that high stress leads to worse OHQoL.

None of the studies were identified which explored the relationship between oral health beliefs and OHQoL. Three studies reported that higher levels of smoking were related to worse OHQoL. Six studies suggested that visiting the dentist for an emergency was related with worse OHQoL, while one suggested dental visit for check-up was related to better OHQoL. Six studies out of the eleven found that greater the time elapsed since last visit was associated with worse OHQoL. Two studies indicated that tooth brushing frequency was associated with OHQoL. Only one study was identified which reported that lower relative social status (subjective SES) was associated with one or more impacts fairly or very often indicating worse OHQoL.

#### Conclusions from the systematic review

The results from the above studies are inconclusive of the relationship between environmental and individual factors and OHQoL. The findings of most of the studies reviewed showed inconsistencies due to methodological insufficiencies. Firstly, most of the studies were observational and cross-sectional and hence did not provide a causal evidence for the association between these factors and OHQoL. Secondly, most of the studies examined individual relationships in isolation due to lack of adoption of a theoretical framework (a priori) to understand complex relationships among variables. Thirdly, based on the quality assessment criteria (adapted from strobe guidelines), most of the studies were poor quality studies. For example, either did not include how study size was derived at or did not account for confounding. The heterogeneity in data analysis techniques with some studies reporting bivariate analysis and some regression analysis meant it is difficult to draw conclusions on the associations between different variables and OHQoL.

A brief summary of the environmental and individual variables identified from within the literature as predictors of OHQoL in adults is presented (Tables 2.3.1 and 2.3.2). For reasons of practicality not all the variables identified in the systematic review could be included in this study. It should be noted that the purpose of this review was to identify possible predictors to be included in the main study rather than providing evidence for a relationship.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Predictor** | **No of studies** | **Authors and Date** | **Study design** | **Measure** | **Result-Relationship between variable and OHQoL** |
| **Education** | 23 | Acharya et al., 2009,  Brennan et al., 2009,  Brennan et al., 2008,  Emami et al., 2010,  Ikebe et al., 2004,  Klages et al. 2005,  Lahti et al., 2008,  Locker & Slade, 1994,  Pereira et al., 2009,  Pires et al., 2006,  Pohjola et al., 2009,  Sousa et al. 2009,  Srisilapanan & Sheiham, 2001,  Marino et al., 2008 | Cross-sectional | OHIP-14,  OHIP-20,  OHIP,  OIDP | No relationship found (p > 0.05) |
| Caglayan et al., 2009\*\*\*,  Gomes et al., 2009\*,  Hassel et al., 2006\*,  Kushnir et al., 2004\*,  Richman et al., 2007\*,  Sanders, 2010\*,  Walter et al., 2007\*,  Zini & Cohen, 2008\*  Brennan and Spencer, 2009\*\*\*\* | Cross-sectional | OHIP-14,  OIDP,  OHIPG-49,  NHANES- OHIP | More education better OHQoL |
| **Employment**  \*p≤0.05, \*\*p<0.01, \*\*\*p<0.001, \*\*\*\*p<0.0001 | 7 | Acharya et al., 2009,  Emami et al., 2010,  Ikebe et al., 2004,  Kim et al., 2009 | Cross-sectional | OHIP-14,  OHIP-20 | No relationship found |
| Lou & McGrath, 2008\* McGrath & McGrath, 2002\* Sanders & Spencer, 2004\* | Cross-sectional | OHIP-14,  OHIPC-14 | Higher job status (White collar job) better OHQoL |

Table 2.3.1 Environmental characteristics identified from the systematic review

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Predictor** | **No of studies** | **Authors and Date** | **Study design** | **Measure** | **Result-Relationship between variable and OHQoL** |
| **Income** | 18 | Brennan et al., 2009,  Brennan et al., 2008,  Emami et al., 2010,  Ikebe et al.,2004,  Locker & Slade, 1994,  Matear et al., 2006,  Pereira et al., 2009,  Richman et al., 2007,  Sousa et al., 2009,  Zini & Cohen, 2008 | Cross-sectional | OHIP-14,  OHIP-20,  OHIP,  OIDP | No relationship found |
| Guzeldemir et al., 2009 \*  Locker & Quinonez, 2009\*\*\*,  Sanders, 2010\*\*\*,  Sanders et al., 2009a\*\*\*,  Sanders et al., 2009b\*\*\*,  Sanders et al., 2006 (low absolute material resource, one or more impact(s) fairly/very often),  Sanders & Spencer, 2004\*\*,  Srisilapanan & Sheiham, 2001\*\* | Cross-sectional | OHIP-14,  NHANES- OHIP,  OIDP | Low income worse OHQoL |
| **Marital status** | 7 | Ikebe et al., 2004,  Matear et al., 2006,  Pereira et al., 2009,  Richman et al., 2007,  Srisilapanan & Sheiham, 2001 | Cross-sectional | OHIP-20,  OHIP-14,  OIDP | No relationship found |
| Emami et al., 2010\*,  Kim et al., 2009\* | Cross-sectional | OHIP-14 | Not married worse OHQoL |

\*p≤0.05, \*\*p<0.01, \*\*\*p<0.001, \*\*\*\*p<0.0001

Table 2.3.2 Individual characteristics identified from the systematic review

\*p≤0.05, \*\*p<0.01, \*\*\*p<0.001, \*\*\*\*p<0.0001

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Predictor** | **No of studies** | **Authors & Date** | **Study design** | **Measure** | **Result-Relationship between variable and OHQoL** |
| **Age** | 31 | Acharya et al., 2009,  Acharaya, 2008,  Baba et al., 2008,  Baker et al., 2006,  Brennan & Spencer, 2005,  Emami et al., 2010,  Hagglin et al., 2007,  Hayran et al., 2009 (LN),  Heydecke et al., 2003 (RCT),  Ikebe et al., 2007,  Kida et al., 2006,  Kim et al., 2009,  Kushnir et al., 2004,  Locker, 2003,  Locker & Quinonez, 2009,  Masalu & Astrom, 2003,  Matear et al., 2006,  Pereira et al., 2009,  Tabolli et al., 2009,  Walter et al., 2007,  Zini & Cohen, 2008 | Cross-sectional, Longitudinal, RCT | OHIP-14, OHIP-J,  OHIP-20,  OIDP | No relationship found |
| Astrom et al., 2006\*\*,  Hassel et al., 2007 \*\* | Cross-sectional | OIDP,  OHIP-G | More age better OHQoL |
| Bekes et al., 2009\*\*\*,  Ide et al., 2006\*\*,  John et al., 2007\*,  Lahti et al., 2008\*\*,  Quandt et al., 2007\*,  Robinson et al., 2001\* | Cross-sectional | OIDP,  OHIP-14, NHANES-OHIP,  OHIPG-49, OHIPJ-45, OHIPC-14 | Less age better OHQoL or More age worse OHQoL |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Predictor** | **No of studies** | **Authors & Date** | **Study design** | **Measure** | **Result-Relationship between variable and OHQoL** |
| **Gender** | 42 | Acharya 2008,  Acharya & Sangam 2008,  Baker et al., 2006,  Barros et al., 2009,  Brennan & Spencer 2005,  Brennan & Spencer 2009,  Brennan et al. 2008,  Emami et al.2010,  Hagglin et al., 2007,  Hassel et al., 2006,  Hassel et al., 2007,  Hayran et al., 2009 (LS),  Ikebe et al., 2007,  Kida et al., 2006,  Klages et al., 2005,  Kushnir et al., 2004,  Lahti et al., 2008,  Locker & Slade 1994,  Masalu et al., 2003,  Matear et al., 2006,  Pereira et al., 2009,  Pires et al., 2006,  Pohjola et al., 2009,  Saub & Locker, 2006,  Sousa et al., 2009,  Srisilapanan & Sheiham, 2001,  Walter et al., 2007,  Zini & Cohen, 2008 | Cross-sectional | OHIP-14,  OHIP-20, OHIPG-49,  OIDP | No relationship found |

\*p≤0.05, \*\*p<0.01, \*\*\*p<0.001, \*\*\*\*p<0.0001

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Predictor** | **No of studies** | **Authors & Date** | **Study design** | **Measure** | **Result-Relationship between variable and OHQoL** |
| **Gender** | 42 | Caglayan et al.,2008\*,  Gomes et al., 2009\*\*\*,  Ide et al., 2006 \*\*\*,  John et al., 2007\*,  Locker & Quinoz, 2009\*,  Marino et al, 2008\*\*,  Mason et al., 2006 \*\*,  Richman, 2007\*,  Sanders, 2010 \*,  Sanders et al., 2009 \*\*,  Tabolli et al., 2009\*,  Thomson et al., 2006 \*\* | Cross-sectional | OHIP-G,  OHIP-14,  OIDP,  OHIP-J45, OHIPG-49 | Males better OHQoL |
| Bekes et al., 2009\*\*,  Kim et al., 2009\*, | Cross-sectional | OHIP-14,  OIDP | Males worse OHQoL |
| **Subjective socioeconomic status** | 1 | Sanders et al., 2006 (lower relative social status more one or more impacts fairly or very often) | Cross-sectional | OHIP | Low subjective SES worse OHQoL |
| **Sense of Coherence** | 2 | Emami et al., 2010 | Cross-sectional | OHIP-20 | No relationship found |
|  |  | Savolainen et al., 2005\*\*\* | Cross-sectional | OHIP | Low SOC worse OHQoL |
| **Social Support** | 3 | Brennan & Spencer, 2009 \*\*,  Hydecke et al., 2004\*\*\* (emotional support & intrumental support),  Sander & Spencer, 2005\* | Cross-sectional | OHIP-14 | Low social support worse OHQoL |
| **Perceived stress** | 3 | Locker & Allen, 2002,  Locker &Slade, 1994,  Sanders & Spencer, 2005 (p<0.001) | Cross-sectional | OHIP, OHIP-14 | High stress worse OHQoL |
| **Oral health beliefs** | 0 |  |  |  |  |

\*p≤0.05, \*\*p<0.01, \*\*\*p<0.001, \*\*\*\*p<0.0001

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Predictor** | **No of studies** | **Authors & Date** | **Study design** | **Measure** | **Result-Relationship between variable and OHQoL** |
| **Dental behaviour –Smoking** | 3 | Mcgrath & McGrath, 2002 \*\*,  Sanders 2010 \*\*\*\*,  Thomson et al., 2006 \*\*\*\* | Cross-sectional | OHIP-14, NHANES- OHIP | More smoking worse OHQoL |
| **Dental Behaviours-Dental visiting pattern** | 23 | Brennan et al., 2006\*\*,  Brennan et al., 2005\*,  Brennan et al., 2008\*,  Hunt et al., 1995\*,  Jones et al., 2004\*\*,  Sanders et al., 2009 \*\*\*, | Cross-sectional | OHIP-14,  OHIP-49 | Dental visit for emergency- worse OHQoL |
| Lawrence et al., 2008\*\*\*, | Cross-sectional | OHIP-14 | Dental visit for check- up-better OHQoL |
| Brennan et al., 2005,  Brennan et al., 2009,  Jensen et al., 2008,  Pereira et al., 2009,  Richman et al., 2007 | Cross-sectional | OHIP-14, OIDP | Time since last visit-No relationship found |
| Montero et al., 2008\*,  de Oliveira & Nadanovsky, 2005\*\*,  Pohjola et al., 2009\*\*\*,  Sanders et al., 2009 \*\*\*,  Walter et al., 2007\*,  Wandera et al., 2009 \*\*\* | Cross-sectional | OIDP, OHIP-14 | More time since last visit-worse OHQoL |
| **Dental Behaviours-Tooth brushing** | Brennan et al., 2009\*,  Brennan et al., 2008 \*\* | Cross-sectional | OHIP-14 | More tooth brushing frequency better OHQoL |

\*p≤0.05, \*\*p<0.01, \*\*\*p<0.001, \*\*\*\*p<0.0001

### Environmental Characteristics and Oral health

Characteristics of the environment may be characterised into social and physical ([Eyler *et al.*, 2002](#_ENREF_136)). Social characteristics are interpersonal or social factors such as family, friends, healthcare providers and socio-economic status ([McLeroy *et al.*, 1988](#_ENREF_290)). Physical characteristics are those settings such as the home, neighbourhood, and workplace ([Yen and Syme, 1999](#_ENREF_468)).

**Social determinants of health**

Some possible environmental characteristics relate to the social determinants of health described by WHO ([2005](#_ENREF_266)). The social determinants of health are defined as ‘the conditions of the environment, in which people are born, grow up, live, work and age, and the systems put in place to deal with illnesses’ and may be economic or physical ([Marmot, 2005](#_ENREF_266)). The quantity and quality of these material and social resources and the fairness of their allocation between population groups determines differences seen in the health between these groups. Thus, differences in health result from the fact that people live very different lives in their social context. This suggests that a reduction in health inequalities requires reduction in the material and social differences that people experience in their day-to-day lives. This review will first discuss existing evidence for the link between these social determinants and oral health. The review will focus on the social environmental characteristics rather than physical environmental characteristics. The social environmental characteristics; objective SES (comprising of education level, income and occupation) and social network identified from the systematic review will be discussed in detail.

#### Socioeconomic status (SES)

Individuals higher in the social hierarchy enjoy better health than those below them. The Whitehall studies ([Marmot *et al.*, 1991](#_ENREF_270)) in British civil servants revealed a gradient pattern between SES and health indicating that health improved and mortality decreased at each higher step of occupational grade. Since then the link between SES and health has been reported repeatedly and it has been stressed that action should be taken to reduce the social gradient in health by tackling the social determinants of health ([Marmot *et al.*, 2008](#_ENREF_267); [Marmot, 2010](#_ENREF_269)).

In simple terms SES reflects one’s social position ([Adler and Snibbe, 2003](#_ENREF_9)) and can be seen as an indicator of one’s resources and status ([Fujishiro *et al.*, 2010](#_ENREF_149)). Objective socioeconomic status may be indicated by income; social status measured by level of education and work status measured by occupational prestige ([Bartley, 2004](#_ENREF_35)). Although these three indicators overlap, they are distinct ([Adler and Snibbe, 2003](#_ENREF_9)) and quantify different things; for example education level reflects knowledge, credentials and social networks, income determines access to quality of housing, nutrition and health care and occupation reflects social standing or class ([Nakao and Treas, 1994](#_ENREF_306); [Macintyre, 1997](#_ENREF_262)). Typically, studies use either one, all three indicators or a composite indicator.

***Difference between Objective SES and Subjective SES***

Socioeconomic status can be divided into Objective SES, as indicated by occupation, income and education ([Saegert *et al.*, 2007](#_ENREF_367)) differs from subjective SES which is ‘the individual's perception of [his] own position in the social hierarchy’ ([Jackman and Jackman, 1973](#_ENREF_196)). For clarity within this research, objective SES will be considered as an environmental characteristic and subjective SES as an individual characteristic.

##### Objective SES, clinical status and oral health related behaviours

The SES-health gradient extends to numerous health problems, including heart disease ([Winkleby *et al.*, 1992](#_ENREF_466); [Damiani *et al.*, 2011](#_ENREF_105)), cancer, stroke, diabetes ([Connolly *et al.*, 2000](#_ENREF_93)), hypertension ([Everson *et al.*, 2002](#_ENREF_135)), infant mortality, arthritis, back ailments, mental illness, kidney diseases, and many others ([Gruttadauria *et al.*, 2011](#_ENREF_159)) including oral health.

The link between socioeconomic status and oral health is well established ([Watt and Sheiham, 1999](#_ENREF_448); [Locker, 2000](#_ENREF_245); [Sheiham *et al.*, 2011a](#_ENREF_389)). Disparities in oral health have been repeatedly demonstrated in both children and adults, using different markers of oral health, different indicators of objective socioeconomic position, and in different countries ([Watt and Sheiham, 1999](#_ENREF_448); [Locker, 2000](#_ENREF_245); [Thomson *et al.*, 2004](#_ENREF_425); [López *et al.*, 2006](#_ENREF_253); [Sanders *et al.*, 2006a](#_ENREF_371); [Sanders *et al.*, 2006b](#_ENREF_375); [Sabbah *et al.*, 2007](#_ENREF_365)).

Paulander and colleagues ([2003](#_ENREF_332)) in a random sample of 35, 50, 65 and 75 year-olds evaluated the association between oral disease and level of education, as an indicator of SES. They found lower education in all age groups was related to larger number of missing teeth, more attachment loss and fewer intact tooth surfaces. Further oral health related behaviours such as tooth cleaning and dietary habits did not differ between the low education and high education groups. Although education level was seen to be related to oral health, the role of confounders was not evaluated in the study, thus making the results less reliable. Sabbah and colleagues ([2009](#_ENREF_366)) found results similar to Paulander and colleagues ([2003](#_ENREF_332)). Low levels of education and income were found to be related to increased periodontal attachment loss, fewer intact occlusal surfaces and increased gingival bleeding. The education and income disparities in all clinical oral health indicators persisted even after adjusting for health-related behaviours. This indicates that health related behaviours partly explain the link between socioeconomic status and oral health. Contrary to previous study higher levels of education and income were associated with higher levels of health-enhancing behaviours such as less smoking, visiting the dentist frequently and eating fresh fruits and vegetables ([Sabbah *et al.*, 2009](#_ENREF_366)). That is, there were more unfavourable oral health related behaviours among poorer and less educated individuals, while health enhancing behaviours were more common among the more educated and more affluent. Again after adjusting for potential confounders, education and income still remained signiﬁcant determinants of health related behaviours. Australian Dental Statistics and Research Unit report on social determinants of oral health ([Tomarken and Waller, 2003](#_ENREF_427)) found that low income was associated with poor oral health status. Low-SES groups tend to have poorer oral health than those who were better off socioeconomically, particularly with respect to the prevalence of periodontitis and tooth loss ([Turrell *et al.*, 2007](#_ENREF_429); [Lawrence *et al.*, 2008](#_ENREF_228); [Nguyen *et al.*, 2010](#_ENREF_313)). A recent systematic review of socio-economic indicators and dental caries in adults provided evidence that socioeconomic indicators, such as subject’s schooling, income, occupation are associated with a greater severity of dental caries in adults ([Costa *et al.*, 2012](#_ENREF_96)).

##### Objective SES and OHQoL

The link between different markers of SES and OHQoL is inconsistent with mixed results. A review (Table 2.3.1) of studies investigating the relationship between educational attainment and OHQoL shows mixed results varying between studies showing no relationship ([Locker *et al.*, 1994](#_ENREF_252); [Srisilapanan *et al.*, 2001](#_ENREF_408); [Ikebe *et al.*, 2004](#_ENREF_192); [Klages *et al.*, 2005](#_ENREF_212); [Pires *et al.*, 2006](#_ENREF_343); [Hassel *et al.*, 2007](#_ENREF_167); [Brennan *et al.*, 2008](#_ENREF_56); [Lahti *et al.*, 2008](#_ENREF_223); [Acharya *et al.*, 2009a](#_ENREF_3); [Brennan and Spencer, 2009](#_ENREF_53); [Kim *et al.*, 2009](#_ENREF_209); [Pereira *et al.*, 2009](#_ENREF_336); [Pohjola *et al.*, 2009](#_ENREF_345); [Sousa *et al.*, 2009](#_ENREF_406); [Tabolli *et al.*, 2009](#_ENREF_417); [Emami *et al.*, 2010](#_ENREF_126)), to studies finding a direct relationship with high levels of education related to better OHQoL ([Kushnir *et al.*, 2004](#_ENREF_221); [Sanders *et al.*, 2004](#_ENREF_374); [Hassel *et al.*, 2006](#_ENREF_166); [Saub *et al.*, 2006](#_ENREF_377); [Marino *et al.*, 2008](#_ENREF_265); [Caglayan *et al.*, 2009](#_ENREF_65); [Gomes *et al.*, 2009](#_ENREF_154); [Tsakos *et al.*, 2009](#_ENREF_428); [Sanders, 2010](#_ENREF_369); [Papaioannou *et al.*, 2011](#_ENREF_327)).

Similar to educational status studies suggest that income was unrelated to OHQoL ([Srisilapanan *et al.*, 2001](#_ENREF_408); [Matear *et al.*, 2006](#_ENREF_276); [Richman *et al.*, 2007](#_ENREF_355); [Brennan *et al.*, 2008](#_ENREF_56); [Brennan and Spencer, 2009](#_ENREF_53); [Pereira *et al.*, 2009](#_ENREF_336); [Sousa *et al.*, 2009](#_ENREF_406); [Emami *et al.*, 2010](#_ENREF_126)). On the other hand studies have shown higher income to be associated with better OHQoL ([Locker *et al.*, 1994](#_ENREF_252); [Sanders *et al.*, 2004](#_ENREF_374); [Makhija *et al.*, 2006](#_ENREF_263); [Ikebe *et al.*, 2007](#_ENREF_191); [Guzeldemir *et al.*, 2009](#_ENREF_163); [Locker *et al.*, 2009](#_ENREF_250); [Sanders *et al.*, 2009](#_ENREF_370); [Brennan and Spencer, 2010](#_ENREF_54)).

The reason for such mixed results can be attributed to the use of different measures used to measure both objective SES and OHQoL. Many studies have been undertaken in different age groups and countries. Another explanation could be the different statistical techniques used in these studies to analyse results. Most of these studies report results based on the interaction of two variables not taking into account the complex relationships among the different variables within a model. In addition, many studies discussed above are cross-sectional and do not provide enough evidence for a causal relationship. For example, links between SES and oral health can be explained through psychosocial and behavioural pathways, which cross-sectional data cannot study over time. Thus a temporal sequence to these associations cannot be interpreted through these studies.

The studies supporting the association between objective SES and OHQoL support the materialist explanation of health inequalities. Further studies which do not support this association also compel us to think that other factors might be operating between objective SES and health and that this relationship might not be a simple one. The evidence from the oral health and general health literature suggests that an association exists between health and SES. In the next section the explanations of existence of such inequalities are given.

#### Explanations for inequalities in oral health

The main existing explanations for inequalities in health fall into three groups: - behavioural, material and psychosocial. These explanations are discussed below in relation to oral health.

##### Material explanations

The materialist perspective emphasizes the role of the external environment, which is beyond the individuals’ control. Material explanations consider access to tangible resources such as food, shelter, services and amenities that are less available to people from lower social groups. The lack of material resources is reflected in the poor income, dangerous working conditions, poor housing quality, poor food quality and other areas of daily life.

In relation to oral health, the materialist explanation impacts on the purchasing power for food ([Sisson, 2007](#_ENREF_399)). People from lower income groups tend to buy foods which are high in carbohydrates and sugar content which pose a risk for the development of caries ([Rugg-Gunn and Edgar, 1984](#_ENREF_362)) because they are cheaper than fruits and vegetables. Similarly the cost of dental treatment and cost incurred to access dental treatment can hinder people from low income groups to access care.

However, the explanatory power of the material explanations has often been questioned and it is argued that despite the increase in life expectancy as a result of better standards of living, inequalities still persist ([Wilkinson, 1992](#_ENREF_462); [Wilkinson, 1996](#_ENREF_463); [Richard, 1997](#_ENREF_352)). Hence, other explanations were suggested to give a clearer picture.

##### Behavioural and Cultural Explanations

The behavioural and cultural explanation argues that differences in norms and values make people from lower socio-economic status adopt risky behaviours. This explanation was first considered in the Black report ([2002](#_ENREF_393)). Thereafter studies have documented persistent differences between the social groups in relation to smoking, attending the dentist, diet and oral hygiene practices. The argument suggests that the lower a person’s income or social status the more likely they will be to engage in behaviours with health damaging consequences. Although behavioural and cultural explanations suggest risky behaviours to be the cause of health inequalities, they do not explain why such differences exist between social classes. To explain this variation, Bartley ([2004](#_ENREF_35)) suggested a sub model: within the cultural and behavioural model known as the ‘direct behavioural model’.

The direct behavioural model rests on the assumption that the people with lower income and status possess low levels of personality characteristics such as intelligence, coping styles, internal locus of control or sense of coherence ([Bosma *et al.*, 1999](#_ENREF_49)) that explain adverse health outcomes. Conversely, people with positive personality traits arrive in more socially advantaged position, possess better health and will be in more socially favoured circumstances ([Bartley, 2004](#_ENREF_35)).

However this model has not been extensively researched until recently in relation to medicine and oral health. Bernabé and colleagues ([2009](#_ENREF_41)) found high levels of sense of coherence (SOC) to be related to positive oral health behaviours independent of the SES but failed to provide evidence of a moderating role of SOC on the relationship between SES and oral health related behaviours. Similar findings were also suggested by Stronks and colleagues ([2013](#_ENREF_358)) who observed a role of psychological factors in determining health behaviours but found an even stronger role of material factors in the process. According to this study, although people developed risky behaviours such as smoking due to low levels of positive personality traits, it was more significantly attributable to material deprivation suggesting that behaviours are an intervening variable between SES and health.

The direct behaviour model is in essence part of the psychosocial explanation for health inequalities. The above discussion outlines the role of direct behaviour determined by psychological traits on health inequalities; however studies testing the relative importance of psychological and material factors suggest a stronger role for the latter in explaining health inequalities ([Rongen *et al.*, 2013](#_ENREF_358)).

An alternative hypothesis argues that the reason people with lower incomes take up smoking is not attributable to their low income as they are not hindered by low income to quit smoking ([Bartley, 2004](#_ENREF_35)). Here culture seems to play a role in determining uptake of risky behaviours. This theory suggests that behaviours are not freely chosen but are inﬂuenced by cultural norms of behaviour and hypothesized that these norms of behaviour differ between the social groups.

Research has examined the role of alcohol, tobacco consumption, diet, dental self-care (brushing with ﬂuoride toothpaste) and dental attendance in causing inequalities in oral health ([Makhija *et al.*, 2006](#_ENREF_263); [Sanders *et al.*, 2006b](#_ENREF_375)). These studies, using the behavioural explanation have formed the basis for behaviour change interventions such as the ‘five a day’ and the ‘brushing for life’ initiative. It has been well documented that such interventions aiming to change behaviour have failed to tackle inequalities and may increase the gap between the rich and the poor ([Petersen Pe. *et al.*, 2010](#_ENREF_341); [Sheiham *et al.*, 2011b](#_ENREF_390); [Watt, 2012](#_ENREF_451)). These behaviour change interventions fail due to the lack of appreciation of the wider determinants of health such as the psychological, social and environmental factors as emphasised within the bio-psychosocial model. Thus, an appreciation of the social context in which behaviour choices are made is necessary to understand behaviour choices made by individuals. Recent studies in oral health have shown a range of psychological factors, such as self-esteem ([Locker, 2009](#_ENREF_247)), locus of control ([Reisine and Litt, 1993](#_ENREF_349)), self-efficacy ([Buglar *et al.*, 2010](#_ENREF_60)) and sense of coherence ([Baker *et al.*, 2010](#_ENREF_29)) to be related to oral health and oral health behaviours. Also these factors might operate to explain the gradient between socioeconomic status and health which is discussed in detail in the later sections. Thus it is important not to only rely on behavioural explanations but to consider other perspectives also.

##### Psychosocial Explanations

Psychosocial perspective argues that health inequalities result from differences in the psychological traits and resources between socioeconomic groups. Individuals from lower socioeconomic backgrounds or living under relative socio-economic disadvantage are hypothesized to experience higher levels of psychosocial stress ([Marcenes and Sheiham, 1992](#_ENREF_264)), perceive lower levels of social support ([Gore, 1978](#_ENREF_156)), and have lower levels of sense of coherence ([Bernabé *et al.*, 2009](#_ENREF_41)) than individuals from higher socioeconomic groups.

There are two mechanisms through which psychosocial factors such as stress could inﬂuence health ([Elstad, 1998](#_ENREF_125)). First, the direct model postulates that stress leads to the development of ill health by triggering a speciﬁc chain of events which can lead to the development of speciﬁc diseases. The indirect model proposes that people experiencing higher levels of psychosocial stress are more likely to make behavioural or lifestyle choices that are damaging to health.

In relation to oral health it is seen that people with higher levels of stress have higher risk of developing diseases such as periodontitis ([Marcenes and Sheiham, 1992](#_ENREF_264)) and have been found to have poor oral health related behaviours such as self-care scores ([Sanders and Spencer, 2005b](#_ENREF_373)). Also diseases like dental caries can be caused by the indirect effects of psychosocial factors such as stress leads people to indulge in unhealthy eating habits leading to increased risk of dental caries ([Sisson, 2007](#_ENREF_399)).

##### Summary for explanations of health inequalities

There is evidence to support all three pathways explaining inequalities in oral health. Thomson and colleagues ([2004](#_ENREF_425)) found that adult oral health is predicted by not only childhood socioeconomic advantage or disadvantage, but also by oral health in childhood. They examined 789 members of a longitudinal cohort at age 5 and 26 years. Those who were of low socioeconomic status at age 5 years had substantially greater risk of caries and periodontal disease in adulthood. A similar pattern was found (when controlling for socioeconomic status) among those with high levels of caries at age 5 years and oral disease at age 26 years.

It has been suggested that impaired foetal nutrition can, not only lead to low birth weight, but also leave a child with an inbuilt vulnerability to disease in later life ([Graham, 2002](#_ENREF_158)). Burt and Pai ([2001](#_ENREF_63)) in a systematic review found no relationship between low birth weight and increased risk of caries. However Nicolau and colleagues ([2003](#_ENREF_314)) demonstrated that socioeconomic and biological risk factors in early life are signiﬁcantly related to dental caries experience at 13 years of age. None of the explanations for health inequalities are mutually exclusive; but may work together to produce inequalities both at the individual and population levels.

The *life course perspective* sees health at any given age as a result not only of current conditions but also the embodiment of prior living conditions from conception onwards ([Kawachi *et al.*, 2002](#_ENREF_203)). In relation to oral health this explanation is the most comprehensive in explaining the inequalities in oral health as it presents the interaction of materialist, behavioural and psychosocial factors over time. The life course perspective not only explains development of dental disease in individuals, but also accounts for the persistence of these inequalities over time in spite of improvements in living standards and knowledge about health and health promotion through the transmission of health beliefs, attitudes and behaviours between the generations.

Adams and colleagues ([2004](#_ENREF_6)) in a secondary analysis of data from Newcastle thousand families study (prospective cohort study) found socioeconomic position at different stages of life were associated with self-reported limiting long-standing illness in men. Men who were upwardly mobile were healthier than those they leave behind in stable manual circumstances, but less healthy than those they join in the non-manual classes who have experienced social stability, and vice versa. This suggests that people carry their experience of deprivation, or affluence, with them, in health terms, throughout their life consistent with the life course and the accumulative perspective of socioeconomic variations in health. Additionally, these results reflect the possibility of health outcomes to improve in lower SES groups if they are upwardly mobile in the workplace.

A recent study using the structural equation modelling techniques explored the reciprocal relationships between SES and health status and found that the causal path from SES to health is stronger than the reverse ([Mulatu and Schooler, 2002](#_ENREF_301)). This study also revealed that one third of the mediating mechanisms between SES were accounted for by health-related lifestyles/behaviours and psychosocial distress. However, the effect of SES on health was greater due to the differences in psychological distress when compared to the effects of health-related lifestyles/behaviours.

The CSDH (WHO, 2008) described health-care system to be an important social determinant of health, influenced by and influencing the effect of other social determinants of health. Access to and utilization of health care is vital to good and equitable health. Different health delivery systems also influence the socioeconomic variations in health outcomes. A study by Sanders and colleagues (2009) found that the coverage and generosity of welfare state benefits appeared to influence levels of inequality in population oral health quality of life. It is out of scope of this PhD to discuss this elaborately.

Thus, how SES influences health status is complex and poorly understood. Mostly SES is studied as an independent outcome variable not accounting for the role other variables might play in explaining the gradient between SES and health ([Adler *et al.*, 1994](#_ENREF_7)).

#### Models of inequality

The explanations for the health inequalities has translated into models that explain the ways several factors come together to contribute to health inequities. They depict how social determinants of health affect health outcomes. It is important to review the models of inequalities because these models explicitly show the linkages among different types of health determinants. One such model is by Brunner and Marmot.

#### Brunner and Marmot Model

Brunner and Marmot ([1999](#_ENREF_271)) presented (Figure 2.4.1) a model that described biological pathways within the social context, connecting clinical and public health perspectives on health. Social structures (top left of the diagram) via the three main explanations of health inequalities discussed earlier operate to influence well-being and health (bottom right). Material circumstances are related to health directly, and via the social and work environment. These in turn shape psychological factors and health-related behaviours. Early life experiences, cultural, and genetic factors also exert influences on health. Further, the balance of influences on health depends on geographical location and historical circumstances of the population in question. This also resonates with the life course explanation of health inequalities.

Determinants like psychosocial stress and social network used to explain health inequalities fit into the ‘psychological’ and ‘social environment’ sections of the model, respectively. The model also reflects that the psychological and social factors are influenced by the ‘social structure’ rather than existing in isolation.

Newton and Bower ([2005](#_ENREF_311)) applied this model (to oral health) for studying the complex interlinking causal pathways. They stress that the model locates risk factors for oral disease both at the societal and individual level, highlighting the importance of social processes rather than just individual behaviours.

The model is useful in oral epidemiology because it encourages research into pathways between social structure, social environment and oral health ([Newton and Bower, 2005](#_ENREF_311)). This is important because much current oral health research is largely restricted to explaining disease in terms of lifestyle practices and behaviours. There has been limited research looking at psychological and social pathways. However, research examining the pathways between psychosocial stress and periodontal disease ([Marcenes and Sheiham, 1992](#_ENREF_264)), sense of coherence ([Baker *et al.*, 2010](#_ENREF_29)) and oral health-related behaviours ([Thomson *et al.*, 2011](#_ENREF_426)) are examples of the growing interest in the role of psychosocial factors in oral health inequalities.

Material factors

Social Structure

Work

Social Environment

Psychological

Health Behaviours

Brain Neuro –Endocrine and Immune Response

Pathophysiological Changes

Organ Impairment

Well-Being

Mortality

Morbidity

Early Life

Genes

Culture

Figure 2.4.1 Brunner & Marmot Model

These models of inequalities are compatible with the Wilson and Cleary model which has been used to guide this research. Within the Wilson and Cleary model the mechanisms of how environmental characteristics such as SES effect oral health are rather vague. Also the environmental and individual characteristics within the Wilson and Cleary model have been boxed separately with no explanation of how the interaction between these characteristics might affect OHQoL. Thus, the model of inequalities such as the Brunner and Marmot model might help to explain this gap and will be used to theorise these unclear relationships within the Wilson and Cleary model.

#### Social network

A social network is a unit of social structure that includes persons or groups and ties of emotional support which connect the individuals or groups ([Cooke *et al.*, 1988](#_ENREF_94)). It is an environmental characteristic which quantifies the web of social relationships that surround an individual ([Fischer, 1982](#_ENREF_141)). Objective SES and social network are distinct concepts. Objective SES reflects the large-scale social, political, and economic structures and processes, whereas social network relates to the community and interpersonal level of social organization ([Milroy and Milroy, 1992](#_ENREF_297)).

##### Social Network, clinical status, oral health related behaviours and OHQoL

Petersen and Nortov ([1989](#_ENREF_340)) conducted a cross-sectional study in a sample of 216, 67 year olds in Denmark to test the association between social network and dental health. This study reported that people with low family networks, fewer friends and weak neighbour contacts had a higher and significant prevalence of dentures in both jaws, reported irregular dental visiting patterns and were observed to be edentulous. Hanson and colleagues ([1994](#_ENREF_164)), however, found in their study of middle aged men in Sweden that there was a insignificant association between the prevalence of dentures in both jaws and different aspects of their social network. Although they found that weak social network was significantly related to fewer functioning teeth and more anterior open spaces even after accounting for the effects of social class. The variation can be attributed to differences in the conduct of the studies, while the former ([Petersen and Nortov, 1989](#_ENREF_340)) used questionnaires the latter ([Hanson *et al.*, 1994](#_ENREF_164)) used clinical examination for measuring dental health status. The measures used for assessing social networks and dental health status in both studies are different and not well explained by Petersen and Nortov ([1989](#_ENREF_340)). Despite the differences both studies agree on the overall results that dental health problems are more frequent among people with weak social networks. Maupomé and Macentee ([1998](#_ENREF_282)) conducted a study similar to Hanson and colleagues ([1994](#_ENREF_164)) in Canada in 521 participants over 70 years of age using the same measure of social network. They found consistent results with the previous study in Sweden with more anterior open spaces being related to poor social networks and no association between complete dentures and social network.

A recent cross-sectional study (secondary analysis of a population survey) by Sabbah and colleagues([2011](#_ENREF_364)) in American older adults (60 years) showed that widowed and people with fewer friends (social network indicated by marital status and number of friends) had a higher extent of periodontal attachment loss. This finding is supported by a longitudinal study conducted in US in males aged 40-75 years which reported that having at least one friend and attending social religious meetings lowered the risk of developing chronic periodontitis ([Merchant *et al.*, 2003](#_ENREF_294)). Merchant and colleagues ([Merchant *et al.*, 2003](#_ENREF_294)) used marital status, number of close friends and relatives, frequency of contact with friends and relatives and, affiliations and participation in religious groups and community organizations as a measure of social network. Similar findings have been reported by Arcury and colleagues([2011](#_ENREF_21)) in the US found older adults over 60 years of age dwelling in rural areas who had greater social engagement (measured by frequency of participation in social activities in social clubs and churches) reported better self-rated oral health, had a greater number of retained teeth and fewer oral health problems. Similar to previous studies it was seen that low self-rated oral health and having fewer teeth was also related to smaller social networks indicated by number of children, friends and relatives and frequency of contacts with them both personal or by telephone.

All the studies reported above are cross-sectional except one ([Merchant *et al.*, 2003](#_ENREF_294)) and therefore they do not help to determine causality. Further most studies sampled older adults so the results cannot be generalised to younger people because older adults had different circumstances while growing up as compared to younger people who have more access and means of socialization today. Two ([Hanson *et al.*, 1994](#_ENREF_164); [Merchant *et al.*, 2003](#_ENREF_294)) studies were restricted to only males which again questions their generalisability. However, all the studies used large samples, mostly national surveys with sound sampling strategies, for example Arcury and colleagues([2011](#_ENREF_21)) used a stratified random sample of older adults. Overall, the design and sample size of these studies provide credibility to the associations found between social network and oral health. They yield consistent findings despite being conducted in different countries and settings. Thus, future research should explore the effects of social networks on oral health through longitudinal studies. Further, such studies are warranted due to the emphasis on the social determinants of health in tackling oral and general health inequalities ([Marmot, 2005](#_ENREF_266)). The causes of the health inequalities have been suggested to be social, thus, environmental factors such as the individual’s social network might prove to be an important health promotion avenue in future ([Marmot, 2005](#_ENREF_266)).

The systematic review (Table 2.3.1) found no study exploring the relationship between social network and OHQoL, hence only studies exploring relationships between social network and clinical status or oral health behaviours are reported above. Although the relationship between social network and oral health has not been widely researched until recently, a number of studies have reported such associations of social network with general health in the medical literature. The next section will provide evidence for the relationship between social network and health from the general health literature.

#### Social Network and General Health

Given the lack of evidence linking social network and oral health, a review of the general health literature revealed several studies that provided evidence for the effect of the components of the social network on mortality and morbidity. One such study is by Berkman and Syme ([1979](#_ENREF_40)) who conducted a longitudinal study in the US to explore the relationship between social network (measured by the number of contacts with family and friends, marital status, church memberships and other affiliations) and mortality in 30-69 year olds. All four measures of social network predicted mortality over 9 years with marital status and the number of contacts being the strongest predictors. They found an inverse relationship between the individual’s social network and, mortality and morbidity with higher or stronger social networks predicting lower rates of mortality and morbidity. The effects were significant even after controlling for SES and health related behaviours such as smoking, use of alcohol etc. Subsequent, other longitudinal studies in America ([House *et al.*, 1982](#_ENREF_184); [Schoenbach *et al.*, 1986](#_ENREF_384)) and Sweden ([Welin *et al.*, 1985](#_ENREF_453)) showed similar and consistent findings suggesting a significant role of social network in influencing health. Studies have implicated the role of social network on an individual’s mental health by reducing risk of depression among the elderly and boosting self-conﬁdence in people with a greater number of social ties ([Bondevik and Skogstad, 1998](#_ENREF_47)). Social networks have been associated with lower total mortality by reducing deaths from cardiovascular disease and prolonging the survival of men with established coronary heart disease ([Kawachi *et al.*, 1996](#_ENREF_202)). There is also evidence that poor social networks are associated with worse subjective health ([Howard, 1998](#_ENREF_186)).

Most of the general health studies provide evidence for the relationship between health and social networks. This evidence provides a further case for exploring the possibility of such a relationship in relation to oral health.

#### Summary of environmental characteristics

Objective SES and social network have been shown to be associated with oral health status, oral health related behaviours and OHQoL. But the literature is inconsistent and does not explain the mechanisms through which these environmental characteristics affect OHQoL. Most studies report the effect of SES on oral health as one interaction among the many others measured and do not use a theoretical framework to map the interactions that should be studied. Thus these studies only help to show that an association exists but not how it occurs. The literature also showed some methodological insufficiencies such as cross-sectional data. Thus, to confirm the relationships, longitudinal studies are needed. Simultaneous interactions of both individual and environmental characteristics need to be tested within the Wilson and Cleary model. Environmental characteristics (e.g. SES) and individual characteristics are implicated, but not tested in relation to oral health. Thus, studying the effect of SES on oral health in isolation will not provide any concrete answer to tackle the problem of health inequalities. All the explanations of inequalities in health have to be considered together. To achieve this we need strong theoretical mapping of all the explanations through a conceptual model. Hence, use of Wilson and Cleary model informed by the explanations in Brunner and Marmot might help to test such multiple factors and their relationships elucidating mechanisms which govern these relationships.

### Individual Characteristics and Oral Health

Ferrans and colleagues ([2005](#_ENREF_140)) categorized individual characteristics that may influence health outcomes into demographic, developmental, psychological, and biological factors. Individual factors are resources, attitudes and factors perceived differently by different individuals. The Wilson and Cleary model does not incorporate a life course perspective and so ignores developmental factors. As a result only demographic and psychological factors are reviewed here. Demographic factors include sex, age, marital status, and ethnicity.

The role of psychological factors is rather well documented in the medical literature. Psychological factors such as social support, perceived stress and personality traits such as sense of coherence have been implicated in the pathogenesis and expression of large number of diseases. Psychological factors are dynamic, modifiable, and responsive to interventions ([Ferrans *et al.*, 2005](#_ENREF_140)).

The next section will discuss the individual factors identified in the systematic review (Table 2.3.2).

#### Social Support

Within the systematic review (Table 2.3.2) self-perceived social support was an individual factor that might impact on oral health. Social support evolved out of the family stress literature ([Cooke *et al.*, 1988](#_ENREF_94)) as a potential key to the well-being of individuals, and particularly for those experiencing major life transitions and crises ([Caplan, 1974](#_ENREF_69); [Mccubbin and Boss, 1980](#_ENREF_286)). For example, a wife adjusting to her husband’s death, or a young adult involved in a long job search may use social support to cope with their stress. Therefore social support is implicated as an important resource which facilitates coping with crisis and adaptation to change ([Cobb, 1976](#_ENREF_77)). Social support begins *in utero* with maternal care and is then acquired from members of the family, friends, coworkers and the society as a whole. Research implicates a potential role of social support in devising effective preventive measures for several diseases and conditions ([Berkman, 1995](#_ENREF_37)).

As social support is an intuitive concept, its definition varies widely. In lay terms it is defined as ‘the resources provided by others’, "provided by other people and arises within the context of interpersonal relationships” ([Gottlieb, 1981, p.151](#_ENREF_157)) or as "support accessible to an individual through social ties to other individuals, groups, and the larger community" ([Lin *et al.*, 1979, p.109](#_ENREF_235)).

Cobb ([1976](#_ENREF_77)) provided a very specific definition of social support in three statements which together he called as ‘subjective sense of social support’. He stated social support to be the information leading the individuals’ to believe that they are cared for and loved, esteemed and valued and that they belong to a network of communication and mutual obligation.

House ([1981](#_ENREF_183)) offered a more explicit definition of social support along the same lines as Cobb ([1976](#_ENREF_77)) but outlined four broad types of social support:-

1. *Emotional*- providing empathy, caring, love, trust, esteem, concern, and listening

2. *Instrumental*- providing aid in kind, money, labour, time, or any direct help

3. *Informational*- providing advice, suggestions, directives, and information for use in coping with personal and environmental problems

4. *Appraisal*- providing affirmation, feedback, social comparison, and self-evaluation

The instrumental support proposed by House is not included in Cobb's definition, yet it is important to define the full scope of social support ([Cooke *et al.*, 1988](#_ENREF_94)). Both definitions are widely used. The categories within these definitions were tested and confirmed by Cooke and colleagues ([1988](#_ENREF_94)) in expectant mothers and first time parents. However this study added a new category of ‘Altruistic Support’ which refers to the information which leads you to believe that you are worthwhile because of what you have done with and for others.

Social support is multifaceted because it depends on the perceptions of the individual as it ‘is likely to be effective only to the extent it is perceived’ ([House, 1981](#_ENREF_183)). Therefore, it is important that a person must perceive social support to be available before it can be useful ([Bruhn and Philips, 1984](#_ENREF_58)).

Research suggests two mechanisms through which social support works;- first a direct role of promoting recovery from stress or crisis experiences and secondly, a protective role as a buffer against the effects of stress ([Mccubbin and Boss, 1980](#_ENREF_286); [House, 1981](#_ENREF_183)).

##### Distinction between social support and social network

Social support and social networks are related but distinct. Social network is described in structural terms, like size, range, density, proximity and homogeneity ([House *et al.*, 1988b](#_ENREF_185)) while social support refers to the qualitative aspects of the social network, the interactive process by which emotional, instrumental, or financial aid is obtained from one's social network ([Bowling, 1991](#_ENREF_51)). Social support in this study will refer to the subjective ratings of the adequacy of social contacts or networks. Callaghan and Morrissey ([1993](#_ENREF_66)) advocated the use of perceived support to measure social support with the help of reliable and valid measures and House ([1981](#_ENREF_183)) felt social support to be effective only to the extent it is perceived. Therefore perceived social support, being subjective in nature, is an individual characteristic and social network has been discussed as an environmental characteristic in this study.

##### Social Support, clinical status and oral health related behaviours

Evidence suggests that adequate social support can protect people in crisis from a wide variety of pathological states: from low birth weight to death, from arthritis through tuberculosis to depression, alcoholism, and other psychiatric illness ([Nuckolls *et al.*, 1972](#_ENREF_319); [Cobb, 1976](#_ENREF_77)). Furthermore, it is suggested that social support can reduce the amount of medication required, accelerate recovery and aid compliance with prescribed medical regimens ([Nuckolls *et al.*, 1972](#_ENREF_319); [Cobb, 1976](#_ENREF_77)). In medicine, high levels of perceived social support have been found to be related to better cardiovascular function ([Orth-Gomer *et al.*, 1993](#_ENREF_324); [Uchino, 2009](#_ENREF_432)), lesser chances of having stroke ([Ikeda *et al.*, 2008](#_ENREF_193)) and low levels of hypertension ([Lepore *et al.*, 1993](#_ENREF_231)). Some studies also implicate a role of social support in boosting the immune system ([Cruess *et al.*, 2000](#_ENREF_101); [Lutgendorf *et al.*, 2000](#_ENREF_260); [Dixon *et al.*, 2001](#_ENREF_118)), having positive effects on patient self-care and diabetes outcomes ([van Dam *et al.*, 2005](#_ENREF_436)) and better patient adherence to medical treatment ([DiMatteo, 2004](#_ENREF_116)).

In relation to oral health, social support research has been limited. Bernabe and colleagues ([2011](#_ENREF_42)) showed that adolescents who perceived higher levels of social support had lower caries experience and increment. However, support from a special person was more relevant for these adolescents than from family and peers. Similar findings were reported in adults by Brennan and Spencer ([2010](#_ENREF_54)) among 1859 Australians aged 30 years where higher levels of perceived social support were related to fewer decayed teeth. However, this association disappeared after adjusting for effects of visiting the dentist, tooth brushing, sex and income, whereas the study in adolescents reported the association independent of demographic characteristics and dental behaviours. This might be due to a low response rate (43%) reported in the latter study conducted in adults which can introduce non-response bias. A cross-sectional study in 251 females in Brazil reported that high levels of periodontal disease were predicted by low levels of emotional support in adulthood ([Nicolau *et al.*, 2007](#_ENREF_315)). However, American older adults (60 years) needing more emotional support did not demonstrate a greater prevalence of periodontitis or loss of periodontal attachment ([Sabbah *et al.*, 2011](#_ENREF_364)). These conflicting results can be due to the differences in composition of the populations used in both the studies. The first one used a sample of mothers and the latter one used a sample of older adults, thus reflecting the need of different kinds of support in different stages of life. Also suggests that the single item measure used in both the studies may be inadequate to tap the different aspects of social support due to its multidimensional nature. Another cross-sectional study in males in Sweden ([Hanson *et al.*, 1994](#_ENREF_164)) found low number of functioning teeth and anterior open tooth spaces to be associated with insufficient social support. However the prevalence of complete dentures and fixed bridges was not predicted by social support. Overall, the results implied that dental health problems are relatively more frequent among persons with weak social support ([Hanson *et al.*, 1994](#_ENREF_164)). Although the studies suggest an association between oral clinical status and social support, it needs further testing and verification because all the studies are cross-sectional, and a causal inference cannot be reached.

A cross-sectional study of 350 Brazilian low income parents found that availability of instrumental support was associated with determining utilization of dental services ([Baldani *et al.*, 2011](#_ENREF_31)). In Brazil children have free access to schools, which provide free health and dental care services. Despite this free provision the use of these services is low. The instrumental support as measured by child being enrolled in school or kindergarten increased the likelihood of the child having attended the dentist at least once even after adjusting for socioeconomic and demographic variables. On the other hand another cross-sectional study demonstrated that instrumental aid (information about dental care or presence of dental services) was not helpful in motivating the Latino mothers (15-44 years) to seek dental care for their children. By contrast when friends and family provided dental social support, by means of a combination of instrumental aid and influence (helping mothers to make appointments), material aid (helping them to get to their appointment), and/or emotional aid (accompanying mothers to their children's dental appointments) was strongly associated with use of dental services in children ([Nahouraii *et al.*, 2008](#_ENREF_305)). An RCT conducted in a small sample of 36 Chinese immigrant mothers demonstrated that inclusion of a component of social support in an oral health education programme improved mother infant bonding by directly affecting the levels of psychological distress and thus effecting the health overall ([Yuan and Freeman, 2011](#_ENREF_470)). Although this study did not measure the direct effect of social support on oral health, it does elucidate the possible role of social support in oral health interventions.

A recent cross-sectional study by Sabbah and colleagues([2011](#_ENREF_364)) in American older adults (60 years) measured social support and found that adults who needed more emotional help during the past year had higher prevalence of smoking and reported fewer dental visits. Brennan and Spencer ([2009](#_ENREF_53)) in a cross-sectional study with a sample of 1,859 participants aged around 30 years old in Australia found that low levels of social support was related to less frequent tooth brushing. The Australian Dental Statistics and Research Unit report on social determinants of oral health ([Tomarken and Waller, 2003](#_ENREF_427)) also suggested that as the availability of social support increased from low to high levels, dental visiting and dental self-care increased significantly.

##### Social Support and OHQoL

A cross-sectional study with sample of 1,859 participants aged around 30 years old in Australia found that low levels of social support were related to worse OHQoL ([Brennan and Spencer, 2009](#_ENREF_53)). This study measured social support with the multidimensional scale of perceived social support (MSPSS) and OHQoL with OHIP-14. A cross-sectional study of OHQoL in 249 fully edentulous patients with conventional dentures showed that emotional support (coping mechanism) in the form of receiving comfort and understanding from others significantly improved OHQoL scores. On the other hand instrumental support in the form of getting help and support from other people did not improve but rather worsened OHQoL in adults ([Heydecke *et al.*, 2004](#_ENREF_173)). However the above studies only report an association between OHQoL and social support rather than a causal relationship.

A recent longitudinal study in Brazil conducted in 1403 pregnant pre-partum and post-partum women compared the effects of different levels of social support on OHQoL ([Lamarca *et al.*, 2012](#_ENREF_224)). Two groups of women were compared, one with work-based social network and the others with home-based social networks. Women with home-based social networks reported low levels of social support (low and moderate levels of positive interactions) and worse OHQoL. These findings are restricted to a sample of pregnant women and cannot be generalized to other populations.

Evidence gathered from a wide range of studies both on oral health and general health suggest that social support may play an important role in maintaining health and mitigating the deleterious effects of environmental and social stress. Greater social support has been related to reductions in mortality rates and the incidence of both mental and physical illnesses. Social support has been seen to help in coping with pregnancy and improving immunological resistance. In relation to oral health the role of social support in helping people attain better oral health status, accessing dental care and achieving better OHQoL has been suggested. However due to the paucity of longitudinal studies in relation to oral health and complex nature of social support, which may occur in different ways, more comprehensive studies are required. Further most of the studies do not define the meaning and measure of social support clearly. The meanings and measures of social support and social network are often overlapped.

#### Sense of Coherence

The concept of Sense of Coherence (SOC) was put forward by Aaron Antonovsky in 1979 to explain why some people become ill under stress whereas others stay healthy. It arose from the Salutogenic theory, which emphasises seeking health rather than illness. The Salutogenic theory has two key elements, first, individual orientation towards problem solving and second, a capacity to use available resources.

Therefore SOC is defined as:

“*a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one’s internal and external environments in the course of living are structured, predictable and explicable (comprehensibility) (2) the resources are available to one to meet the demands posed by these stimuli (manageability) and (3) these demands are challenges, worthy of investment and engagement (meaningfulness)”* ([Antonovsky, 1987, p.19](#_ENREF_17))*.*

Comprehensibility is the cognitive process of how a person perceives the life challenges/events he is exposed to. Manageability is behavioural component that refers to the extent to which a person feels they can cope. Meaningfulness is a motivational component which provides an understanding of how much one feels that life makes sense, and challenges are worthy of commitment.

Antonovsky’s work focuses on one’s responses to stimuli and use of available resources to overcome these stressors. He called the resources as Generalized Resistance Resources (GRRs) consisting of biological, material and psychosocial factors. Examples of GRRs are money, knowledge, experience, self-esteem and healthy behaviours. With available resources people with high SOC tend to be more motivated, better understand what is needed and more capable of mobilizing cognitive, behavioural and motivational factors to cope with life and perceive life as consistent, structured and understandable. Therefore Eriksson and Lindstrom ([2006](#_ENREF_133)) suggest that SOC is not a personality trait but instead a global orientation. Antonovsky ([1987](#_ENREF_17)) suggested that SOC is developed throughout life and is tentative in childhood, more definite in adolescence and fully stable in third decade of life.

Antonovsky ([1979](#_ENREF_15)) believed that, in general, a person with a strong SOC is more likely to feel less stress and tension, and to believe that he or she can meet demands. He further suggested that the SOC concept interacts with a person’s natural coping style, upbringing, financial assets, and social support. That is, the extent to which these are available is a major determinant in the development of a strong or weak SOC. Further, this concept is applicable to health as Antonovsky conceptualized health within a stress-resource domain, where the availability of the resources predicts one’s movement towards health and health promoting behaviours. Thus, this explains why some people become ill under stress while others remain healthy. A recent systematic review on SOC ([Eriksson and Lindstrom, 2006](#_ENREF_133)) provided evidence that SOC is a major determinant of health. There is also a review of SOC and QoL by the same authors.

##### SOC, clinical status and oral health related behaviours

There has been research to test SOC in relation to its effects on oral health status, oral health related behaviours and OHQoL. There is an increase in the number of recently published studies exploring these relationships among children and adults. Freire and colleagues ([2001](#_ENREF_148)) examined the association between SOC, oral health status and oral health related behaviours in a cross-sectional study in Brazil with 664, 15 year olds. High SOC was associated with lower experience of caries in adolescents. However this association disappeared after adjusting for potential confounders. Caries experience was related to dental attendance, which in turn was associated with SOC. That is, adolescents with high SOC were more like to visit the dentist for mainly check-ups rather than when in trouble. Therefore, be SOC may influence dental attendance and dental attendance may influence dental caries. The lack of association between SOC and clinical status could be attributed to the young age of the group studied. Further cross-sectional design could not eliminate the effect of maternal care during childhood which would influence current health status, rather than adolescents own oral health-related behaviour and SOC. In a subsequent analysis of the same data, Freire and colleagues ([2002](#_ENREF_147)) mothers’ SOC was associated with their children's levels of dental caries, periodontal disease, and pattern of dental attendance. Thus, suggesting that mother-related factors may have a stronger influence on adolescents’ current oral health status than their own self-care or psychological status.

Conversely, Dorri and colleagues’ ([2010](#_ENREF_120)) cross-sectional study of sixth grade adolescents in Iran found stronger SOC to be related to higher frequencies of tooth brushing. These findings are consistent with an 18 month longitudinal study by Ayo-Yusuf and colleagues ([2009](#_ENREF_26)) in 1025 South African eight grade school children in which a higher sense of coherence was associated with twice daily tooth brushing. It was seen that adolescents with high SOC were living with their mothers and had formal housing. In the case of children these can be seen as the GRRs mentioned by Antonovsky ([1979](#_ENREF_15)) which help in the development of high SOC ([Ayo-Yusuf *et al.*, 2009](#_ENREF_26)).

A recent Finnish study in 15 year-olds also associated oral health related risk behaviours and SOC. Less smoking, less alcohol consumption and better social competence were all associated with a strong SOC in both girls and boys ([Mattila *et al.*, 2011](#_ENREF_281)). Although this study claimed that SOC can be used to identify adolescents with risk behaviours, it did not consider the role of parents, family or SES which play a central role in development of high or low SOC. Again due to its cross-sectional nature causation could not be confirmed. Overall, the studies with adolescents suggest a high SOC is associated with positive oral health behaviours. These studies also suggest that SOC might affect oral health status through oral health behaviours. The studies also point that in case of adolescents GRR’s such as maternal and family environment might help in the development of high or low SOC which determine oral health related behaviours and consequently affect oral health status.

In adults, a cross-sectional study in Finland found SOC to be related to both clinical status and subjective oral health. Individuals with strong SOC had more teeth, fewer decayed teeth, less periodontal pockets and good perceived oral health even after adjustment for confounders, such as demographic and socioeconomic factors ([Bernabé *et al.*, 2010](#_ENREF_43)). Lindmark and colleagues ([2011b](#_ENREF_238)) investigated Swedish adults aged 20-80 where higher SOC scores predicted fewer occurrences of a periodontal pockets ≥4 mm and a lower risk of plaque, thereby implicatinghigher SOC levels as protective against plaque and periodontitis. Although the above two studies give some evidence of the association between oral health status and SOC, they present some limitations. First, they are cross-sectional, and secondly, environmental and individual variables pertinent to oral health inequalities were not simultaneously tested. Because SOC is related to other psychosocial determinants of health ([Sullivan, 1993](#_ENREF_413); [Wolff and Ratner, 1999](#_ENREF_467); [Kivimaki *et al.*, 2002](#_ENREF_210); [Holmberg *et al.*, 2004](#_ENREF_177); [Konttinen *et al.*, 2008](#_ENREF_213)) and the latter are associated with oral health ([Sheiham and Nicolau, 2005](#_ENREF_391); [Sisson, 2007](#_ENREF_399)) the possibility that the association between SOC and oral health found in this study could be explained by confounding due to unmeasured factors cannot be excluded.

Other cross-sectional studies conducted in Finland in large nationally representative samples of 30-64 year old dentate adults showed that strong SOC was related to higher frequencies of tooth brushing ([Savolainen *et al.*, 2005b](#_ENREF_381); [Bernabé *et al.*, 2009](#_ENREF_41)), regular dental attendance ([Savolainen *et al.*, 2004](#_ENREF_378); [Bernabé *et al.*, 2009](#_ENREF_41)) and less intake of sugar products ([Bernabé *et al.*, 2009](#_ENREF_41)). The association between SOC and different oral health related behaviours remained even after controlling for SES and demographic factors ([Bernabé *et al.*, 2009](#_ENREF_41)). A recent Swedish study in 910 adults aged 20-80 years of age also supported the relationship between oral health related behaviours and SOC ([Lindmark *et al.*, 2011a](#_ENREF_237)). Again, high SOC was related to better dietary choices after adjusting for all the confounders. Individuals with a stronger SOC also had better knowledge of dental health and positive attitudes towards oral health.

All the studies of the relationship between SOC and oral health related behaviours have both strengths and limitations. Their strengths include large nationally representative samples of adults with excellent participation rates along with different oral health behaviours. Again a limitation is their cross-sectional design. Overall, consistent results across children and adults are compelling and suggest further research exploring the gaps in the current literature should be conducted.

##### SOC and OHQoL

According to the Wilson and Cleary model ([1995](#_ENREF_464)), individual characteristics such as SOC impact on OHQoL. However this relationship has not been tested widely in the context of oral health. In a large sample of 4039 Finnish adults aged 30-64 years, those who possessed a strong SOC had significantly fewer oral health related problems (as measured by OHIP-14) compared to those with a weak SOC ([Savolainen *et al.*, 2005a](#_ENREF_380)). SOC was related to all seven subscales of OHIP-14 although the association was higher with the psychological discomfort, psychological disability and handicap subscales. This association supports SOC as a psychological resource to modify a person’s subjective assessment of his or her oral health. This is further supported by the findings of a follow-up study by Savolainen and colleagues ([2009](#_ENREF_379)) reinforcing a relationship between strong SOC and subjective oral health in adults. A recent study testing the simultaneous effects of type of treatment and SOC on OHQoL in edentate adults aged over 65 years of age confirmed the previous findings that strong SOC was related to better OHQoL ([Emami *et al.*, 2010](#_ENREF_126)). Although the total OHIP scores and subscale scores except the functional limitation subscale were not significantly related to SOC, participants with a high SOC assigned lower scores to this subscale. Unlike the previous study ([Savolainen *et al.*, 2005a](#_ENREF_380)) where SOC was related to psychological domains, in edentate individuals wearing removable prostheses, the functional domain was the only aspect related to SOC. This can be attributed to the different needs of people at different stages of life and the particular difficulties of wearing a denture.

In a 6 month longitudinal study ([Baker *et al.*, 2010](#_ENREF_29)) in 439 Malay children aged 12-13 years a strong SOC was related to fewer symptoms, better functioning, greater health perceptions and a better QoL. These findings have been supported by recent experimental evidence in a RCT conducted in Thai school children ([Nammontri *et al.*, 2013](#_ENREF_309)) that tested a SOC intervention and found that it increased SOC and improved OHQoL. This is strong evidence that OHQoL can be influenced by SOC.

Eriksson and Lindstroms’ ([2006](#_ENREF_133)) systematic review on SOC and HRQoL found a strong SOC to be related to fewer symptoms and better self-rated health and HRQoL in both adults and children. Hence, it would be important to understand the relationship of SOC to OHQoL by means of a longitudinal study in adults. Also no study has so far identified SOC as a mediating factor between signs and symptoms, function and general health perceptions and overall QoL in adults.

#### Perceived Stress

Cox ([1978, p.25](#_ENREF_97)) defined stress as a ”perceptual phenomenon arising from a comparison between the demand on the person and his ability to cope”. Perceived stress is elicited when persons believe their demands exceed their ability to cope ([Lazarus and Folkman, 1984](#_ENREF_230)). Demands can either be things person may not be able to fulfill e.g. a given deadline for work or insufficient resources to meet one’s demands e.g. pay may not be enough to support oneself or one’s family. This definition was further elaborated by Cohen and colleagues ([1995, p. 3](#_ENREF_88)) who described stress as “*a process in which environmental demands tax or exceed the adaptive capacity of an organism, resulting in psychological and biological changes that may place person at risk for disease*”. This definition is very useful as it suggests that stress is an imbalance between internal (body conditions) or external (work) environment, reflecting that adaptive capacity of the organism varies from person to person leading to changes which put the individual at risk for disease. Thus stress is subjective and the experienced level of stress is a function of objective stressful events, coping processes and personality factors ([Cohen *et al.*, 1983](#_ENREF_86)).

Developing this theme, Cohen and colleagues ([1995](#_ENREF_88)) argued that stress has been generally studied from three perspectives. First, the environmental stress perspective which relates the stress to life events and omits subjective perception. Second, psychological stress emphasizes the subjective perception and evaluation of stress. Third, biological stress perspective focuses on the activation of the physiological systems responsive to the physical and psychological demands. When a confronting environmental demand presents, people appraise it according to the available coping resources, if perceived to be threatening an emotional response is evoked which leads to risk of onset of the disease. Therefore, biological is a manifestation of the other two. Perceived stress has been implicated to play a role in development of both systemic and oral diseases.

##### Perceived stress, clinical status and oral health related behaviours

Psychological stress is a risk factor for both physical and psychological disease including acute respiratory illnesses ([Cohen *et al.*, 1991](#_ENREF_90)), cardiovascular diseases ([Dimsdale, 2008](#_ENREF_117)), cancer ([Mundy-Bosse *et al.*, 2011](#_ENREF_302)) and many other diseases and conditions. It has been seen that people under stress tend to engage in poor health practices such as increased smoking, drinking alcohol and eating poorly which tend to be risk factors for physical illnesses ([Cohen and Williamson, 1988](#_ENREF_91)).

In relation to oral health perceived stress as a result of life events such as the death of a spouse was shown to increase the rate and development of dental caries ([Sutton, 1993](#_ENREF_416)) and periodontal disease ([Croucher *et al.*, 1997](#_ENREF_100); [Hugoson *et al.*, 2002](#_ENREF_189)). Marcenes and Sheiham ([1992](#_ENREF_264)) in a cross-sectional study of 164 male workers in Brazil aged 35-44 years showed high levels of perceived work stress were related to poor periodontal health which remained significant even after controlling for socio-economic status. It was also seen that workers with high levels of work-related mental demands were more likely to have teeth with bleeding gums and with pockets. Findings have also shown that levels of stress were higher in patients with rapidly progressive periodontitis as compared to groups with routine chronic adult periodontitis and those without significant periodontal destruction ([Monteiro da Silva *et al.*, 1996](#_ENREF_299)). Although the studies provide some evidence of an association between oral health status and stress, most of them have used measures of life events (environmental stress) to report the level. The life event scales such as the Holmes and Rahe scale does not consider the meaning or impact of an event for the individual ([Cohen *et al.*, 1983](#_ENREF_86)). Also these life event scales account for major life events and not the daily hassles a person encounters. Further, most of these studies have been conducted in male populations and have specifically tapped work related stress. Thus the findings of these studies cannot be generalised.

A longitudinal study in 16 matched pairs of medical students with those participating in a major academic examination and a control group without current academic stress reported that the examination group of students showed less thorough but similar frequency of oral hygiene. Thus the result of this study suggested that psychosocial stress may induce neglect of oral hygiene and increase of plaque accumulation ([Deinzer *et al.*, 2001](#_ENREF_107)). Another study conducted in war inflicted adults in Croatia suggested that adults exposed to any kind of war stress had a significantly worse periodontal status. War exposed individuals rarely brushed their teeth, visited the dentist and changed toothbrushes, but more frequently drank alcohol and smoked, in comparison to other groups, especially those who have not been exposed to war stress ([Spalj *et al.*, 2008](#_ENREF_407)).

It is evident from the above literature that currently there are limited number of existing studies exploring the relationship between stress and oral health status and related behaviours. Although these studies link perceived stress to oral health and behaviours, most are cross-sectional. Most have either explored the effect of work related stress, or stress in special circumstances such as war or exams. The stress perceived by people in normal daily life may not be so severe and so the results may not be generalisable.

##### Perceived Stress and OHQoL

Locker and colleagues ([2000](#_ENREF_249)) suggested that perceived stress lead people to view their oral health more negatively. Sanders and Spencer ([2005b](#_ENREF_373)) found that higher perceived stress in adults was associated with low self-rated oral health, even after adjusting for gender, age, income and missing teeth. Higher perceived stress was a significant predictor of poorer general health and oral health in ethno-racial groups in United States ([Watson *et al.*, 2008](#_ENREF_447)).

The search found only one study that explored the relationship between perceived stress and OHQoL. A large (n=3678) cross-sectional study of Australian adults aged 18-91 years found higher perceived stress scores was associated with higher OHIP-14 scores. Because the data were collected at one point in time, it is not possible to establish the temporal sequence of events and infer whether any of the relationships was aetiological.

Literature exploring the effect of perceived stress on oral health status, oral health related behaviours and OHQoL is limited. The current literature on perceived stress and oral health mostly limits itself to testing whether stress is causal and is restricted by its cross-sectional nature. Moreover, none of the studies prospectively take into account other relevant social pathways and factors which might mediate the effects of stress on oral health. One such factor is sense of coherence which has been implicated as a resource for tackling stress ([Antonovsky, 1979](#_ENREF_15)). Both adults and children with high sense of coherence experience lower levels of perceived stress, supporting its role as a stress modifier ([Eriksson and Lindstrom, 2006](#_ENREF_133); [Nielsen and Hansson, 2007](#_ENREF_316)). Therefore it would be useful to test simultaneous effects of such factors on oral health which will enable us to identify determinants of oral health and OHQoL. The association between oral health and perceived stress also provides evidence for the possible role of perceived stress in accounting for the disparities in oral health.

#### Subjective Socioeconomic Status

Subjective socio-economic status taps into people’s perceptions of how they rank in in relation to others. The specific underlying mechanism through which subjective SES influences health is unclear, although Singh-Manoux and colleagues ([2005](#_ENREF_398)) provided three hypotheses explaining how subjective SES might be a better predictor of health as compared to objective measures. First, they suggest that subjective SES is a more accurate measure of social position as it might take into account the past and perceived future prospects. This is supported by studies that have found subjective SES to give a clearer picture of an individual’s socio-cultural circumstances when compared to the objective indicators ([Ostrove *et al.*, 2000](#_ENREF_325); [Singh-Manoux *et al.*, 2003](#_ENREF_397); [Singh-Manoux *et al.*, 2005](#_ENREF_398); [Franzini and Fernandez-Esquer, 2006](#_ENREF_146); [Demakakos *et al.*, 2008](#_ENREF_109)). Some authors have suggested subjective SES is a multidimensional concept and thus provides a better synthesis of the different elements of SES at the individual level ([Borg and Kristensen, 2000](#_ENREF_48)). For example, objective indicators such as the level of education may provide the same ratings for two individuals with the same level of education but those possessing degrees from more prestigious universities might rate their subjective status more highly. This hypothesis very closely follows the theory of social causation in which social structure influences health outcomes.

A second hypothesis is that subjective SES is important because it assesses a relative position in the social hierarchy rather than absolute one. The concept of relative position in society better explains the SES and health gradient Wilkinson ([1996](#_ENREF_463)). The association between health and subjective SES is mediated through perceptions of place in the social hierarchy. Such perceptions may produce negative emotions that translate into direct effects on the physiological processes and the neuroanatomical structures, leading to an increase in biological vulnerability to disease. They also act indirectly through the adoption of unhealthy behaviours ([Wilkinson, 1992](#_ENREF_462)).

The third hypothesis suggests that the association between subjective SES and health could be spurious. They argued that an individual’s assessment of their own SES is mediated by other factors such as their health status or that these subjective ratings are affected by a response bias or other individual/personality variables, such as self-esteem. However studies testing the test-retest reliability and predictive utility of subjective SES in large, multi-ethnic national samples both in the UK and the US have showed that this measure consistently presents adequate test–retest reliability, and is associated with self-reported health even after controlling for traditional measures of SES ([Operario *et al.*, 2004](#_ENREF_323); [Singh-Manoux *et al.*, 2005](#_ENREF_398)). Based on the results of these studies the argument for response bias can be ruled out. Although the effect of psychosocial variables on the causal link between SES and health needs further testing ([Singh-Manoux *et al.*, 2005](#_ENREF_398)).

##### Subjective SES, clinical status, oral health related behaviours and OHQoL

Evidence on subjective SES as a correlate of oral health is scarce. The systematic review found only one study of subjective SES in relation to oral health ([Sanders *et al.*, 2006a](#_ENREF_371)). The study conducted among 2,915 Australian adults aged 43–57 years reported that people with lower subjective SES (as measured using the MacArthur Scale of Subjective Social Status) had < 24 teeth, rated their oral heath as poor or fair and were less satisfied with their ability to chew. Lower levels of subjective SES were also related to worse OHQoL. Thus an increase in the prevalence of oral conditions was seen to be related to a decrease in the subjective SES. This relationship existed even after adjusting age, sex, country of birth, smoking, alcohol use, body mass index, frequency of tooth brushing and interdental cleaning. Although this study provided evidence for the potential association between subjective SES and oral health, it does not clearly indicate a causal relationship. Thus, a longitudinal study is needed to test this relationship further.

##### Subjective SES and General Health

Given the lack of evidence linking subjective SES and oral health, a review of the general health literature reveals several studies across different populations in which higher subjective SES is associated with better health. Moreover, these relations generally remained after controlling for objective indicators of SES ([Ostrove *et al.*, 2000](#_ENREF_325); [Singh-Manoux *et al.*, 2003](#_ENREF_397); [Singh-Manoux *et al.*, 2005](#_ENREF_398); [Franzini and Fernandez-Esquer, 2006](#_ENREF_146); [Demakakos *et al.*, 2008](#_ENREF_109)). A cross-sectional study in 991 Taiwanese elders found low subjective SES (using McArthur’s scale of subjective social status) to be associated with poorer self-rated health and more physical activity difficulties measured by IADL (Instrumental Activity of Daily Living), even after adjustment for objective SES ([Hu *et al.*, 2005](#_ENREF_187)). Another study in adults over 52 years (part of the English Longitudinal Study of Ageing), with 3368 men and 4065 women showed that outcome measures such as self-rated health, long-standing illness, depression, hypertension, diabetes, central obesity, high-density lipoprotein cholesterol, triglycerides, fibrinogen, and C-reactive protein to be related to subjective SES. Likewise, among Mexican-origin individuals living in low-income neighbourhoods in Texas subjective SES was associated with all health outcomes after controlling for objective SES ([Franzini and Fernandez-Esquer, 2006](#_ENREF_146)). This association of subjective SES with mental health and self-reported health was further supported by Singh-Manoux and colleagues ([2005](#_ENREF_398)).

Another study comparing objective and subjective socioeconomic status with psychological and physical variables among 157 healthy white women revealed that subjective SES was more consistently and strongly related to psychological functioning and health-related factors such as self-rated health, heart rate, sleep latency, body fat distribution, and cortisol habituation to repeated stress ([Adler *et al.*, 2000](#_ENREF_8)). Again as seen in the previous studies most of the associations remained significant even after controlling for objective SES.

A longitudinal study by Cohenand colleagues ([2008](#_ENREF_89) ) showed that higher subjective SES was prospectively associated with lesser susceptibility to upper respiratory tract infections. The study sample consisted of 193 healthy men and women aged 21-55 years and the effect of subjective SES was independent of objective SES.

Most of the studies on subjective SES and health are cross-sectional, thus the association that higher subjective SES contributes to better health should be interpreted with caution. However the results of these studies do suggest a consistent role of psychological perceptions of social status in contributing to the SES-health gradient ([Singh-Manoux *et al.*, 2005](#_ENREF_398)) and suggest that this may be of importance for oral health too.

#### Oral Health Beliefs

Beliefs are a powerful personal resource influencing a person’s life at any period of time, to enable them to produce results by their actions and to negotiate their lives through various cycles ([Bandura, 2006](#_ENREF_33)). Beliefs play an important role both in determining how people behave and deciding what they perceive and place confidence in. Thus oral health beliefs operate through their impact on cognitive, motivational, affective and decisional processes contributing to good health ([Bandura, 2006](#_ENREF_33)). According to Rosenstock ([1966](#_ENREF_359)), oral health beliefs are related to oral health behaviours. Similarly, Helman ([1990](#_ENREF_169)) also suggested that perceptions and ideas about oral health and illness underpin oral health related behaviours in individuals. However, understanding of the relationship is complex.

##### Oral health beliefs, clinical status and oral health related behaviours

A cross-sectional study with 708 wives of American white families to study health beliefs related to preventive dental behaviours classified health beliefs (Chen and Tatsuoka ([1984](#_ENREF_72)). They are: (1) **Perception of susceptibility**-the belief that a dental disease can happen to the individual; (2) **Severity**-the perception that the disease would have serious consequences; (3) **Salience**-the belief that doing something about the disease is more important than doing other things; (4) **Benefits**-the belief that the action will be of benefit for either preventing or alleviating the seriousness of the disease; (5) **Barriers**-the perception that the action will cause inconvenience or entail high cost; and (6) **General Motivation**-the extent of interest in and concern about health matters. Variables measured in the study were health beliefs (based on the categories mentioned above), preventive behaviours such as tooth brushing, dental flossing and dental visits, and socio-economic variables. Based on the results of the study the perceptions of salience and barriers were the strongest predictors of preventive behaviour, second strongest predictors were the benefits, while susceptibility and severity were the weakest predictors, general motivation did not show any relationship. The authors of this study defined perception of salience ‘as the time spent in talking about the condition of the health of the teeth, the worthwhileness of money spent for dental care, the importance of dental problems compared with other health problems and the priority of visiting the dentist when one is busy. Barriers signify the perceived financial difficulty caused by the high cost of dental care, the anxiety over pain and the unavailability of the dentist. The positive relationship between perception of salience and barriers is consistent with the previous studies ([Antonovsky and Kats, 1970](#_ENREF_19); [Shuval, 1971](#_ENREF_394)) which used the same definitions of the terms as in this study. However, studies by Kegeles ([1963a](#_ENREF_204); [1963b](#_ENREF_205)) did not show any relationship with salience although found strong associations with barriers as with the previous studies. The differences in the results found in the above studies might be due to variation in the definitions of the terms such as salience. The above studies have some limitations such as some were conducted either solely in woman ([Chen and Tatsuoka, 1984](#_ENREF_72)) or males ([Kegeles, 1963a](#_ENREF_204); [Kegeles, 1963b](#_ENREF_205)) samples while some samples in the studies had access to free dental care ([Kegeles, 1963a](#_ENREF_204); [Kegeles, 1963b](#_ENREF_205); [Antonovsky and Kats, 1970](#_ENREF_19)) when compared to others. Further from the results of these studies we cannot derive at a causal inference as all the studies are cross-sectional.

Nakazono and colleagues ([1997](#_ENREF_307)) derived the 18-item Oral Health Belief questionnaire based on data from the International Collaborative Study of Oral Health Outcomes (ICS-II) conducted in the US adults. They categorised 18 items into five oral health belief sub-scales corresponding to the Health Belief Model ([Rosenstock, 1966](#_ENREF_359))which are perceived seriousness, benefit of preventive practices, motivation, perceived importance and efficacy of the dentist. The components of these five subscales are similar to the dental health beliefs explored in the previous mentioned studies. The perceived seriousness and importance subscales (similar to susceptibility and severity) showed moderate correlation as was seen in the Chen and Tatsuoka’s study ([1984](#_ENREF_72)) where both were seen to be the weak predictors of preventive dental behaviour. The correlations among other subscales were not reported in the paper.

##### Oral health beliefs and OHQoL

Research on oral health beliefs is mostly focussed on exploring the health beliefs of the communities as a predictor of a behaviour and/or access to dental care ([Kwan and Holmes, 1999](#_ENREF_222); [Kelly *et al.*, 2005](#_ENREF_206); [Scambler *et al.*, 2010](#_ENREF_382)) rather than using it as a predictor of OHQoL. Broadbent and colleagues ([2006](#_ENREF_57)) in their study explored the stability of the oral health beliefs in a sample of 742 young adults at ages 15, 18 and 26 years and found that young adults who held unfavourable dental health beliefs had poorer oral health. It was reported that most of the unfavourable dental beliefs were in relation to the benefit of preventive practices (a subscale described by Nakazono and colleagues, 1997) such as use of fluoridated water or avoidance of sweet foods. This finding is supported by a recent longitudinal study in 12-13 year old Malay children which showed more positive oral health beliefs predicted better OHQoL ([Baker *et al.*, 2010](#_ENREF_29)). Only the above two studies both in children were found which tested the relationship between oral health beliefs and OHQoL. In future studies, whether oral health beliefs are related to OHQoL in adults or not should be tested because an understanding of relevant health belief systems is crucial in developing group/individual sensitive health interventions programmes.

#### Dental Behaviours and OHQoL

Dental behaviours such as dental self-care, dental visiting patterns and tobacco chewing habits have been shown to be related to OHQoL.Australian Dental Statistics and Research Unit report on social determinants of oral health ([Tomarken and Waller, 2003](#_ENREF_427)) found low dental visiting and self-care scores were associated with worse OHQoL. McGrath and Bedi ([2001](#_ENREF_285)) in a qualitative study in UK adults found a positive impact of regular dental attendance on people’s perception of their OHQoL. The study also suggested that those adults who were irregular attenders or just attended the dentist when having problem had poorer OHQoL as compared to their counterparts. A recent prospective study by Thomsonand colleagues ([2011](#_ENREF_426)) with 932 participants in New Zealand investigated the effect of routine dental attendance over time on the experience of caries, missing teeth and self-rated oral health. The data on dental attendance were collected at ages 15, 18, 26, and 32. The main finding of this study was that routine dental attendance predicted better oral health outcomes. By the age of 32 the routine attenders had better self-reported oral health and less tooth loss and caries. This finding persisted after controlling for gender and socio-economic status. The results of this study are consistent with a previous cohort study by Thomson and colleagues ([2004](#_ENREF_425)) in New Zealand in young adults where the problem-oriented attenders were three times more likely to experience caries-associated tooth loss over an eight-year period. Both the studies provide evidence for an association between dental attendance and oral health using both clinical and self-reported measures, but they do not use a measure of OHQoL to test the relation between dental attendance and OHQoL.

Savolainen and colleagues ([2005a](#_ENREF_380)) found in a large sample consisting of 4039 Finnish adults aged 30-64 years old that those who had higher impacts (measured by OHIP-14) signifying worse OHQoL had irregular dental attendance. However a recent 12 month follow-up study in Australia testing whether routine dental attendance improved OHQoL in adults found no significant association between OHIP scores and dental attendance. However it found that dental attendance was associated with a greater improvement in OHQoL when influenced by a person’s residential location ([Crocombe *et al.*, 2011](#_ENREF_98)). The results of this longitudinal study suggest that pattern of dental attendance might be influenced by the area which further determines the availability of services in a particular location and dental behaviours of people living in that area. The finding highlights the issue of health inequalities existing in different areas.

Savolainen and colleagues ([2005a](#_ENREF_380)) found in a large sample consisting of 4039 Finnish adults aged 30-64 years old that those who had higher impacts (measured by OHIP-14) signifying worse OHQoL, brushed their teeth less frequently. Similarly, Brennan and Spencer (2009) in a cross-sectional study with sample of 1,859 participants aged around 30 years old in Australia found that higher tooth brushing frequency was related to lower OHIP-14 scores and thus better OHQoL. However both these studies have limitations that they are cross-sectional and do not provide enough evidence to suggest a causal relationship. In a national cross-sectional cohort of 87,134 Thai adults aged between 15 and 87 years it was reported that smokers had worse OHQoL ([Yiengprugsawan *et al.*, 2011](#_ENREF_469)).

The studies discussed above relate and suggest that different dental behaviours like tooth brushing, visiting the dentist and smoking are all related to OHQoL. The strengths of the studies include use of large nationally representative samples with a wide age range which provide some evidence for possible association between dental behaviours and OHQoL. Consistent results have been obtained from different countries for this association. However, most of these studies are cross-sectional and do not provide evidence for a causal relationship between the two. Moreover, these studies test different variables and interactions among them in isolation not taking into account complex inter-relationships. Although these studies do provide evidence for the association no conclusion can be drawn.

The association between dental behaviours and disparities in OHQoL provides a behavioural explanation for oral health inequalities. However, it has been suggested that behaviours alone cannot account for such inequalities as they are acquired and influenced by wider determinants such as psychological, social and environmental factors ([Watt, 2007](#_ENREF_450)). Therefore a prospective study testing the association between dental behaviours and OHQoL taking into account effects of other possible factors using advanced statistical techniques is needed.

#### Summary of individual characteristics

The detailed review of individual characteristics identified from within the systematic review (Table 2.3.2) suggests several are related to oral health. Sense of coherence, perceived stress, social support, subjective SES, dental behaviours and oral health beliefs have all been associated to oral health status, oral health related behaviours and OHQoL. This suggests that such psychological resources impact oral health, but the pathways through which such actions occur are not investigated in these studies. This is due to the failure to adopt a theoretical model. Thus, simultaneous effects of environmental characteristics and individual characterises in relation to oral health are under-explored.

#### Interaction of Individual and Environmental characteristics

Within the Wilson and Cleary model, it is unclear how the individual and environmental characteristics interact, because both the characteristics are boxed as separate and no pathway is specified to show interactions. Several studies suggest that SES effects oral health via several possible plausible pathways including behaviours, differential availability and use of health services, the cumulative adverse effects of chronic stress, and the inability to meet chronic stress with resources that may help to diffuse its psychological and biological impact ([Taylor *et al.*, 1997](#_ENREF_420)).

##### Role of health related behaviours in SES and health relationship

A number of studies have suggested that lower SES individuals are more likely to adopt health damaging behaviours such as smoking, eating unhealthy foods, consuming alcohol ([Lynch *et al.*, 1997](#_ENREF_261); [Pomerleau *et al.*, 1997](#_ENREF_346); [Everson *et al.*, 2002](#_ENREF_135); [Hanson and Chen, 2007](#_ENREF_165)). It has also been suggested that people from low SES are less likely to embrace preventive health behaviours ([Coburn and Pope, 1974](#_ENREF_78)). A longitudinal study in US in a nationally representative sample of 3617 adults with both men and women showed that lower levels of SES (measured by education level and income) were associated with significantly higher prevalence of health risk behaviours such as smoking, sedentary lifestyles and unhealthy diets ([Mulatu and Schooler, 2002](#_ENREF_301)).

##### Role of stress in SES and health relationship

A possible mechanism for the health-modulating effects of SES is in its relationship with chronic stress. It is suggested that chronic stress experienced by people is highly influenced by the environment in which one lives. This stress is experienced at four levels, work level (satisfaction with job), community level (e.g quality of neighbourhoods), family level (lack/availability of emotional support and care) and at the level of friends ([Taylor *et al.*, 1997](#_ENREF_420)). People in low job profiles with low incomes are likely to live in areas which have limited facilities and have higher hazards such as more noise, pollution, crime which tends to put such people under chronic stress. Chronic stress is further implicated to effect health outcomes with higher levels of stress predicting poor health ([Cohen and Williamson, 1988](#_ENREF_91)). Thus it can be interpreted that as one’s environment worsens, stress increases and health becomes poor. At the family level, lack of cohesiveness, emotional support and warmth in the relationship between the parent and child have health damaging effects on the child. Children from families with financial constraints tend to experience more stress, report more symptoms and adopt risky and unhealthy health behaviours ([Mechanic and Hansell, 1989](#_ENREF_292); [Bradley and Corwyn, 2002](#_ENREF_52)). Similar effects can be seen with respect to peer influence where stress can be perceived as a result of rejection and conflicts with fellow peers, who can also influence adoption of risky behaviours. Work related stress due to events such as unemployment and job changes led to increased physiological strains as measured by increased serum epinephrine levels and increased illness diagnosis ([Kasl and French, 1962](#_ENREF_201); [Cobb, 1974](#_ENREF_76)).

##### Role of psychosocial resources in SES and health relationship

Psychosocial resources, which include optimism, coping style, a sense of mastery or personal control, sense of coherence and social support, influence the relationship between SES and health ([Taylor and Seeman, 1999](#_ENREF_421)). Cohen and colleagues ([1999](#_ENREF_87)) in separate analyses of the American and Finnish samples demonstrated that positive psychological factors (greater social support; less anger, depression, and perceived stress) and beneficial health practices (non-smoking; drinking and exercising moderately) were associated with both higher levels of SES and better self-reported health. In a large sample of 4,263, 30 to 64 year-old dentate adults, people with high or middle level of education were found to have greater SOC which was associated with more regular pattern of dental attendance ([Savolainen *et al.*, 2004](#_ENREF_378)). Similarly mothers with high SOC from low-socioeconomic status were seen to manage their lives better and also take their child to dental services more frequently for dental check-ups ([Silva *et al.*, 2011](#_ENREF_395)). However a previous study in adults provided limited support for the moderating role of SOC on the relationship between SES and oral health-related behaviours ([Bernabé *et al.*, 2009](#_ENREF_41)). Similarly studies have shown that people from low SES tend to be affected by more social conflicts (arguments, hostility) in their social relationships ([Schuster *et al.*, 1990](#_ENREF_385)), have higher social (residential crowding, high levels of crime) stressors in their environment and thus perceive lower levels of social support ([Evans *et al.*, 1989](#_ENREF_134); [Lepore *et al.*, 1991](#_ENREF_232)). Low levels of social support are related to higher stress levels and poor health outcomes ([Cobb, 1976](#_ENREF_77)). Psychosocial resources thus seem to influence the appraisal of events whether they are stressful or not and thus modify the behavioural, physiological, and neuroendocrine responses to stress. Thus, psychosocial resources seems to be an important mechanism in determining the SES and health gradient.

#### Summary of environmental and individual characteristics

The literature review (Table 2.3.1 and 2.3.2) suggests that OHQoL is influenced by multiple factors, these factors together are known as the determinants of health which are known to cause health inequalities ([Marmot, 2005](#_ENREF_266)). These health determinants include genetic susceptibility, physical environment, personal lifestyles and behaviours, psychosocial resources and, social, cultural and economic factors. Although all the studies reviewed acknowledge that OHQoL is governed and determined by several factors but how these factors operate and interact is not clear. A key challenge is the lack of use of theories and accompanying conceptual models which guide how multiple factors might be operating at different levels, which might help to derive the chains of causal inference ([Krieger, 2001](#_ENREF_219); [Diez Roux, 2004](#_ENREF_115)). Another problem revealed within the literature review is that most of the studies only investigate the associations between a factor and oral health, after adjustment for multiple additional factors. However, the chains of causation and the different levels at which factors operate are often ignored. Krieger ([1994](#_ENREF_218)) argues that this approach tends to favour more the downstream factors (oral health related behaviours) and tends to ignore upstream factors (socio-economic status). Thus, more studies are needed which take into account the role of multiple factors (e.g., biological, individual, and environmental) in shaping health outcomes, as well as dynamic interactions within and between these factors.

Consequently, in order to understand the determinants of OHQoL it is very important to use theory which helps us to structure our ideas, to explain causal connections between potential factors such as environmental characteristics and outcomes such as OHQoL. The use of models like Wilson and Cleary model along with Brunner and Marmot model will help us to answer questions like who and what is responsible for population patterns of oral health, oral disease, and well-being. Thus, these models will bring all the explanations of health inequalities (materialist, behavioral and psychosocial) together, which will assist in studying the necessary inter-relationships within and among the potential variables. The identification of the potential pathways through which determinants of health affect OHQoL will help to streamline evidence based oral health promotion strategies.Therefore, the purpose of this study was to identify factors which influence OHQoL of adults.

### Aim

The aim of this research is to identify clinical and psychosocial determinants of oral health related quality of life in adults.

### Objectives

* To recruit a cohort of adults
* To collect data over time on clinical variables, symptom status, functional status, general health perceptions, individual and environmental characteristics and overall wellbeing within the Wilson and Cleary model
* To examine the longitudinal relationships within the data to identify determinants of OHQoL

## MATERIALS AND METHODS

### Overview

Prospective longitudinal clinical examination and self-report questionnaire study.

### Selection of Populations

* The target population was adults, 18 years and over in India
* The accessible population was employees aged 18 years and above working in Friends Auto Ltd in Faridabad, India (Friends Auto Ltd. is located in the industrial town of Faridabad in North India on outskirts of the national capital of New Delhi. It is one of the largest manufacturers of automobile leaf springs in India. There are two units in the company consisting of 700 employees each, with approximately 95% of them being male).
* The intended sample was adult employees working in the unit-I of Friends Auto Ltd, who provided written consent and could complete the questionnaires.

### Exclusion criteria

* Employees declining to take part.

### Recruitment

Employees who met the inclusion criteria were identified at the work premises. A few days before the first session, with the help of company management, a notice was circulated among the employees about the study. The researcher (EG) obtained a list of all employees from the human resource department, visited the premises, informed the employees about the study in groups of 10-20 people and gave them information sheets and consent forms to read and take away. Employees willing to take part were requested to put the completed consent forms in a box provided at the reception of the company. A list was made by the researcher (EG) of the employees willing to take part. According to the list two employees were called at a time to the first session where the researcher (EG) conducted clinical examination and administered the questionnaires. All the participants were assured that participation was voluntary and they could withdraw at any time.

#### Inducements

As an acknowledgement of their participation each participant was given a ticket for a prize draw at both data collection stages. At the first time point a television was awarded and at the follow-up a refrigerator was given as the prize.

### Sampling

Bakerand colleagues([2010](#_ENREF_29)) found a correlation of 0.32 between SOC & OHQoL as measured by CPQ11-14 in Malay children. Using this effect size and accounting for 15 independent variables a final sample size of 100 people would yield a 98% power to detect a difference as significant for a threshold for P at 0.05.

However, this study was conducted in adults, using a different measure of OHQoL and did not account for loss to follow-up. Assuming an appreciable number of employees would decline to take part, others would be lost to follow-up and that the relationships may not be so strong, it was decided to invite the entire workforce of 700 people to participate with an intended sample of 500 people. Samples of this size were used by Bakerand colleagues ([2010](#_ENREF_29)) and, Gururatana and colleagues ([2011](#_ENREF_160)) in children.

### Permission and Liaison

The study was approved by:

* Ethical review process, University of Sheffield
* Friends Auto Ltd., Faridabad, India (Approval letter, see Appendix A)
* Staff taking part in the study

### 

### Variables

Variables selected for measurement corresponded to the stages of Wilson and Cleary’s ([1995](#_ENREF_464)) model of patient outcomes (Figure 3.8.1).

### Selection and development of measures

#### Clinical Variables

The clinical variables were dental status, periodontal status, malocclusion and mucosal lesions. These data were collected via oral examination using the normative indices suggested by WHO ([WHO, 1997](#_ENREF_457)) (Appendix B). Caries treatment need, prosthetic status and prosthetic treatment need were also recorded using the WHO ([1997](#_ENREF_457)) criteria.

To check for consistency of measurement of all clinical variables, test-retest reliability was assessed by randomly re-testing, at least 10% of the sample. A Kappa statistic was calculated for the intra-examiner agreement.

#### Individual Characteristics

The individual characteristics included participants’ age, sex, sense of coherence, social support, perceived stress, oral health beliefs, subjective SES and dental behaviours and were collected at baseline and follow-up using questionnaires (Appendix C).

##### Sense of Coherence

Sense of Coherence was measured by Antonovsky’s Orientation to Life questionnaire (SOC-13) ([Antonovsky, 1987](#_ENREF_17)) that consists of 13 statements rated on a Likert scale ranging from ‘Never’= “1” to ‘Always’= “7”. Eriksson and Lindstrom’s ([2006](#_ENREF_133)) review of the validity of the SOC-13 scale, included 127 studies, with internal consistency in the range 0.70 to 0.95. According to that review, the SOC-13 scale is a valid, reliable, and cross-culturally applicable instrument. The questionnaire has been used in at least 33 languages in 32 countries with at least 15 different versions of the questionnaire. However to our knowledge this scale has not been used in an Indian population before so no local reliability and validity data were available.

##### Perceived Stress

Perceived stress was assessed using the 4 item Cohen’s Perceived Stress Scale (PSS-4) derived from the PSS-14. Participants answered each item on a five point Likert scale, ranging from ‘never’ (0) to ‘very often’ (4). Co-efficient alpha reliability for PSS-4 is 0.72, test-retest reliability is 0.55 over a two month interval ([Cohen *et al.*, 1983](#_ENREF_86)). Mitchell and colleagues([2008](#_ENREF_298)) compared all three versions of PSS in adults and found the Cronbach’s alphas for the 14-item, 10-item, and 4-item as 0.89, 0.91, and 0.82 respectively. PSS is the most widely used scale in oral health research due to its favourable psychometric properties ([Marucha *et al.*, 1998](#_ENREF_274); [Sanders and Spencer, 2005b](#_ENREF_373); [Watson *et al.*, 2008](#_ENREF_447)). PSS-10 ([Banerjee *et al.*, 2007](#_ENREF_34)) and PSS-14 ([Laxmaiah *et al.*, 2011](#_ENREF_229)) have been previously used in an Indian population, however no validity and reliability data were reported. Other translated versions (such as Spanish, Greek, Korean) demonstrate adequate reliability and validity with alphas ranging from 0.79 to 0.82 and test retest reliability ranging from 0.76 to 0.86 ([Remor, 2006](#_ENREF_351); [Baek *et al.*, 2010](#_ENREF_27); [Andreou *et al.*, 2011](#_ENREF_14)).

##### Social Support

The multidimensional scale of perceived social support **(**MSPSS) ([Zimet *et al.*, 1990](#_ENREF_471)) was used to measure social support. The MSPSS measures perceived adequacy of social support from 3 sources: family, friends, and significant others. Twelve-item ratings are made on a 7-point Likert scale from very strongly disagree (1) to very strongly agree (7). Cronbach’s coefficient alpha for the total MSPSS is 0.93. The family, friends, and signiﬁcant other subscales demonstrated α’s of 0.91, 0.89, and 0.91 respectively ([Canty-Mitchell and Zimet, 2000](#_ENREF_68)). This scale has been tested in a large number of different settings and populations and was reported to have favourable psychometric properties ([Canty-Mitchell and Zimet, 2000](#_ENREF_68); [Chou, 2000](#_ENREF_74)).

Figure 3.8.1 Summary of variables mapped to the Wilson and Cleary model

**Biological and Physiological Variables**

* Dental Caries & treatment need
* Periodontal status
* Malocclusion
* Prosthetic status & treatment need
* Mucosal Lesions

**OHQoL**

Oral Health Impact Profile (OHIP-14)

**Overall QoL**

Satisfaction with Life Scale (LSS-5)

**Individual Characteristics**

Age, Gender,

Stress, Sense of Coherence,

Social Support, Subjective SES

Oral Health Beliefs, Dental Behaviours

**Environmental Characteristics**

Social Network, Marital Status, Occupation, Income,

Education, Religion

**General Health Perceptions**

Current Health Scale (CHS-9)

However, the use of MSPSS as a measure of social support has been mainly restricted to Western research, with only a few exceptions. Eker and Arkar ([1995](#_ENREF_124)) and Akhtarand colleagues ([2010](#_ENREF_11)) standardised Turkish and Urdu language versions and demonstrated good internal reliability (alphas of 0.89 and 0.92 respectively). MSPSS has been used in India to measure social support among families and workplace ([Jethwani and Sawant, 2010](#_ENREF_199)). However to our knowledge, there have been no attempts to adapt and standardise an Indian language version of the MSPSS.

##### Oral Health Beliefs

Oral health beliefs were measured by the oral health belief questionnaire items used by Nakazono and colleagues ([1997](#_ENREF_307)). This scale has been tested in ICS-II (International Collaborative Study of Oral Health Outcomes) study in the US. The ICS-II items are scored on a four point Likert scale ranging from "strongly disagree" to "strongly agree". The 18 items comprise 5 subscales: perceived seriousness, benefit of preventive practices, benefit of plaque control, efficacy of the dentists and perceived importance. Perceived seriousness and benefits of preventive practices showed average internal reliability ranging from 0.53 to 0.80 among the ethnic groups. Carmines and Zeller ([1979](#_ENREF_70)) suggested Cronbach’s alpha values above 0.50 as acceptable for group comparisons. However the other three subscales (benefit of plaque control, efficacy of dentists and perceived importance) had values below 0.50. Lower values for these subscales can be attributed to the smaller number of items when compared to the perceived seriousness and benefit of preventive practices subscales. Although this questionnaire has not been tested widely, these subscales explore a broad range of oral health beliefs that no other questionnaire identified in the literature explores. Therefore, this questionnaire was tested and used in this study.

##### Dental Behaviour

Dental behaviours such as dental visiting patterns, tobacco chewing habits and oral hygiene practices were measured according to the items from the National Oral Health Survey conducted by the Dental Council of India ([Mathur *et al.*, 2004](#_ENREF_277)) as these items have been adapted to an Indian setting. Dental visiting patterns were assessed by the item used in the WHO’s simplified questionnaire for interviewing adults on oral health ([Shah *et al.*, 2007](#_ENREF_387)). All the dental behaviours items (n=5) except the frequency of tobacco smoking were added to get a scale for ease of analysis. Scores on all items were added to yield a total score (Possible total scores range from 5 to 14).

##### Subjective Socioeconomic Status

The MacArthur Scale of Subjective Social Status ([Adler *et al.*, 2000](#_ENREF_8)) is a single-item measure of self-perceived social rank. Participants place a cross on a 10-rung ladder to represent their position relative to other people in society. This scale has been used both in health and oral health research ([Operario *et al.*, 2004](#_ENREF_323); [Sanders *et al.*, 2006a](#_ENREF_371)). The test-retest reliability was found to be adequate with Spearman’s coefficient 0.62 (p<0.01) ([Operario *et al.*, 2004](#_ENREF_323)). Only one study was found which used the MacArthur scale in India, on the relationship between subjective and objective indices of SES and metabolic syndrome in Mumbai ([Suchday *et al.*, 2008](#_ENREF_412)). This study found a modest positive correlation between subjective SES and objective SES (r= 0.24, P<0.04) and suggested further use of this scale in India.

#### Environmental Characteristics

Environmental characteristics included **occupation, income, education, ethnicity (religion), marital status and social network measured using questionnaires (Appendix C).**

##### Social Network

The abbreviated Lubben social network scale (LSNS-6) comprises three questions that evaluate kinship ties and another three that evaluate non-kin ties; each scored on a 0 to 5 scale. A validation study in three European cities (7432 elderly men and women) found an overall Cronbach’s α of 0.83 that was consistent across all cities ([Lubben *et al.*, 2006](#_ENREF_254)). The subscales demonstrated alphas of 0.84 and 0.82 for the family and friends subscales respectively ([Lubben *et al.*, 2006](#_ENREF_254)). LSNS-6 has been used widely ([Lubben *et al.*, 2006](#_ENREF_254); [Crooks *et al.*, 2008](#_ENREF_99)) and has established a clinical cut point of 12 which represents a value below which individuals are identified as socially isolated ([Lubben, 1988](#_ENREF_255); [Rubinstein *et al.*, 1994](#_ENREF_361)). This scale has never been used with an Indian population.

#### Subjective Health Outcomes

Data on subjective health outcomes of symptoms and functional status (OHQoL), general health perceptions (GHP) and overall quality of life were also collected from questionnaires (Appendix C).

##### Symptoms and Functional status (OHQoL)

Symptom and functional status were measured using the *Oral Health Impact Profile* (OHIP-14) ([Slade and Slade, 1997](#_ENREF_402)). The 14–item questionnaire comprises seven domains: functional limitations, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. Participants are asked whether in the past three months they have experienced the problem described by each item. The participants rate their problems on a five-point Likert scale coded as never (score 0), hardly ever (1), occasionally (2), fairly often (3) and very often (4).  OHIP-14 has been recently used with the Indian population to assess OHQoL in adults, pregnant women and university students ([Acharya, 2008](#_ENREF_2); [Acharya and Sangam, 2008](#_ENREF_5); [Acharya *et al.*, 2009a](#_ENREF_3); [Acharya *et al.*, 2009b](#_ENREF_4); [Ingle *et al.*, 2010](#_ENREF_195)). Acharya ([2008](#_ENREF_2)) found good internal reliability (α= 0.85). Test-retest reliability was high with the Spearman’s rank co-efficient values for the subscales ranging from 0.75 to 0.96. These data suggest that OHIP-14 has adequate psychometric properties in an Indian population.

##### General Health Perception (GHP)

The current health scale was used to measure self-rated health ([Bentzen and Christiansen, 1993](#_ENREF_36)). This nine item scale uses five point Likerts from “agree entirely” to “disagree entirely”. Bentzen and Christiansen ([1995](#_ENREF_234)) reported a good internal reliability (α= 0.88). Due to these acceptable properties, the current health scale has been recommended by Bentzen and Christiansen ([1995](#_ENREF_234)) for use in general practice to assess self-perceived actual health status. Literature searches detected no examples of the scale being used in India.

##### Overall Quality of Life

Global life satisfaction was measured using the 5-item Satisfaction with life scale (SWLS) ([Diener *et al.*, 1985](#_ENREF_113)). The participants respond on a 7-point scale, from 1 (strongly disagree) to 7 (strongly agree). The SWLS has been tested in numerous studies ([Diener *et al.*, 1985](#_ENREF_113); [Lewis *et al.*, 1995](#_ENREF_234); [Lucas *et al.*, 1996](#_ENREF_256); [Oishi, 2006](#_ENREF_322)). The internal consistency (Cronbach’s α) has been consistently high, and generally exceeds values of 0.87. A two month test-retest reliability coefficient of 0.82 has been reported ([Diener *et al.*, 1985](#_ENREF_113); [Lewis *et al.*, 1995](#_ENREF_234)). The use of this scale with an Indian population has been limited to only a few studies. Biswas-Diener and Diener ([2001](#_ENREF_45)) reported good internal reliability (α=0.80) in a study conducted in the slums of Calcutta to explore the life satisfaction of the people living there. Another study of Indian immigrants in Canada reported moderate internal consistency of 0.77 ([Vohra and Adair, 2000](#_ENREF_438)).

### Translation of the measures

All questionnaires were linguistically and culturally adapted to the Hindi language using the back translation technique in order to maintain cross-cultural equivalence. Back translation is a phase conducted as part of the forward-backward translation procedures, which involves items being translated from an original source language into target language and then being retranslated back to the original language ([Schmidt and Bullinger, 2003](#_ENREF_383)). In this procedure, translation was made independently by two bilingual speakers, who discussed and produced a consensus Hindi version, which was translated back into English by a third translator having excellent knowledge of the English language and who had not seen the original version. Any substantial discrepancies were checked between the original and back translated versions by a panel consisting of two bilingual dentists. This procedure was repeated until an acceptable Hindi version was derived. The definitive version was pretested in 10 Hindi speaking people in Sheffield. Second testing was done in a convenience sample of 10 patients attending the Department of Oral Medicine at Sudha Rastogi Dental College in India by a collaborating dentist (NG) at the institution. A final test of the Hindi version was conducted 4 weeks before the study with 10 employees within the company (selected from the unit-II of the company), but different from the intended sample. All the recommendations by the participants were recorded and a final version was produced for the study.

Some of the recommendations suggested by the participants included were-

* Most of the people found the translated version of the question 8, 11 and 12 in the sense of coherence questionnaire difficult to understand and interpret. Therefore, the language was simplified.
* Within the oral health belief questionnaire, people did not respond to questions on fluoride and dental floss. When enquired about reasons, participants reported that they did not know what these were. Hence, a category of ‘don’t know’ was added to the responses, to eliminate missing data.

### Conduct

#### Training and Calibration

The principal researcher (EG) conducted all the clinical examinations according to the WHO diagnostic criteria ([WHO, 1997](#_ENREF_457)). Two other dentists assisted with the questionnaire administration and by recording clinical data. Both were trained by the principal researcher (EG). The principal researcher (EG) was calibrated by a dentist trained in conducting dental surveys using the WHO criteria at the collaborating site (Sudha Rastogi Dental College) in India.

#### Equipment

The clinical examination required minimal equipment with high levels of infection control. The equipment required included a chair, good source of light, mouth mirrors, explorers, periodontal probe, cotton pliers, probes, examination trays, cotton wool, disposable gloves, recording sheets, pencil, pen, computer, and other relevant resources.

All non-disposable equipment was pre-wrapped and sterilized at the Sudha Rastogi College of Dental Sciences & Research which was located near the study area. The number of non-disposable instruments matched the number of participants that were examined each day to avoid re-use of instruments and to avoid on-site sterilisation as the examinations took place during the company working hours.

#### Procedure

##### Data Collection

Data were collected at Friends Auto Ltd, India, in two stages. Baseline data (T1) were collected in April-June 2012 and the follow-up (T2) in October-November 2012. At T1 the participants were clinically examined and completed questionnaires (Table 3.10.1). At T2, the participants completed the same questionnaires again (Table 3.10.1).

##### Data collection at baseline (T1)

1. The researcher (EG) attended the work premises, informed the employees about the study in groups of 10-20 people and gave them information sheets and consent forms to read and take away. Employees willing to take part were requested to put the completed consent forms in a box provided at the reception of the company.
2. A list was made of the employees willing to take part in the study. Two employees were called at a time to the first session where the researcher (EG) conducted the clinical examinations and administered the questionnaires.
3. All clinical examinations were conducted in a room with good ambient light. Participants were examined sitting on a chair with mouth illuminated by head light. The data were entered into a clinical examination form by a trainee dentist.
4. Meanwhile the second participant waiting for the clinical examination was administered the questionnaire by a second trainee dentist. Questions and their choices were read to participants who were unable to read and understand the questionnaires. A record was kept of all the participants who were assisted in this way.
5. Following the clinical examination and completion of questionnaires all the participants were informed by the researcher (EG) about the follow-up data collection and were requested to participate at the second time point (after 3 months).
6. Consistency of the clinical examinations was checked by re-examining patients straight after the clinical examination. The patients selected for checking consistency were decided by rolling a ten sided dice; a roll of X was used to determine a re-examination for checking consistency. The number received on the dice was the number of patients after which a re-examination was conducted.

##### Data collection at follow-up (T2)

Three months later the questionnaires were administered again to the participants to collect follow-up data. Clinical examinations were not conducted at follow-up. A list of all the participants from baseline was prepared according to departments. These people were called in groups of five and were given questionnaires to complete.

#### Pilot Studies

In a series of pre-tests of the data collection tools the questionnaire was administered to 10 Hindi speaking students in Sheffield to assess its suitability in Hindi, time to answer the questionnaire, language simplicity and ease of understanding; in a convenience sample of 10 patients attending the Department of Oral Medicine at Sudha Rastogi Dental College in India and in another pilot study at another unit of the company assessing the consistency of the examiner in applying the clinical criteria and conduct of the study as described in section 3.9.

#### Data transfer

Data were transferred by EG directly into SPSS. Ten percent were rechecked for accuracy against the original hard copies (SB, EG). The quality of the data transfer was checked by a preliminary analysis of data.

#### Problems and Pitfalls

One anticipated problem was drop-out of the employees within the three months period. Another problem was employees not wanting to devote time for the study due to job demands. For these reasons, inducements in the form of prizes were offered to employees to attract their interest for the study and only those employees were recruited who were willing to take part in the study at both time points.

Table 3.10.1 List of variables in the study

|  |  |
| --- | --- |
| **Variables collected at Time 1** | **Variables collected at Time 2** |
| Dental caries and treatment need, Periodontal disease, Malocclusion, Mucosal lesion, Prosthetic status and need | Not collected at Time 2 |
| Income, Occupation, Education, Marital status, Religion | Not collected at Time 2 |
| Social Network | Social Network |
| Sense of Coherence, Stress, Social Support, Oral Health Beliefs, Dental Behaviours, Subjective SES, Age, Gender | Sense of Coherence, Stress, Social Support, Oral health beliefs, Dental Behaviours, Subjective SES |
| Symptom Status and Functional Status (OHQoL)  General Health Perceptions  Overall Quality of Life | Symptom Status and Functional Status (OHQoL)  General Health Perceptions  Overall Quality of Life |

#### 

#### Data management

The clinical data and the environmental factors of education, occupation, marital status and religion were not transformed (Appendix C).

For individual factors, each measure was summed to generate total raw scores. For example in SOC-13, all the items were computed to generate a total score (items 1, 2, 3, 7 and 10 are reverse scored). Higher scores indicate lower sense of coherence. Social support involved calculating three subscale scores called family support, friends support, and others support. Subscale scores are added to give a total social support score (Possible total scores range from 12 to 84). Higher scores indicate lower perceived social support. The same procedure was followed for the other individual and environmental variables (Table 3.10.2).

OHQoL was assessed using OHIP-14; all items were summed to generate total raw scores. Higher scores represented greater levels of impact and worse oral health quality of life (Table 3.10.2).

The current health scale (9 items) measured general health perceptions. All items were added to derive raw scores with items 3, 4, 7 and 8 being reverse coded. Higher scores indicate poor health (Table 3.10.2). Overall quality of life was assessed using the five items of the satisfaction with life scale. All items were added to generate raw scores. Higher cumulative scores indicate more dissatisfaction with life. In all cases, high values of scores can be taken to indicate low levels of the factors concerned.

Table 3.10.2 Summary of data management

|  |  |  |
| --- | --- | --- |
| **VARIABLES** | **SCORING PROCEDURES** | **CODE** |
| ***Clinical Factors***  Caries  Caries Treatment Need | Code=1+2= Decayed  Code=4+5= Missing  Code=3= Filled  Code=1+2=Fillings needed  Code=6=Extraction needed  Code=3+4+5+7+8=Other care needed | Code=1+2= Decayed  Code=4+5= Missing  Code=3= Filled  Code=1+2=Fillings needed  Code=6=Extraction needed  Code=3+4+5+7+8=Other care needed |
| Periodontal status | Code=0=Healthy gingiva  Code=1=Bleeding  Code=2 =Calculus  Code= 3+4= Pockets | Code=0,1=Low  Code=2 =Moderate  Code= 3+4=High |
| Malocclusion | Code=1= <=25 (no or slight malocclusion)  Code=2=26-30 (Definite  malocclusion)  Code=3=31-35 (Severe malocclusion)  Code=4=>=36 (Very severe or handicapping malocclusion) | Code=1= <=25 (no or slight malocclusion)  Code=2=26-30 (Definite  malocclusion)  Code=3=31-35 (Severe malocclusion)  Code=4=>=36 (Very severe or handicapping malocclusion) |
| Mucosal Lesions, Prosthetic Status  Prosthetic Need | Coded same to original | Coded same to original |
| ***Individual Characteristics***  Age, Gender  Sense of Coherence | Appendix C  13 items on a 7-point scale | Appendix C  Total all items to generate raw scores of SOC (1,2,3,7 & 10 were reversed scored) |
| Stress | 4 items on a 5-point scale | Total all items to generate raw scores (2 and 3 were reversed scored) |
| Social Support | 12 items on 7-point scale  4 items each in three subscales (family, friends and significant others) | Total all items in subscales to generate subscale scores, add all subscale scores to generate total scores |
| Oral Health Beliefs | 18 items on 5-point scale | Total all items to generate raw scores |
| Dental Behaviours | Tooth brushing, Tobacco chewing, Dental attendance | Total score for items 1,2,4,5,6 to generate raw scores (Refer Appendix C) |

|  |  |  |
| --- | --- | --- |
| Subjective SES | 1-item measure consisting of a 10 rung ladder | Bottom 1-4 rungs= 1  5th rung=2  6th rung= 3  7th rung=4  Top 8-10 rung=5 |
| ***Environmental Characteristics***  Socio-economic status  Religion, Marital status | Income, education, occupation  Religion, Marital status | Refer Appendix C |
| Social Network | 6-items scale with 3 questions each in two subscales family and friends scored from 0 to 5 | Total 3 items in each subscale to get subscale scores, add subscale scores to generate total scores |
| ***Subjective Health Outcomes***  OHQoL | 14 items on 5-point scale | Total all items to generate raw scores |
| General Health Perceptions | 9 items scale on 5-point scale | Total all items to generate raw scores (3,4,7 & 8 are reversed scored) |
| Overall Quality of Life | 5 items scale on 7-point scale | Total all items to generate raw scores |

#### Data analysis strategy

Data were analysed in three stages.

**Stage 1** described the distribution of all variables using appropriate measures of central tendency and spread and proportions for the independent and outcome variables at baseline and follow-up. Participants who failed to answer more than one seventh of the questions were excluded from the analysis. Other missing data were replaced by the sample mean/median/baseline scores.

The reliability and validity of all the questionnaires were assessed including test-retest reliability, internal reliability and construct validity.

The key characteristics of the study sample and those lost to follow-up were compared.

All analyses were conducted in SPSS (Version 20).

**Stage 2** explored the determinants of OHQoL using appropriate bivariate analyses. Pearson’s correlation and spearman’s rank correlation was used to test the associations between baseline clinical, individual factors and environmental factors with QHQoL, GHP and overall QoL at follow-up.

Non-parametric tests, the Mann Whitney U test and Kruskal Wallis test were conducted to identify differences in clinical status (caries status, missing teeth and periodontal diseases) between clinical status at baseline and oral related health quality of life (OHQoL), general health perceptions (GHP) and overall quality of life (QoL) at follow-up.

**Stage 3** Finally, structural equation modelling (SEM) was used to test the complex relationships and identify predictors in the Wilson and Cleary model in lagged analysis (Figure 3.10.1).

**A**

**B**

**C**

**D**

**E**

**G**

**F**

Figure 3.10.1 Data analysis strategy

A lagged analysis uses data collected at two time points to test longitudinal relationships between different combinations of variables. For example, the model (Figure 3.10.1), hypothesizes that B is predicted by A, F and G. In order to provide strong evidence of this relationship data should be longitudinal and account for baseline levels of the outcome variable, thus associations are tested between A,B,F and G at baseline with B at follow-up. This process can then be repeated for C, D and E at follow-up, using baseline values for the preceding variables.

The parameters of the models were estimated with maximum likelihood (ML) estimation and bootstrapping using AMOS 20 ([Horvath *et al.*, 2013](#_ENREF_181)). The bootstrap framework has been advocated as the best approach to testing direct and indirect eﬀects in mediation models ([Wallerstein, 1992](#_ENREF_442); [Antonovsky, 1996](#_ENREF_18); [Nilsson *et al.*, 2012](#_ENREF_317); [Bezares-Sarmiento *et al.*, 2013](#_ENREF_44)). Following Shrout and Bolger’s ([1996](#_ENREF_18)) techniques, 900 bootstrap samples were created (resampled from the original dataset) in order to derive less biased standard errors and 95% conﬁdence interval (CI) bootstrap percentiles. Bias-corrected 95% CI (BC 95% CI) are reported, as these have been shown to be more accurate ([May and West, 2000](#_ENREF_283)).

## RESULTS

### Introduction

A total of 580 people enrolled for the study at baseline in May 2012. Follow-up in October 2012 involved 495 participants. Employees’ leaving the job (n=85) was the only reason for the loss to follow-up and were of similar demographic characteristics as the rest of the sample.

The results in this chapter are presented in three main sections:-

Section 4.2 overviews the sample with regards to gender, age, socio-economic status and clinical data. Descriptive data are presented for all the variables at baseline and follow-up. The internal and test-retest reliability of the measures is also provided in this chapter.

Section 4.3 reports the associations between independent and dependent variables at baseline and follow-up. The Wilson and Cleary model guided the analyses testing the hypothesised relationships, using bivariate Pearson and Spearman’s rank correlations.

Section 4.4 presents the results from structural equation modelling (SEM) to test complex interrelationships among the variables.

### Descriptive analysis

#### Demographic data

The mean age of the participants was 33.1 years (range 18-72). Most were males (96% n=475) and Hindu. Three quarters earned less than 10,000 Rupees per month and almost 70% were operators or helpers in the factory (Table 4.2.1). More than half of the participants were either educated only up to primary or high school level.

Table 4.2.1 Demographic profile of 495 participants at baseline

|  |  |
| --- | --- |
| Participants | % |
| Male | 96.0 |
| Age  18-29  30-39  40-49  50+ | 38.0  34.7  18.6  8.7 |
| Monthly Income (in Rupees)  4,000-10,000  10,001-20,000  20,001-30,000  30,001-50,000  >50,001 | 73.5  17.0  5.3  3.0  1.2 |
| Level of educational attainment  Illiterate  Primary  High School  Graduate  Professional  Other | 12.3  19.6  38.0  21.6  4.2  4.2 |
| Occupation  Manager  Supervisor  Operator  Helper  Others | 9.9  12.9  22.4  44.2  10.5 |
| Religion  Hindu  Muslim  Sikh  Christian  Other | 96.4  2.2  0.8  0.4  0.2 |

#### Clinical Data

Mean DMFT in the sample was 2.13 (SD=3.92) with highest DMFT scores among those above 40 years and above (Table 4.2.2, Table 4.2.3 & Fig 4.2.1). Approximately, 40 % of the participants needed one or more fillings, 20 % needed extractions and 26.5% needed other kinds of interventions such as endodontic, prosthetic or surgical procedures.

Table 4.2.2 Dental condition among 495 participants

|  |  |
| --- | --- |
|  | Mean (SD) |
| DT | 1.054 (1.661) |
| MT | 0.909 (3.45) |
| FT | 0.165 (0.717) |
| DMFT | 2.129 (3.921) |

Table 4.2.3 DMFT among 495 participants according to age groups

|  |  |
| --- | --- |
| **Age** | **DMFT (Mean)** |
| 18-29 | 1.127 |
| 30-39 | 1.860 |
| 40-49 | 3.130 |
| 50+ | 5.488 |

Only 10.4 % of the people had healthy gingivae or bleeding (CPI= 0 &1) as highest score in any sextant. 74.5% of the people had calculus (CPI= 2) as the highest score (Table 4.2.4). While, 15.1% people had pockets 4-5mm or more as the highest score in any sextant.

Table 4.2.4 CPI status of 495 participants

|  |  |
| --- | --- |
| **CPI status** | **%** |
| Low CPI= 0, 1 | 10.4 |
| Moderate CPI= 2 | 74.5 |
| High CPI= 3&4 | 15.1 |

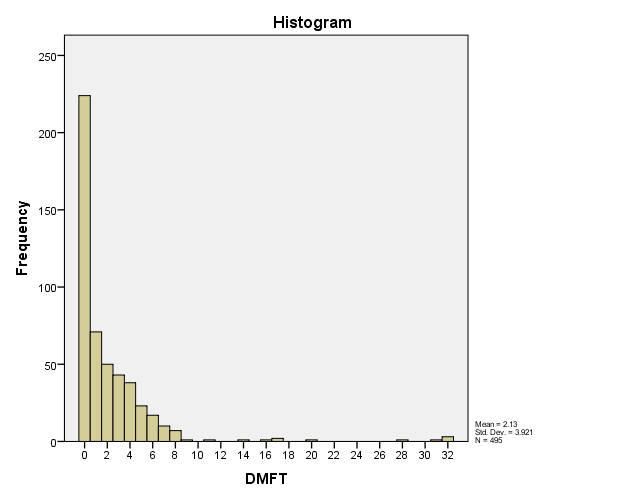


Figure 4.2.1 Frequency distribution of DMFT

Nearly all participants (96.6%) scored Dental Aesthetics Index (DAI) (Table 4.2.5), <=25 which suggests no abnormality or minor malocclusion with no need or slight need for treatment.

Table 4.2.5 Severity of malocclusion among 495 participants

|  |  |
| --- | --- |
| **Dental Aesthetic Index** | **%** |
| <=25 (no or slight malocclusion) | 96.6 |
| 26-30 (Definite malocclusion) | 2.0 |
| 31-35 (Severe malocclusion) | 0.2 |
| >=36 (Very severe or handicapping malocclusion) | 0.2 |

6.7% of the participants had mucosal lesions with a tentative diagnosis of tobacco pouch keratosis, oral submucous fibrosis and leukoplakia. Most participants had no prosthesis and no prosthetic need in either the upper or lower jaws (Table 4.2.6).

Table 4.2.6 Prosthetic status and need among 495 participants

|  |  |  |
| --- | --- | --- |
|  | Upper (%) | Lower (%) |
| **Prosthetic Status**  No prosthesis  Bridge  More than one bridge  Partial Denture  Full removable denture | 97.0  1.4  0.4  1.0  0.2 | 98.4  0.2  0.2  0.8  0.4 |
| **Prosthetic Need**  No prosthesis needed  Need for one unit prosthesis  Need for multiunit prosthesis  Need for a combination of one and multiunit  Need for full prosthesis | 88.5  6.3  2.6  1.8  0.8 | 86.5  6.5  4.6  1.8  0.6 |

#### Individual & Environmental Factors

##### Chronic stress

Stress was assessed using the shortened version of Cohen’s Perceived stress scale (PSS-4) ([1983](#_ENREF_86)) in which high scores indicate more stress. Scores were normally distributed at baseline and follow-up. Table 4.2.8 shows the means scores at two time points.

##### Sense of Coherence

Sense of Coherence was measured by the short form of the Antonovsky’s Orientation to life questionnaire (SOC-13) ([1987](#_ENREF_17)). Higher scores indicate weaker sense of coherence. Scores were normally distributed at baseline and follow-up. Table 4.2.8 shows the means scores at two time points.

##### Social Support

The Multidimensional Scale of Perceived Social Support (MSPSS) ([Zimet *et al.*, 1990](#_ENREF_471)) was used as a measure of social support. Higher scores indicate lesser perceived social support. Scores were normally distributed at baseline and follow-up. Table 4.2.8 shows the means scores at two time points.

##### Social Network

Social network was measured using abbreviated Lubben Social Network Scale (LSNS-6). Higher scores indicate smaller social networks. Scores were normally distributed at baseline and follow-up. Table 4.2.8 shows the means scores at two time points.

##### Oral health beliefs

Oral health beliefs were measured by the oral health belief questionnaire ([Nakazono *et al.*, 1997](#_ENREF_307)). Higher scores indicate negative oral health beliefs. Scores were normally distributed at baseline and follow-up. Table 4.2.8 shows the means scores at two time points.

##### Subjective SES

Subjective SES was measured using the MacArthur Scale of Subjective Social Status. Participants were asked to place a cross on the rung of a 10-rung ladder. Those scoring on the first four rungs from the bottom (denoting the lowest subjective social status) were assigned the value 1; those scoring on rung five were assigned the value 2; those scoring at rung six were assigned the value 3; those scoring at ring 7 were assigned the value 4 and those scoring on rungs 8-10 were assigned the value 5 (denoting the highest subjective social status). Higher SES ladder scores are associated with better health.

##### Dental Behaviours

Higher scores indicate worse dental behaviours. Scores were normally distributed at baseline and follow-up. Table 4.2.8 shows the means scores at two time points. More than half of the people (68.7%) brushed their teeth once a day and only 30.5% reported brushing teeth twice daily. Out of the 42% (n=208) who reported smoking, 151 (30.5%) smoked up to 5 times daily. Most participants (57.6%) did not chew tobacco. About two thirds of the participants reported to have visited the dentist only when in trouble (Table 4.2.7).

#### Subjective Health Outcomes

##### Symptoms and Functional status (OHQoL)

Symptom and functional status were measured using the *Oral Health Impact Profile* (OHIP-14) (Slade and Slade, 1997). Higher scores indicate poor oral health related quality of life. Scores were normally distributed at baseline and follow-up. Table 4.2.8 shows the means scores at two time points.

##### General Health Perceptions

The Current Health Scale was used to measure self-ratings of health (Bentzen and Christiansen, 1993). Higher scores indicate poor health. Scores were normally distributed at baseline and follow-up. Table 4.2.8 shows the means scores at two time points.

* + - * 1. Overall Quality of Life

Overall QoL was measured by Satisfaction with life scale (SWLS). Higher cumulative scores indicated higher dissatisfaction with life. Scores were normally distributed at baseline and follow-up. Table 4.2.8 shows the means scores at two time points.

Table 4.2.7 Dental behaviours

|  |  |
| --- | --- |
| **Dental Behaviour** | **%** |
| Oral Hygiene practices  Once a day  Twice a day  Don’t clean everyday | 68.7  30.5  0.8 |
| Tobacco smoking habits  Yes, I smoke now  I used to smoke  I have never smoked | 42.0 (n=208)  10.5  47.5 |
| Frequency of tobacco smoking (n=208)  Up to 5 times  >5 times <10 times  >10 times <20 times  >20 times | 30.5  6.9  3.6  1.0 |
| Chewing tobacco  Yes  No | 42.4  57.6 |
| Pattern of dental attendance  Regular check-up  Only when having trouble  Never been to the dentist | 13.7  68.7  17.6 |
| Frequency of dental attendance  Within last 6-12 months  >12months-5 years  Never | 34.1  14.7  51.3 |

Table 4.2.8 Descriptive data for the study variables

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Measures** | **Baseline Mean (SD)** | **Follow-up Mean (SD)** |
| Chronic Stress | PSS-4 | 10.260 (3.598) | 10.046 (3.259) |
| Sense of Coherence | SOC-13 | 40.579 (14.359) | 33.894 (13.784) |
| Social Support | MSPSS-12 | 31.272 (16.600) | 31.570 (16.175) |
| Oral Health Beliefs | OHBQ-18 | 36.717 (10.871) | 34.171 (8.895) |
| Dental Behaviours | DB-5 | 9.280 (1.971) | 9.220 (2.028) |
| Social Network | LSNS-6 | 22.311 (6.193) | 22.979 (5.871) |
| Symptoms and Functional status (OHQoL) | OHIP-14 | 19.939 (7.577) | 18.440 (7.151) |
| General Health Perceptions | CHS-9 | 21.151(7.588) | 20.555 (8.407) |
| Overall QoL | LSS-5 | 15.604 (7.441) | 18.018 (8.509) |

Table 4.2.9 Internal reliability and test-retest correlation of the variables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Measures** | **Cronbach’s reliability coefficient Baseline** | **Cronbach’s reliability coefficient Follow-up** | **Test-retest correlation (ICC)** |
| Chronic stress | PSS-4 | 0.457 | 0.304 | 0.454\*\* |
| Sense of Coherence | SOC-13 | 0.742 | 0.764 | 0.575\*\* |
| Social Support | MSPSS-12 | 0.882 | 0.855 | 0.534\*\* |
| Oral Health Beliefs | OHBQ-18 | 0.851 | 0.787 | 0.679\*\* |
| Dental behaviours | DB-5 | 0.445 | 0.446 | 0.728\*\* |
| Social Network | LSNS-6 | 0.783 | 0.801 | 0.662\*\* |
| Symptoms and Functional Status | OHIP-14 | 0.883 | 0.853 | 0.597\*\* |
| General Health Perceptions | CHS-9 | 0.778 | 0.827 | 0.626\*\* |
| Overall QoL | LSS-5 | 0.732 | 0.815 | 0.494\*\* |

***\*\*Correlation is significant at the 0.01 level (2-tailed)***

**4.2.7 Reliability of all questionnaires**

Cronbach’s reliability coefficients of all scales were assessed at baseline and follow-up. Except for the perceived stress and dental behaviours scale (0.30 to 0.45), the Cronbach’s alpha coefficients of all scales were above 0.7 and were deemed adequate (Table 4.2.9)

Table 4.2.9 presents the test-retest reliability represented by intra-class correlation coefficients (ICC) for all questionnaires at two time points and, were considered acceptable.

### Bivariate analyses

Preliminary assessments of lagged associations between study variables at baseline and follow-up were made using appropriate bivariate analyses (Tables 4.3.1-4.3.6).

#### Relationships between clinical status, individual factors, environmental factors and OHQoL at baseline with OHQoL at follow-up

Tables 4.3.1 and 4.3.2 present the lagged analyses between clinical status, individual factors, environmental factors and OHQoL at baseline and OHQoL at follow-up. Employees who had higher OHIP scores indicating worse oral health quality of life at follow-up were those who at baseline had worse OHQoL, higher age, lower sense of coherence, higher stress levels, lower social support, lower income, manual work type and lower social network ties. Employees who had worse OHQoL at follow-up also had more decayed and missing teeth with worse periodontal health at baseline.

#### Relationships between clinical status, individual factors, environmental factors, OHQoL and GHP at baseline with GHP at follow-up

Tables 4.3.3 and 4.3.4 present the lagged analyses between clinical status, individual factors, environmental factors, OHQoL and GHP at baseline and GHP at follow-up. Employees who had higher GHP scores (worse health perceptions) at follow-up were those who at baseline had worse GHP, worse OHQoL, higher age, lower sense of coherence, higher stress levels, lower social support, poor oral health beliefs, worse dental behaviours and lower subjective SES. Among the environmental factors lower education, lower income, manual work type and lower social network ties at baseline were associated with worse GHP at follow-up. Also employees who had worse GHP at follow-up were those who had more decayed and missing teeth with worse periodontal health at baseline.

Table 4.3.1 Relationships between individual, environmental, and OHQoL at baseline and OHQoL at follow-up in lagged analyses

|  |  |
| --- | --- |
| **Independent variables**  **(Baseline)** | **r-value** |
| **Individual factors**  Age  Gender  Sense of coherence  Stress  Social support  Oral health beliefs  Dental behaviours  Subjective SES | -0.016 (3 equal cut points)  -0.083  0.227\*\*  0.220\*\*  0.186\*\*  0.072  0.036  -0.076 |
| **Environmental factors**  Education  Income  Occupation  Marital status  Social Network  Baseline  OHQoL | -0.054 (3 categories)  -0.129\*\* (categories), -.006 (Raw)  0.090\*  -0.100\*  0.118\*\*  0.597\*\* |

*\*\* Pearson’s correlation is significant at the 0.01 level (2-tailed).*

*\*Pearson’s correlation is significant at the 0.05 level (2-tailed).*

Table 4.3.2 OHQoL at follow-up by clinical status at baseline

|  |  |  |
| --- | --- | --- |
| Clinical status | Mean Ranks | r |
| Caries status  DT=0  DT>0 | 223.16 \*  281.16 \* | 0.211## |
| Missing teeth  MT=0  MT>0 | 228.97 \*  308.11\* | 0.249## |
| Periodontal status  Low CPI (0,1)  Moderate CPI (2)  High CPI (3,4) | 193.31\*\*  246.98\*\*  274.16\*\* | 0.184## |

*\*(Mann-Whitney U test) (p=0.00), \*\*(Kruskal-Wallis test) (p=0.004).*

*## Spearman’s correlation is significant at the 0.01 level (2-tailed).*

#### Relationships between clinical status, individual factors, environmental factors, OHQoL, GHP and overall QoL at baseline with overall QoL at follow-up

Tables 4.3.5 and 4.3.6 present the lagged analyses between clinical status, individual factors, environmental factors, OHQoL, GHP and overall QoL at baseline and overall QoL at follow-up. Employees who were less satisfied with life at follow-up, were less satisfied with life, had worse GHP, worse OHQoL, lower sense of coherence, higher stress levels, lower social support, poor oral health beliefs, worse dental behaviours and lower subjective SES at baseline.

Among the environmental factors lower education, lower income, lower occupational grade and lower social network ties at baseline were associated with less satisfaction at follow-up. There were no significant relationships found between clinical status at baseline and overall QoL at follow-up.

#### Summary of key relationships between clinical status, individual factors, environmental factors at baseline and OHQoL, GHP and overall QoL at follow-up.

Individual factors: Social support, SOC and stress at baseline were related to OHQoL, GHP and overall QoL at follow-up. Environmental factors: Income, occupation and social network at baseline predicted OHQoL, GHP and Overall QoL at follow-up. Other significant bivariate relationships found have been summarised in Figure 4.3.1.

Table 4.3.3 Relationships between independent variables and general health perceptions in lagged analyses

|  |  |
| --- | --- |
| **Independent variables**  **(Baseline)** | **r-value** |
| **Individual factors**  Age  Gender  Sense of coherence  Stress  Social support  Oral health beliefs  Dental behaviours  Subjective SES | 0.217\*\*, -0.060 (3 equal cut points)  -0.106\*  0.358\*\*  0.352\*\*  0.153\*\*  0.208\*\*  0.230\*\*  -0.249\*\* |
| **Environmental factors**  Education  Income  Occupation  Marital status  Social Network  Baseline  GHP  OHQoL | -0.243\*\* (3 categories)  -0.273\*\*. -.007 (Raw)  0.264\*\*  -0.100\*  0.183\*\*  0.626\*\*  0.266\*\* |

*\*\* Pearson’s correlation is significant at the 0.01 level (2-tailed).*

*\*Pearson’s correlation is significant at the 0.05 level (2-tailed).*

Table 4.3.4 General health perception at follow-up by clinical status at baseline

|  |  |  |
| --- | --- | --- |
| Clinical status | Mean Ranks | r |
| Caries status  DT=0  DT>0 | 236.81\*  262.91\* | 0.091# |
| Missing teeth  MT=0  MT>0 | 234.95\*  289.22\* | 0.163## |
| Periodontal status  Low CPI (0,1)  Moderate CPI (2)  High CPI (3,4) | 171.28\*\*  251.79\*\*  265.61\*\* | 0.162## |

*\*(Mann-Whitney U test) (p<0.05), \*\*(Kruskal-Wallis test) (p=0.000).*

*Spearman’s correlation between clinical status at baseline and GHP at follow-up*

*##Spearman’s correlation is significant at the 0.01level (2-tailed).*

*#Spearman’s correlation is significant at the 0.05level (2-tailed).*

Table 4.3.5 Relationships between independent variables and overall quality of life in lagged analyses

|  |  |
| --- | --- |
| **Independent variables**  **(Baseline)** | **r-value** |
| **Individual factors**  Age  Gender  Sense of coherence  Stress  Social support  Oral health beliefs  Dental behaviours  Subjective SES | 0.013, -0.054 (3 cut points)  -0.183\*\*  0.216\*\*  0.328\*\*  0.215\*\*  0.210\*\*  0.240\*\*  -0.330\*\* |
| **Environmental factors**  Education  Income  Occupation  Marital status  Social Network  Baseline  Overall QoL  GHP  OHQoL | -0.180\*\* (3 categories)  -0.281\*\*, 0.071 (Raw)  0.259\*\*  -0.012  0.182\*\*  0.494\*\*  0.273\*\*  0.187\*\* |

*\*\*Correlation is significant at the 0.01 level (2-tailed).*

*\*Correlation is significant at the 0.05 level (2-tailed).*

Table 4.3.6 Overall quality of life at follow-up by clinical status at baseline

|  |  |  |
| --- | --- | --- |
| Clinical status | Mean Ranks | r |
| Caries status  DT=0  DT>0 | 240.45\*  258.08\* | 0.061 |
| Missing teeth  MT=0  MT>0 | 251.43\*  237.16\* | -0.043 |
| Periodontal status  Low CPI (0,1)  Moderate CPI (2)  High CPI (3,4) | 206.95\*\*  253.07\*\*  234.75\*\* | 0.022 |

*\*(Mann-Whitney U test) (p>0.05), \*\*(Kruskal-Wallis test) (p>0.05).*

*Spearman’s correlation between clinical status at baseline and overall QoL at follow-up*

Figure 4.3.1 Summary of the significant bivariate relationships

**BASELINE FOLLOW-UP**

* Gender\*\*, Sense of coherence\*\*, Stress\*\*,Social support\*\*,

Oral health beliefs\*\*,

Dental behaviours\*\*,

Subjective SES\*\*

* Education\*\*, Income\*\*,

Occupation, Social Network\*\*

* Overall QoL\*\*, GHP\*\*,

OHQoL\*\*

* Age\*\*, Gender,

Sense of coherence\*\*, Stress\*\*,

Social support\*\*,

Oral health beliefs\*\*,

Dental behaviours\*\*,

Subjective SES\*\*

* Education\*\*, Income\*\*,

Occupation\*\*, Marital status,

Social Network\*\*

* Decayed teeth\*\*, Missing teeth, Periodontal status\*\*
* GHP\*\*, OHQoL\*\*
* Sense of coherence\*\*,

Stress\*\*, Social support\*\*

* Income\*\*, Occupation,

Marital status, Social Network\*\*

* Decayed teeth\*\*, Missing teeth\*\*,

Periodontal status\*\*

* OHQoL\*\*

OHQoL

General Health Perceptions

Overall QoL

*\*\*Correlation is significant at the 0.01 level (2-tailed).*

### Structural equation modelling

Structural equation modelling (SEM) with observed and latent variables was used to analyse the data. Total scores for all the variables were used as observed variables in the SEM analysis, with the exception of socio-economic status which was represented as a latent construct with education, occupation and salary as the three indicators. Separate SEM were run for each clinical variable.

#### Wilson and Cleary model as a structural model

The Wilson and Cleary model was used as the conceptual framework to guide SEM. Each of the direct and indirect relationships hypothesised within the model were examined using a prospective design (Section 3.10.8). Decayed teeth were included in the first model as the observed clinical factor. Measures of subjective health included were OHQoL (symptoms and functional status), GHP and overall QoL. Individual factors, sense of coherence, social support, stress, oral health beliefs, dental behaviours and subjective SES were included. Environmental factors consisted of social network and socio-economic status (SES included as a latent variable representing observed variables education, occupation and income). Thus, the model comprised 11 observed and 1 latent variable; sense of coherence, social support, stress, oral health beliefs, dental behaviours, subjective SES, social network and socio-economic status.

The adequacy of overall model ﬁt was assessed using absolute fit indices ([Wiesmann and Hannich, 2008](#_ENREF_460)); chi square test statistic, χ2/df ratio, standardised root mean square residual (SRMR), the root-mean squared error of approximation (RMSEA), goodness of fit (GFI) and a relative fit index; the comparative ﬁt index (CFI). A non-signiﬁcant chi-square indicates that the model is a plausible representation of the relations among the observed variables. A χ2/df ratio < 3.0, SRMR < 0.08 and RMSEA values < 0.06, GFI and CFI > 0.90 were taken to indicate an acceptable model fit ([Salter *et al.*, 2010](#_ENREF_368); [Martin *et al.*, 2011 p.79-88](#_ENREF_273); [Nammontri *et al.*, 2013 p.79-122](#_ENREF_309)).

#### The modified model

The basic Wilson and Cleary model (Figure 2.2.2) hypothesises that the associations between the four main adjacent levels of the model would be the dominant pathways (clinical status-OHQoL-GHP-Overall QoL). Additionally, it acknowledges the role of individual and environmental factors on these main levels. The original model (Figure 2.2.2) also predicted that environmental factors (SES and social network) would directly impact on all three main levels (OHQoL, GHP and Overall QoL).

**Decayed Teeth**

**OHQoL**

**GHP**

**Overall QoL**

**Environmental Factors**

**Individual Factors**

Figure 4.4.1 Modified Wilson and Cleary model

Based on the health inequalities literature (Section 2.4.2) it is known that environmental factors impact on individual factors, therefore, the model hypothesised that the impact of these environmental factors on OHQoL, GHP, and QoL would be mediated through the individual factors. Additionally, a path from SES to clinical status was also added in the modified model in accordance with the revisions to the original Wilson and Cleary model by Ferrans and colleagues ([2005](#_ENREF_140)). All of the individual variables were assumed to directly impact on the three main levels (OHQoL, GHP and Overall QoL) in the model. The modified model can be seen in Figure 4.4.1. This model was an excellent fit to the data (Model 1 in Table 4.4.1).

Table 4.4.1 Fit indices for structural equation model

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Model | *χ2/df*, *p.* | SRMR | RMSEA | 90% CI for RMSEA | GFI | CFI |
| 1 | 1.405,  p = 0.057 | 0.023 | 0.029 | 0.000-0.046 | 0.986 | 0.992 |
| 2 | 1.258,  p = 0.085 | 0.030 | 0.023 | 0.000-0.037 | 0.979 | 0.991 |

***Direct effects***

The bootstrap standardised estimates, SEs and CIs for the direct effects can be seen in Table 4.4.2. All the direct effects can be seen in Figure 4.4.2. In line with the hypotheses within the Wilson and Cleary model, better OHQoL (T2) predicted better GHP (T2) which in turn predicted better overall QoL (T2) (cross-sectionally). Fewer decayed teeth, higher social support, higher SOC and low levels of stress at baseline predicted better OHQoL prospectively. Better GHP’s at follow-up were predicted by higher SOC and lower levels of stress at baseline. Similarly, better overall QoL was predicted by low levels of stress prospectively. Higher SES predicted better health perceptions and overall QoL at baseline.

***Indirect effects***

The bootstrap standardised estimates, SEs and CIs for the total indirect effects can be seen in Table 4.4.3. All the indirect effects can be seen in Figure 4.4.3. Specific indirect pathways for each of these total indirect effects can be seen in Appendix D. Fewer decayed teeth prospectively predicted better GHP via better OHQoL, and better overall QoL through better OHQoL and better GHP. Higher levels of social support predicted better OHQoL through higher SOC prospectively. Higher SOC at baseline predicted better OHQoL via lower levels of stress at follow-up. Likewise social support, SOC and stress at baseline had several significant indirect pathways predicting GHP and overall QoL at follow-up (Appendix D). Higher SES impacted better OHQoL via higher SOC, higher levels of social support and lower levels of stress individually. Better social networks predicted better OHQoL through low levels of stress and higher social support individually. SES and social network had indirect effects on GHP and overall QoL prospectively through several pathways detailed in Appendix D.

#### Final Model

In order to create a statistically more parsimonious model, all the non-significant paths were trimmed from model 1 (Figure 4.4.2, model 2 in Table 4.4.1). Model 2 was an excellent fit to the data accounting for 10%, 26% and 24% of the variance (prospectively) in OHQoL, GHP and Overall QoL respectively. In the final model three individual characteristics, social support, sense of coherence and stress at baseline had direct effects on OHQoL at follow-up (Figure 4.4.2). Neither oral health beliefs nor dental behaviours predicted the SHO. None of the environmental characteristics exerted direct effects on OHQoL. However, in line with the hypotheses, both environmental characteristics- SES and social network had an indirect influence on OHQoL through the individual characteristics (Figure 4.4.3). Clinical status as measured by, decayed teeth at baseline had a direct effect on OHQoL at follow-up. The model was repeated for the other clinical factors and the results were broadly in agreement with those reported above for decayed teeth (Appendix E). With missing teeth as the clinical factor, the direct path from SES to missing teeth was no longer significant (Appendix E). Similarly, with periodontal status as the clinical variable, the direct path from clinical status to OHQoL was no longer significant (Appendix E).

Table 4.4.2 Significant prospective direct and indirect effects for the full model with decayed teeth as the clinical factor

|  |  |  |  |
| --- | --- | --- | --- |
| **Effect** | ***β*** | **Bootstrap SE** | **Bias-corrected 95% CI** |
| **Prospective direct (T1-T2)**  **Socio-economic status (T1)**  General health perceptions (T2)  Overall quality of life (T2)  **Social support (T1)**  OHQoL(T2)  **Sense of coherence (T1)**  OHQoL (T2)  GHP (T2)  **Stress (T1)**  OHQoL (T2)  GHP (T2)  Overall QoL (T2)  **Decayed teeth (T1)**  OHQoL (T2) | 0.232  0.296  0.125  0.120  0.147  0.139  0.156  0.157  0.139 | 0.048  0.048  0.048  0.048  0.049  0.039  0.047  0.045  0.053 | 0.130/0.328\*\*  0.207/0.390\*\*  0.039/0.225\*\*  0.019/0.215\*  0.044/0.236\*\*  0.058/0.211\*\*  0.070/0.250\*\*  0.070/0.247\*\*  0.037/0.245\*\* |
| **Prospective indirect (T1-T2)**  **Socio-economic status (T1)**  OHQoL(T2)  General health perceptions (T2)  Overall quality of life (T2)  **Social network (T1)**  OHQoL (T2)  GHP (T2)  Overall QoL (T2)  **Social support (T1)**  OHQoL(T2)  GHP  Overall QoL  **Sense of coherence (T1)**  OHQoL (T2)  GHP (T2)  Overall QoL  **Stress (T1)**  GHP (T2)  Overall QoL (T2)  **Decayed teeth (T1)**  GHP (T2)  Overall QoL (T2)  *Note: \*\*P<0.01, \*P<0.05,* ***β*** *= boot strapped standardised estimate, SE = standard error, CI = confidence interval,*  *T1 = baseline, T2 = 3 months follow-up, OHQoL = oral health related quality of life, GHP = General health*  *perception, Overall QoL = Overall quality of life* | 0.154  0.148  0.126  0.048  0.038  0.031  0.023  0.059  0.018  0.048  0.090  0.098  0.029  0.034  0.029  0.005 | 0.022  0.027  0.025  0.015  0.012  0.013  0.010  0.016  0.006  0.016  0.019  0.022  0.010  0.013  0.015  0.003 | 0.113/0.198\*\*  0.104/0.208\*\*  0.084/0.181\*\*  0.025/0.082\*\*  0.019/0.070\*\*  0.012/0.063\*\*  0.008/0.048\*\*  0.031/0.092\*\*  0.009/0.032\*\*  0.021/0.083\*\*  0.055/0.132\*\*  0.061/0.148\*\*  0.013/0.054\*\*  0.013/0.064\*\*  0.007/0.066\*\*  0.001/0.014\*\* |

Table 4.4.3 Significant cross-sectional direct and indirect effects for the full model with decayed teeth as the clinical factor

|  |  |  |  |
| --- | --- | --- | --- |
| **Effect** | ***β*** | **Bootstrap SE** | **Bias-corrected 95% CI** |
| **Cross-sectional direct**  **Socio-economic status (T1)**  Decayed teeth (T1)  Social network (T1)  Social support (T1)  Sense of coherence (T1)  Stress(T1)  Oral health beliefs (T1)  Dental behaviours (T1)  Subjective SES (T1)  **Social network (T1)**  Social support  Stress  **Social support (T1)**  Sense of coherence (T1)  **Sense of coherence (T1)**  Stress (T1)  **Oral health beliefs (T1)**  Dental behaviour (T1)  **OHQoL (T2)**  GHP(T2)  **GHP (T2)**  Overall QoL (T2) | 0.104  0.194  0.289  0.359  0.191  0.550  0.497  0.753  0.193  0.142  0.136  0.348  0.123  0.210  0.182 | 0.047  0.050  0.045  0.049  0.047  0.053  0.057  0.041  0.046  0.048  0.045  0.045  0.052  0.042  0.047 | 0.012/0.191\*  0.084/0.287\*\*  0.202/0.377\*\*  0.261/0.450\*\*  0.093/0.276\*\*  0.420/0.635\*\*  0.379/0.603\*\*  0.831/0.664\*\*  0.097/0.282\*\*  0.051/0.244\*\*  0.051/0.228\*\*  0.258/0.435\*\*  0.025/0.232\*  0.129/0.301\*\*  0.092/0.274\*\* |
| **Crossectional indirect**  **Socio-economic status (T1)**  Social support (T1)  Sense of coherence (T1)  Stress(T1)  Dental behaviours (T1)  **Social network (T1)**  Sense of coherence (T1)  Stress (T1)  **Social support (T1)**  Stress (T1)  **OHQoL (T2)**  Overall QoL (T2) | 0.037  0.044  0.168  0.067  0.026  0.009  0.047  0.038 | 0.014  0.014  0.027  0.029  0.011  0.004  0.017  0.013 | 0.015/0.070\*\*  0.019/0.074\*\*  0.118/0.227\*\*  0.017/0.135\*  0.009/0.056\*\*  0.003/0.019\*\*  0.018/0.084\*\*  0.018/0.067\*\* |

*Note: \*\*P<0.01, \*P<0.05,* ***β*** *= boot strapped standardised estimate, SE = standard error, CI = confidence interval, T1 = baseline, T2 = 3 months follow-up, OHQoL = oral health related quality of life, GHP = General health perception, Overall QoL = Overall quality of life*

0.12\*\*

0.19\*\*

**Decayed teeth**

0.12\*

0.12\*

0.18\*\*

0.21\*\*

0.16\*\*

0.16\*\*

0.14\*\*

0.15\*\*

0.30\*\*

0.55\*\*

0.10\*

0.19\*\*

0.36\*\*

0.35\*\*

0.14\*\*

0.14\*\*

0.23\*\*

0.75\*\*

0.14\*\*

**SOC**

**Stress**

**Social support**

**OHQoL**

**(T2)**

**DB**

**Education**

**Social Network**

**QoL (T2)**

**SSES**

**OHB**

**GHP (T2)**

**Occupation**

**Income**

0.19\*\*

0.29\*\*

0.50\*\*

Figure 4.4.1 Significant direct effects for the statistically parsimonious Wilson and Cleary model with decayed teeth as the clinical factor.

Note: \* p < 0.05, \*\* p < 0.01, β= bootstrapped standardised estimate. Solid line = direct effect; T2 = 3 months follow-up, the error terms are omitted for ease of interpretation. Except those variables indicated in the model, all others are at baseline.

0.23\*\*0.07\*

0.03\*\*

0.005\*\*

0.04\*\*

0.03\*\*

0.05\*\*

0.10\*\*

0.10\*\*

0.02\*\*

0.05\*\*

0.06\*\*

0.02\*\*

0.03\*\*

0.04\*\*

0.01\*\*

0.17

0.13\*\*

0.15\*\*

0.15\*\*

0.05\*\*

0.17\*\*

0.04\*\*

0.04\*\*

0.03\*\*

**Social support**

**SOC**

**Stress**

**Decayed teeth**

**OHQoL (T2)**

**GHP (T2)**

**QoL (T2)**

**Social Network**

**Occupation**

**Education**

**Income**

**DB**

**OHB**

**SSES**

Figure 4.4.2 Significant indirect effects for the statistically parsimonious Wilson and Cleary model with decayed teeth as the clinical factor.

Note: \* p < 0.05, \*\* p < 0.01, β= bootstrapped standardised estimate. Solid line = direct effect; T2 = 3 months follow-up, the error terms are omitted for ease of interpretation. Except those variables indicated in the model, all others are at baseline.

Figure 4.4.3 Significant indirect effects for the statistically parsimonious Wilson and Cleary model with decayed teeth as a clinical factor.

Note: \* p < 0.05, \*\* p < 0.01, β= bootstrapped standardised estimate. Solid line = direct effect; dashed lines = indirect effect; T2 = 3 months follow-up, the error terms are omitted for ease of interpretation. Except those variables indicated in the model, all others are at baseline.

## DISCUSSION

### Introduction

This research examined the determinants of adult’s OHQoL within the Wilson and Cleary model using structural equation modelling (SEM). Data were collected over three months on clinical variables, OHQoL, general health perceptions, overall quality of life and, individual and environmental characteristics. OHQoL was predicted by clinical and individual factors directly while environmental factors had an indirect impact through individual factors (Figure 4.4.2 & 4.4.3). Both individual and environmental factors predicted GHP and overall QoL directly while clinical factors exerted an indirect effect.

This is the first study to explore the determinants of OHQoL in adults, guided by a theoretical model, using a prospective design and a robust statistical technique; SEM. This study identified determinants of OHQoL, provided possible pathways through which these factors might exert effects on SHO and suggests avenues for devising new oral health promotion strategies. This study further highlighted how broader social determinants like SES may impact on individual factors, which in turn influence oral health outcomes.

The discussion of these findings is divided into two parts; section 5.2 discusses the determinants and predictors of adults’ OHQoL and other SHO. Additionally, the pathways through which these clinical, individual and environmental factors affect SHO will be discussed. A brief discussion of factors not found to play a significant role in the study (oral health beliefs, dental behaviours and subjective SES) is also presented. Finally, section 5.3 considers the methodological issues and possible limitations of the research. A subsequent chapter summarises the conclusions and recommendations arising from these findings for policy and future research.

### Predictors of Subjective health outcomes

The current study aimed to identify predictors of OHQoL in adults. Since, the study was guided by the Wilson and Cleary (1995) model of patient outcomes, predictors of other subjective health outcomes (GHP and overall QoL) were also identified. The predictors are divided into clinical, individual and environmental factors.

#### Clinical status

Clinical status (Table 4.4.2, decayed teeth, missing teeth; β = 0.13, CI = 0.05-0.24, p < 0.01) directly predicted OHQoL, contrary to previous studies which did not find or found weak relationships between clinical factors and OHQoL ([Weissbecker *et al.*, 2002](#_ENREF_452); [Agardh *et al.*, 2003](#_ENREF_10); [Baker *et al.*, 2010](#_ENREF_29); [Nammontri *et al.*, 2012](#_ENREF_308); [Gururatana *et al.*, 2013](#_ENREF_161)). However, the strength of the relationship between clinical status and OHQoL found in this study is not very strong. Both decayed and missing teeth exerted indirect effects on other SHO; GHP and overall QoL. The third clinical variable; periodontal status did not exert a significant direct effect on OHQoL.

Possible explanations for the difference between these and previous findings may include the levels and distribution of diseases in the sample, types and severity of diseases in question, different type of measures, sample size, models tested in the study, the interaction of the other factors such as environmental and individual factors and statistical methods and different concepts of health and disease.

1. ***Levels and distribution of diseases in the sample***

Marshman and colleagues ([2005](#_ENREF_272)) suggested that studies with low disease samples may not detect associations because of the limited impacts of mild disease on OHQoL. It is suggested that low levels of disease limit the potential influence of clinical factors on SHO. For example, patients with superficial occlusal caries might not experience symptoms severe enough to compromise their OHQoL.

Relationships have been found in high disease samples. McGrath ([2002](#_ENREF_289)), Luo and McGrath ([2008](#_ENREF_259)) and Bandeca and colleagues ([2011](#_ENREF_32)) found links between high dental caries experience (DMFT > 10) and OHQoL in adults. Although the DMFT of 2.12 in this sample was not high according to the WHO standards in adults (DMFT > 14) ([Petersen, 2003](#_ENREF_339)), a significant direct relationship was found between clinical status (decayed teeth) and OHQoL. On the world map of dental caries for 35-44 years old, India is classed under low caries category (DMFT 5-8.9) which could explain the low levels of DMFT for this sample (Petersen, 2003).

Similar, relationships were evident in studies with low levels of disease. Robinson and colleagues ([2005](#_ENREF_357)) found relationships between dental caries (DMFT 0.68), fluorosis and OHQoL among 174, Uganda children.

Most studies compared above were conducted in children and this is the first study to be conducted in an adult population diverse in terms of age and socio-economic status and which gives divergence in the data. In this study, 45% of the sample had one or more decayed teeth with 30% having one or more than one missing teeth. Nearly, half of the sample (55%) had DMF above one, which suggests that although the average DMFT was low, there was a wide distribution of the disease in the sample which might have been the reason for the seen effect between clinical status and OHQoL.

However, it should be noted here that levels and distribution of the disease is not the only factor which might influence the association between clinical status and SHO. Other factors are discussed below.

1. ***Types and severity of diseases***

One explanation for the relationships between decayed teeth or missing teeth and SHO was that the sample presented a range of oral conditions from dental caries, to partial and complete edentulousness.

Periodontal status did not exert a significant direct effect on OHQoL. A possible reason might be that most participants in the study had moderate calculus (CPI rating 2) which is not evidence of periodontal disease *per se* and therefore, may not produce sufficient symptoms to compromise OHQoL. A similar finding was reported by Marino and colleagues ([2008](#_ENREF_265)) where no direct association between periodontal status and OHQoL was found as half of the participants in that sample had only calculus. A recent review of observational studies reported a negative impact of periodontitis on OHQoL. However, as the authors themselves suggest, due to the diversity in thresholds used do define periodontitis and its impacts, the associations found should be interpreted with caution ([Al-Harthi *et al.*, 2013](#_ENREF_12)). This conclusion was supported by a study using standard definitions of periodontitis and Euro-QoL as a measure of OHQoL that found a low prevalence of impact with gingivitis and gingival recession, and a high impact prevalence with pocket depth and loss of attachment ([Brennan *et al.*, 2007](#_ENREF_55)). This highlights that the severity of the periodontal disease might play a role in influencing OHQoL as suggested by this study.

Slade and colleagues ([1996](#_ENREF_403)) showed that missing teeth and number of decayed root surfaces had higher impact on OHQoL than maximum pocket depth. Similarly, Lawrence and colleagues ([2008](#_ENREF_228)) found higher associations for decayed teeth and OHQoL when compared to periodontitis; suggesting that although both the oral conditions impacted OHQoL, they did so to a different extent. These findings support the results from this study that decayed and missing teeth had more pronounced effects on OHQoL than periodontal status. This finding is intuitive because tooth loss is among the most severe outcomes of oral disease. Thus the type of oral disease explains in part at least why clinical status only sometimes relates to OHQoL.

1. ***Different measures***

This study used a standard and most sophisticated OHQoL measure in adults; the Oral Health Impact Profile ([Slade, 1997](#_ENREF_401)) (OHIP-14) which might have captured the social and psychological impacts of oral conditions sensitively along with providing discriminant validity. Similarly, this study used multiple-item questionnaires with high reliability and validity to measure GHP and overall QoL, which enabled the examination of indirect pathways from clinical status to GHP and overall QoL within the model. Previous studies ([Baker, 2007](#_ENREF_28); [Baker *et al.*, 2010](#_ENREF_29); [Nammontri *et al.*, 2013](#_ENREF_309)) did not examine these pathways due to the use of single-item measures. Thus this study might be expected to detect more relationships.

1. ***Sample sizes and nature of sample***

Some studies detect associations between clinical status and OHQoL despite low disease levels due to the power given by large samples. Foster-Page and colleagues ([2005](#_ENREF_144)) found an association between dental caries (DMFS) and OHQoL in 430, 12 year olds in New Zealand. Children with untreated caries had more impacts on OHQoL measured by CPQ 11-14 in a study of 792 children aged 12 year-olds ([Piovesan *et al.*, 2010](#_ENREF_342)). A longitudinal study in 455 Thai students ([Gururatana *et al.*, 2011](#_ENREF_160)) and 439 Malaysian 12-13 year olds ([Baker *et al.*, 2010](#_ENREF_29)) also found relationships between dental caries and OHQoL. In adults, Ide and colleagues ([2008](#_ENREF_190)) in a sample of 6079 adults (20-59 years) found significant relationship between missing teeth and OHQoL. Based on these sample sizes, this sample size of 495 adults may have had sufficient power to find association between some aspects of clinical status and OHQoL.

1. ***Interactions with other factors and statistical methods***

Another explanation for the variation in findings between studies relates to the interaction of others factors. Such environmental and individual factors include self-esteem, SOC, coping strategies and self-regulation ([Savolainen *et al.*, 2005a](#_ENREF_380); [Savolainen *et al.*, 2005b](#_ENREF_381); [Locker, 2007](#_ENREF_246); [Locker, 2009](#_ENREF_247)), which may mediate or intervene in the relationship between clinical status and OHQoL ([Baker, 2007](#_ENREF_28)). Accordingly, this study used a powerful statistical analysis (SEM) to test the complex direct and indirect relationships between multiple factors. Using the same data, Mat ([2009](#_ENREF_275)) could not find relationships between clinical status and OHQoL (symptoms and functional status) in multiple regressions whereas Baker and colleagues ([2010](#_ENREF_29)) found longitudinal relationships in the same data using SEM. SEM indicates direct and indirect effects as it conveys two important aspects of the procedure; that the causal processes are represented by a series of structural equations and that the model generated explicitly conceptualises the theory underpinning the study ([Byrne, 2010](#_ENREF_64)). Research using regression analysis is confined to detecting relatively straightforward associations and may not have been able to assess the multidimensional predictors of OHQoL and both direct and indirect pathways as in the present study.

1. ***Different concepts of health and disease***

Another explanation relates to the model used to guide the studies. The bio-psychosocial model combines two distinct concepts of health; clinical factors reflect disease, whereas subjective outcomes may record health. Locker and Slade ([1994](#_ENREF_251)) suggested that health and disease may be conceptually distinct rather than causally related. Therefore, there may be no relationships to detect. The Wilson and Cleary model attempts to relate these two different concepts of health in a linear relationship. Yet, Locker ([1997](#_ENREF_244)) suggested that not all disease contributed to ill-health (such as mild gingivitis). Furthermore, other factors may play a mediating role on OHQoL. The magnitude of impact on OHQoL may be more influenced by patients’ perceptions of their symptoms, psychological well-being ([Baker *et al.*, 2010](#_ENREF_29)) and personal and social circumstances ([Locker and Slade, 1994](#_ENREF_251)) than disease. The relationship between clinical status and SHO was found after taking into account such factors within the model.

1. ***Conclusion***

Cumulatively, the above explanations suggest that an accessible adult population, standard and valid measures, large sample size and use of powerful statistical technique for analysis were the main reasons why a relationship was found between clinical status and OHQoL in this study. However, these explanations work collectively rather than individually.

Additionally, this study supported observations that SHO are not entirely determined by clinical factors but individual and environmental factors play a role as conceptualised within the model. These factors are discussed below.

#### Individual characteristics

##### Social Support

Adults with greater perceived social support at baseline had better OHQoL, GHP and overall QoL at follow-up. Social support exerted both direct and indirect (via SOC and stress) influences on OHQoL, while only having an indirect influence (via SOC and stress) on GHP and overall QoL (Figs. 4.4.2 & 4.4.3).

In line with the current literature on social support and health, these findings provide further empirical evidence linking social support to SHO that social support determined the subjective well-being of the individuals is consistent with Cobb’s ([1976](#_ENREF_77)) view that it is an important resource which facilitates coping with crisis and adaptation to change. Research implicates social support in protecting against several diseases and conditions ([Berkman, 1995](#_ENREF_37)). Berkman and colleagues’([2000](#_ENREF_39)) conceptualisation is supported by the current study where the model highlighted that social support is influenced by social networks which are embedded within larger social and cultural context consisting of upstream factors such as SES which are seen to condition both social network and, support derived from it. Secondly, the study supports the idea that GRRs like social network and social support determine SOC. Finally, the data support the idea that social relationships act as important mobilising resources for achieving health and in determining subjective well-being.

###### Social Support, general and oral health

In medicine, high levels of perceived social support have been found to be related to better cardiovascular function ([Orth-Gomer *et al.*, 1993](#_ENREF_324); [Uchino, 2009](#_ENREF_432)), lesser chances of having stroke ([Ikeda *et al.*, 2008](#_ENREF_193)) and low levels of hypertension ([Lepore *et al.*, 1993](#_ENREF_231)). Some studies also implicate social support in boosting the immune system ([Cruess *et al.*, 2000](#_ENREF_101); [Lutgendorf *et al.*, 2000](#_ENREF_260); [Dixon *et al.*, 2001](#_ENREF_118)), having positive effects on patient self-care and diabetes outcomes ([van Dam *et al.*, 2005](#_ENREF_436)) and better patient adherence to medical treatment ([DiMatteo, 2004](#_ENREF_116)). A meta-analysis on relationship between social support and well-being found significant correlations between social support and positive mood state, negative mood state, depression, level of functioning, and quality of life ([Wang, 1998](#_ENREF_445); [Wang *et al.*, 2003](#_ENREF_446)).

In relation to oral health, our finding that social support predicted OHQoL over time is consistent with other evidence from social support research in oral health. Although, the research of oral health has been limited, it provides some evidence that social support can predict oral clinical status ([Hanson *et al.*, 1994](#_ENREF_164); [Nicolau *et al.*, 2007](#_ENREF_315); [Brennan and Spencer, 2010](#_ENREF_54); [Bernabe *et al.*, 2011](#_ENREF_42)), oral health related behaviours ([Sabbah *et al.*, 2011](#_ENREF_364)) and OHQoL ([Sanders and Spencer, 2005a](#_ENREF_372); [Brennan and Spencer, 2009](#_ENREF_53); [Brennan and Spencer, 2010](#_ENREF_54); [Lamarca *et al.*, 2012](#_ENREF_224)).

In adults, previous studies conducted in Australia, Brazil and America found social support to be related to oral clinical status and oral health related behaviour. Adults with higher levels of perceived social support had fewer decayed teeth ([Brennan and Spencer, 2010](#_ENREF_54)), higher number of functioning teeth and lower anterior open spaces ([Hanson *et al.*, 1994](#_ENREF_164)) and better periodontal health ([Nicolau *et al.*, 2007](#_ENREF_315)). Overall, the results implied that dental health problems are more frequent among persons with lower social support ([Hanson *et al.*, 1994](#_ENREF_164)). Higher perceived social support was related to lower prevalence of smoking ([Sabbah *et al.*, 2011](#_ENREF_364)), higher dental visits for check-up ([Sabbah *et al.*, 2011](#_ENREF_364)) and higher tooth brushing frequency ([Brennan and Spencer, 2010](#_ENREF_54)).

However, the above studies relate to clinical status and behaviours. Only four studies were found which tested the relationship between OHQoL (measured by OHIP-14) and social support. Sander and Spencer’s ([2005a](#_ENREF_372)) study using a nationally representative sample of 3678 aged 18-91 years concluded that adults with higher perceived social support had better OHQoL after adjusting for potential confounders of sex, age and household income both in multivariate linear regression analysis. Similar findings were reported by Brennan and Spencer ([2009](#_ENREF_53); [2010](#_ENREF_54)) in nationally representative samples (n=632 & 1859 respectively) of Australian young adults. All three of these mentioned studies collected data at one time point and thus causal inferences could not be drawn. Only one longitudinal study with 1403 pregnant and post-partum Brazilian women related higher levels of perceived social support to better OHQoL ([Lamarca *et al.*, 2012](#_ENREF_224)). Again, the findings of this study were important, but the results are restricted to pregnant women and cannot be generalised.

The paucity of data examining links between social support and different oral health outcomes, and the available data is mostly cross-sectional and is unable to decipher causal relationships. Further most of the studies do not define the meaning and measure of social support clearly. The meanings and measures of social support and social network often overlap. In order to overcome the limitations of the previous studies, this study clearly defined social support and network. It further examined social support within a theoretical model along with testing the possible pathways through which social support might work. The present study is the first prospective study which examined the role of social support in determining oral health outcomes in adults. The study supports the findings from previous studies that perceived social support influences OHQoL as well as other SHO. The study further defines possible pathways through which social support might exert its influence on SHO in adults.

Evidence from the wide range of studies on both oral and general health suggests that social support plays an important role in maintaining health (directly promoting recovery from stress) and mitigating (acting as a buffer) the deleterious effects of environmental and social stress ([Mccubbin and Boss, 1980](#_ENREF_286); [House, 1981](#_ENREF_183)). Before discussing the mechanisms and pathways (identified within this study) through which social support impacts SHO, a brief discussion of the studies that suggest social support can be improved through interventions is presented.

###### Social support and health promotion interventions

Several studies have tested the effectiveness of social support interventions in improving health outcomes. Online social support improved adherence to antiretroviral therapy (ART) in patients with HIV ([Horvath *et al.*, 2013](#_ENREF_181)). Another three month intervention in rural Mexico improved women’s lifestyles, self-concept, and symptoms of Metabolic Syndrome ([Bezares-Sarmiento *et al.*, 2013](#_ENREF_44)). A systematic review evaluating the impact and effectiveness of interventions in diabetic adults found peer support to be associated with improved biological indicators (glycemic control, blood pressure, cholesterol); behaviour (physical activity) and psychological traits (self-efficacy, depression and perceived social support). The review also highlighted methodological issues in the included studies ([Dale *et al.*, 2012](#_ENREF_103)). Similar reviews of social support interventions for arthritis patients ([Lanza and Revenson, 1993](#_ENREF_227)), sickle cell disease patients ([Chen *et al.*, 2004](#_ENREF_71)) and smoking cessation ([May and West, 2000](#_ENREF_283)) designed to increase coping ability and adopt healthy behaviours, suggested that although, these interventions show encouraging results, they should be interpreted with caution. Both reviews suggest that future interventions should be more theoretically grounded.

An RCT ([Krieger *et al.*, 2002](#_ENREF_216); [Krieger *et al.*, 2005](#_ENREF_217)) assessed the effectiveness of a social support intervention from community health worker focused on reducing exposure to indoor asthma triggers in children 4-12 years with a follow-up of one year. This study found children receiving high-intensity support improved more than those with low-intensity support with respect to caregiver quality-of-life scores, urgent health services use, symptom days and actions to reduce triggers. These gains were sustained for at least six months ([Krieger *et al.*, 2005](#_ENREF_217)).

A multicenter RCT of cognitive-behavioral treatment in post-myocardial infarction patients, focused on changing the cognitions and behaviours of the patients in order to enhance their perceived social support ([ENRICHD Investigators, 2001](#_ENREF_131)). Therapists guided the patients to enhance their own social networks. At the six-month follow-up, the intervention participants experienced greater increases in social support than the usual-care-group participants ([ENRICHD Investigators, 2003](#_ENREF_130)). This effect attenuated over time, but some benefit remained up to three years after baseline. However, at four-year follow-up intervention group experienced fewer similar current nonfatal myocardial rates and deaths as the usual care group. A post hoc analysis suggested assessments of participants’ social networks to match them with appropriate interventions might have resulted in larger and more durable increases in social support ([Burg *et al.*, 2005](#_ENREF_62)).

To our best knowledge till date, no social support interventions have been conducted in relation to oral health in adults.

Most of the above mentioned studies provide evidence that social support can be improved through well-tailored and theoretically informed interventions resulting in improved symptoms and enhanced coping. Cumulatively, results from intervention studies, evidence from the social support literature (in context to both general and oral health), and results from the current study provide consistent evidence to suggest social support could play an important role in promoting oral health in adults. In order to understand how social support interventions could be applied to oral health, the next section discusses the pathways through which social support maintains health.

###### Social support pathways in maintaining health

Berkman and colleagues ([2012](#_ENREF_84)) proposed three pathways of how social support could contribute to health. Elaborating these pathways might explain how social support might affect oral health and suggest channels through which social support interventions could be applied to improve oral health. The next section discusses the pathways through which social support maintains health.

*Social support as a direct physiological pathway*

This pathway recognises that social support has direct physiological consequences on physical, mental and subjective health outcomes by acting as a key psychosocial “protective” factor to reduce vulnerability to the effects of stress on health. Perceived social support is one of the well-documented psychosocial factors influencing physiological outcomes ([Cohen, 1988](#_ENREF_80); [House *et al.*, 1988a](#_ENREF_182); [Berkman *et al.*, 2000](#_ENREF_39); [Uchino, 2004](#_ENREF_431); [Holt-Lunstad *et al.*, 2010](#_ENREF_178)).

The physiological effect of social support on clinical status was not directly explored in this study as the Wilson and Cleary model does not link individual factors with clinical status. A cross-sectional analysis (Table 1, appendix F) found no significant association between social support and oral clinical status (decayed teeth), contradicting the findings from previous studies which have reported associations between social support and clinical status ([Hanson *et al.*, 1994](#_ENREF_164); [Nicolau *et al.*, 2007](#_ENREF_315); [Brennan and Spencer, 2010](#_ENREF_54)). In this study, social support demonstrated a direct influence on OHQoL (represented by symptoms and functional status). Social support did not impact on GHP and overall QoL but had indirect effects through SOC and stress, which is considered as a psychological mechanism.

*Social support and adoption of healthy behaviours*

The second pathway regards higher perceived social support as related to healthy behaviours that influence health outcomes. Again, this pathway was not directly tested in this research. However, behaviours were unrelated to OHQoL either directly or via clinical status in this study. Although, previous research has supported this relationship, the results should be interpreted with caution owing to their methodological limitations. A systematic review by Umberson and colleagues ([2010](#_ENREF_435)) concluded that social ties influence health behaviour and suggested that this might be because social ties influence or control health habits; for example a spouse might monitor, inhibit, regulate or facilitate health behaviours in a partner promoting health ([Waite, 1995](#_ENREF_440)). Social relationships have been found to be associated with positive health ([Berkman and Breslow, 1983](#_ENREF_38); [Waite, 1995](#_ENREF_440); [Musick *et al.*, 2004](#_ENREF_303); [Denney, 2010](#_ENREF_110)). Thus, social ties can be seen to instil a sense of responsibility and concern for others that enables individuals to engage in healthy along with serving as a medium of providing information and creating norms that further influence health habits and behaviours. Thus, in a variety of ways, social ties may influence health behaviours that in turn may affect health outcomes.

However, it has also been indicated that pathways from social network and social support alone do not explain this relationship fully. This might be due to the low predictive power of measures of social relationships. Alternatively, the inclusion of other mechanisms like social influence and social engagement might strengthen the explanatory power of this concept. What this study adds, is empirical evidence that social relationships comprising social support and network are important for oral health and well-being. It further highlights that this might have implications for oral health promotion but we have to devise social support based interventions based on theory with use of measures which capture the concept of social relationships more comprehensively.

*Social support and psychological mechanisms*

In the final pathway, social support promotes health by facilitating coping with crisis and adaptation to change ([Cohen and Jago, 1976](#_ENREF_79); [Berkman and Syme, 1979](#_ENREF_40)). Thus individuals with more social support, experience less stress and cope better in unfavourable situations. Postulated psychological mechanisms linking social support to health include stress, depression, self-esteem and psychological states and traits ([Cohen, 1988](#_ENREF_80); [Berkman *et al.*, 2000](#_ENREF_39); [Uchino, 2004](#_ENREF_431); [Uchino, 2009](#_ENREF_432)). Cohen and Willis ([1985](#_ENREF_92)) review on the buffering hypothesis of social support suggested that support may prevent or reduce stress appraisals with corresponding influences on emotion-linked physiological responses. They further suggested that “direct effects” of social support on health may be mediated by psychological states and traits such as positive affect, predictability, and a sense of self-worth ([Cohen, 1988](#_ENREF_80); [Berkman *et al.*, 2000](#_ENREF_39)). However, they also caution about making strong inferences about these psychological mechanisms given the lack of direct available evidence as older studies were conducted in relation to mental health outcomes and would statistically control for factors such as stress to demonstrate significant social support links to health ([Berkman *et al.*, 2000](#_ENREF_39); [Cohen, 2004](#_ENREF_82); [Uchino, 2004](#_ENREF_431)). Although, evidence links high levels of social support to lower perceptions of stress, less stress exposure, and lower depression ([Sarason *et al.*, 1990](#_ENREF_376); [Russell and Cutrona, 1991](#_ENREF_363); [Raffaelli *et al.*, 2013](#_ENREF_347)), when these psychological factors are considered as primary outcomes. More recently, Uchino ([2012](#_ENREF_433)) maintains that the available data are not sufficient to demonstrate that these factors are directly responsible for associations between social support and health as most of the previous studies were conceptually less clear about whether psychological factors were confounders or mediators. The recent literature examining the influence of social support on various health outcomes found that this relationship was not statistically mediated by psychological factors such as anxiety, life stress, subjective distress, or depression ([Hilmert *et al.*, 2002](#_ENREF_176); [Clark, 2003](#_ENREF_75); [Cosley *et al.*, 2010](#_ENREF_95); [Taylor *et al.*, 2010](#_ENREF_419)). The lack of support for the buffering mechanism of social support on health can be attributed to use of less precise statistical tests of mediation, lack of conceptual clarity in social support concept and its measures and limited testing of potential mediators ([Uchino *et al.*, 2012](#_ENREF_433)).

This study overcame most of the limitations from the previous studies by using SEM guided by theoretical model, by clearly defining and using a standard measure of social support (perceived), and by testing a new variable SOC as a potential mediator, between social support, stress and health outcomes.

In the present study, the indirect pathway from social support to SHO via stress (representing the stress-buffering pathway) was not significant in the final model. However, Social network indirectly influenced SHO via social support, SOC and stress (Social network->social support->SOC->stress->SHO). Although social support did not indirectly influence SHO via stress, the model supported the theoretical perspective that social support promotes psychological traits such as self-esteem and feelings of worth which are hypothesised to enhance adaptation to stressful conditions and improving health outcomes ([Thoits, 1983](#_ENREF_423); [Cohen, 1988](#_ENREF_80); [Berkman *et al.*, 2000](#_ENREF_39); [Thoits, 2011](#_ENREF_424)). The study demonstrated two indirect pathways through which social support exerted its influence on SHO via psychological traits (Fig. 5.5.2). In the first pathway high levels of social support led to high levels of SOC, which determined better OHQoL and GHP. In the second indirect pathway high levels of social support contributed to high levels of SOC (which provides the ability to utilise resources to cope with stress; discussed in earlier section 6.2.2.1) leading to low levels of stress and thus better SHO. This study demonstrates that sense of coherence and stress are psychosocial pathways through which social support may operate. The findings also suggest that social network (an objective measure) can influence stress levels to impact on SHO. Perceived social support (subjective measure) on the other hand either influenced SHO directly or indirectly through SOC and stress. These findings suggest that both quantity (social network) and quality (depicted by social support) of the social network affected SHO.

Thus, the protective effects of social support might work by mediating SOC or indirectly influencing SOC in coping with stress. Therefore, health promotion interventions might best be devised not in isolation, but by using several pathways together, for example as by Nammontri and colleagues ([2013](#_ENREF_309)) in children where they included components of social support and participation to enhance SOC, improve behaviours and OHQoL.

*Social support as a health promotion framework*

Social support may work through all three pathways mentioned above. Although the effectiveness of social support interventions has been demonstrated in medicine ([van Dam *et al.*, 2005](#_ENREF_436); [Salter *et al.*, 2010](#_ENREF_368)) it has not been used in oral health explicitly. Due to the increased focus of oral health research on determinants of health, the relevance of the concept of social capital has been explored especially in epidemiological studies in children ([Pattussi *et al.*, 2001](#_ENREF_331); [Pattussi *et al.*, 2006](#_ENREF_330)). Three studies were found where interventions containing components of social support were targeted at parents and pregnant mothers in order to improve children’s oral health status ([Plutzer and Spencer, 2008](#_ENREF_344); [Yuan and Freeman, 2011](#_ENREF_470); [Arrow *et al.*, 2013](#_ENREF_22)). However, none of the interventions have been devised for enhancing social support to improve oral health outcomes in adults. Watt ([2002](#_ENREF_449)) suggests exploring social capital, which includes social support, as an important possible area for devising contemporary oral health promotion strategies. This study identifies and provides evidence for pathways through which social support might work and could be used as a basis for devising oral health promotion interventions to improve SHO.

##### Sense of coherence

The present findings support the hypothesis that adults with higher SOC at baseline had better OHQoL, GHP and overall QoL at follow-up (Fig. 4.4.2 & 4.4.3). SOC exerted both direct and indirect (via stress) effects on OHQoL and GHP; with, only indirect (via stress) effects on overall QoL.

Consistent with the current literature on SOC and health, the findings from this study highlight substantial and consistent relationships linking SOC to SHO in line with Antonovsky’s ([1987](#_ENREF_17)) salutogenic theory. Heconceived SOC as a generalized resistance resource (GRRs) for maintaining health and explaining why some people become ill under stress whereas others manage to cope and stay healthy.

Generalized resistance resources (GRRs) consist of biological, material and psychosocial factors such as person’s natural coping style, upbringing, financial assets, and social support. That is, the extent to which these are available is a major determinant in the development of a strong or weak SOC. Moreover, a strong SOC is a natural internal resource to cope with stressors, enabling one’s movement towards health and health promoting behaviors’. A previous study by Wiesmann and Hannich ([2008](#_ENREF_460)) found that SOC mediated the relationship between GRRs and subjective well-being in elderly people. Antonovsky’s conceptualisation is further supported by the current study where GRR’s such as socio-economic status, social network and social support determined SOC, which mediated the relationship with SHO. Thus, the data from this study support the salutogenic idea that SOC, with the availability of other resources, plays an important part in predicting SHO.

###### SOC, general and oral health

Eriksson and Lindstroms’ ([2006](#_ENREF_133)) systematic review on SOC and HRQoL provides comprehensive evidence supporting links between SOC and general health. Strong SOC was related to fewer symptoms and better self-rated health and HRQoL in both adults and children. Low SOC has been related to type 2 diabetes in Swedish women ([Agardh *et al.*, 2003](#_ENREF_10)). A cohort study in cardiovascular disease and cancer patients, 41-80 years old showed that SOC was associated with a thirty per cent reduction of mortality rate ([Surtees *et al.*, 2003](#_ENREF_415)). Low SOC was linked to life dissatisfaction, depression and poor psychosomatic health ([Myrin and Lagerström, 2008](#_ENREF_304)). In addition, SOC appears to be an important factor for better HRQoL ([Drageset *et al.*, 2009](#_ENREF_121)).

In relation to oral health, the finding that SOC predicts OHQoL is compatible with a growing body of evidence that SOC predicts better oral health outcomes. Previous studies suggest that individuals with strong SOC had more teeth, fewer decayed teeth, less periodontal pockets and good perceived oral health ([Bernabé *et al.*, 2010](#_ENREF_43); [Lindmark *et al.*, 2011b](#_ENREF_238)). Strong SOC was related to higher frequencies of tooth brushing ([Savolainen *et al.*, 2005b](#_ENREF_381); [Bernabé *et al.*, 2009](#_ENREF_41)), regular dental attendance ([Savolainen *et al.*, 2004](#_ENREF_378); [Bernabé *et al.*, 2009](#_ENREF_41)) and less intake of sugar products ([Bernabé *et al.*, 2009](#_ENREF_41)). Previous studies ([Savolainen *et al.*, 2005a](#_ENREF_380); [Baker *et al.*, 2010](#_ENREF_29); [Emami *et al.*, 2010](#_ENREF_126); [Gururatana *et al.*, 2011](#_ENREF_160); [Gururatana *et al.*, 2013](#_ENREF_161); [Nammontri *et al.*, 2013](#_ENREF_309)) have found SOC to be a determinant of OHQoL with strong SOC predicting better OHQoL in adults and children.

Although numerous studies have examined the relationships between SOC and oral health outcomes they are predominantly cross-sectional and cannot determine causality. Only studies conducted recently in Malaysia by Baker and colleagues ([2010](#_ENREF_29)) and in Thailand by Gururatana and colleagues ([2013](#_ENREF_161)) were longitudinal. Both studies found that SOC was the most important psychosocial predictor of OHQoL in children. The results indicated that a strong SOC was related to fewer symptoms, better functioning, greater health perceptions and a better QoL. These findings have been supported by recent experimental evidence in an RCT conducted in Thai school children ([Nammontri *et al.*, 2013](#_ENREF_309)) that tested a SOC intervention and found that it increased SOC and improved OHQoL and this causal relationship was found to be in accordance with Bradford Hill’s tests of causation ([Hill, 1965](#_ENREF_174)).

The present study is the first longitudinal study to be conducted with adults to identify predictors of OHQoL. It supports the findings of previous studies in children that SOC influences OHQoL. This study goes one step further in providing evidence for possible pathways through which SOC might act in adults (Section 5.2.2.1.2).

###### Sense of coherence and health promotion interventions

The previous sections suggest that SOC is an important factor for improving SHO. This section will review the studies which provide evidence that SOC can be enhanced through interventions before discussing the pathways that can be used to design such interventions.

In the wider literature, there is debate regarding the stability of SOC over time and whether it changes due to intervention. The current study addressed this issue, although the stability of SOC was only recorded at three months follow-up. There was fluctuation between time-points indicated by test-retest reliability of 0.575 (Table 4.2.9) suggesting that SOC can vary over time and might respond to interventions ([Antonovsky and Sagy, 1986](#_ENREF_20)).

Only a few primary studies have investigated whether it is possible to enhance SOC and in the process improve health outcomes in adults. An RCT conducted in women with fibromyalgia demonstrated that SOC could be enhanced in a Mindfulness-Based Stress Reduction program and was independently related to depression and perceived stress ([Weissbecker *et al.*, 2002](#_ENREF_452)). Another RCT showed talk-therapy in people with mental health problems improved SOC, which led to improved coping and recovery among participants. Similar findings were reported for the effectiveness of psychoanalytically-oriented psychotherapy in improving SOC levels ([Blomberg *et al.*, 2001](#_ENREF_46)). However, a non-controlled trial, using an 8-week multidisciplinary group-intervention program with a Salutogenic approach, focusing on somatic as well as psychological reactions, developed for patients reporting hypersensitivity to electricity, failed to improve SOC ([Hillert *et al.*, 2002](#_ENREF_175)). Participants did achieve better self-knowledge, ability to cope with stress along with identifying underlying causes that might influence health perceptions as well as motivation for additional therapy.

Delbar and Benor ([2001](#_ENREF_108)) examined the effect of a nursing intervention on the ability to cope with symptoms and treatment in a quasi-experiment with people with cancer. The SOC score in the intervention group increased and locus of control improved substantially. These changes were related to decreased intensity of symptoms and increased independence and self-knowledge. Moreover, improvements were associated with patients’ perceptions of familial help and knowledge needed to control non-physical symptoms. These findings support ideas that SOC may be related to coping.

Most of the above mentioned studies provide evidence that SOC can be improved through well-tailored and theoretically-informed interventions. They also indicate that improved SOC is related to improved symptoms, enhanced coping and better self-knowledge. Cumulatively, results from SOC interventions conducted in adults with respect to general health, an RCT conducted in children in relation to oral health ([Nammontri *et al.*, 2012](#_ENREF_308)) and the current study provide consistent evidence that SOC could play a role in promoting oral health in adults. In order to understand how SOC interventions could be applied to oral health, the next section discusses the pathways through which SOC maintains health.

###### Sense of coherence pathways in maintaining health

Antonovsky ([1996](#_ENREF_18)) hypothesised that SOC may promote health via three different pathways; 1) directly affecting physiological consequences, 2) helping people to select health promoting behaviours and, 3) by regulating coping processes. These pathways can either be direct or indirect through different channels such as through individual SES and other generalised resistance resources (GRR’s) ([Savolainen *et al.*, 2005a](#_ENREF_380); [Savolainen *et al.*, 2005b](#_ENREF_381)).

*Sense of coherence as a physiological pathway*

SOC may affect physiological responses tobuffer adverse influences in different life situations ([Suominen *et al.*, 2005](#_ENREF_414)). For example, individuals with higher SOC tend to define stimuli asnon-stressors, thereby experiencing much less tension and stress. This leads todifferences in the physiological states. Individuals with stronger SOC had lowerblood pressure, lower heart rate at rest, higher oxygen uptake capacity, lowercholesterol and triglycerides, and had fewer health problems than those with lowerSOC ([Lundberg and Peck, 1994](#_ENREF_258); [Lindfors *et al.*, 2005](#_ENREF_236)). Low SOC has beenrelated to high serum cortisol ([Kuroki *et al.*, 2011](#_ENREF_220)). Strong SOC maycreate a biological buffer against ill health and disease ([Lindfors *et al.*, 2005](#_ENREF_236)). Aphysiological effect might be likely to influence clinical status. The physiological effect of SOC on clinical status was not directly explored in this study as the Wilson and Cleary framework does not have a direct pathway linking individual factors with clinical status. However, cross-sectional analysis (Table 1, Appendix F) suggested a significant association between SOC and oral clinical status (decayed teeth), in line with previous studies where SOC predicted oral clinical status ([Freire *et al.*, 2001](#_ENREF_148); [Bernabé *et al.*, 2010](#_ENREF_43); [Lindmark *et al.*, 2011b](#_ENREF_238)). In this study, SOC also demonstrated a direct influence on OHQoL (represented by symptoms and functional status) and GHP. Hence, the study suggested that SOC might have wide-ranging impacts on individual’s SHO via physiological and other pathways. This implies that SOC can be used as an intervention tool to improve OHQoL and other SHO in adults.

*Sense of coherence and adoption of healthy behaviours*

SOC may improve health via selecting favourable behaviours that contribute to oral health. SOC has been linked to regular attendance ([Savolainen *et al.*, 2004](#_ENREF_378)) and frequency of tooth brushing ([Savolainen *et al.*, 2005b](#_ENREF_381); [Dorri *et al.*, 2010](#_ENREF_120)). Individuals with greater SOC may perceive themselves to have more control and confidence in their ability to achieve goals. They tend to comprehend the benefit of desirable behaviours such as regular twice daily brushing and are likely to see that it is worth pursuing favourable oral health behaviours. Moreover, people with stronger SOC were more likely to prevent damage, have preventive direction, seek early treatment and demonstrate high compliance ([Antonovsky, 1984](#_ENREF_16); [Antonovsky, 1987](#_ENREF_17); [Antonovsky, 1996](#_ENREF_18)). However, this study did not support pathways leading from SOC to OHQoL via OHB and dental behaviours. These pathways were further tested in the model by considering clinical status as a mediating factor (SOC->OHB->DB->clinical status->OHQoL). Again, the model did not support these pathways. A previous study assessing the relationship between SOC and OHB in children also found them to be unrelated ([Nammontri *et al.*, 2013](#_ENREF_309)). One possible reason for not finding a relationship between SOC and, OHB and dental behaviours, might be the quality of the OHB and dental behaviour scale which may have masked any relationship. Whilst, the reliability of the OHB scale was quite high (α = 0.787-0.851, test-retest reliability = 0.679, p > 0.01, see Section 5.2.10) and it covered wide range of beliefs, the beliefs explored might not have been culturally relevant to an Indian context. For example, the OHB scale enquired about the use of fluoridated water and products, and dental floss which most of the people did not know about and a fifth category of ‘don’t know’ was added to the responses. Additionally, there were some items on ‘dentist’s availability when needed’ and their ‘role in keeping away from dental troubles’, which some people were not sure as they had never visited a dentist before or had insufficient resources to access one. It may be that these problems caused misclassification that masked any relationship between beliefs and SOC. Therefore more appropriate OHB measures are needed for future research in relation to Indian populations. The dental behaviours scale had low reliability (α = 0.445-0.446, test-retest reliability = 0.728, p > 0.01, see section 5.10), thus it might not have captured the dental behaviours appropriately. A more suitable measure is needed for future use.

*Sense of coherence and coping mechanisms*

SOC may promote health by increasing the ability to utilise resources more efficiently to cope with stress. Antonovsky ([1987](#_ENREF_17)) postulated that those with greater SOC tend to be more able to manage and overcome stressors. Managing tension successfully leads to positive health ([Antonovsky, 1987](#_ENREF_17)). Adolescents with low SOC exposed to stress reported illness more than twice as often as the unstressed ones ([Nielsen and Hansson, 2007](#_ENREF_316)). People with higher SOC have lower stress, distress ([Hood *et al.*, 1996](#_ENREF_179)) and depression ([Myrin and Lagerström, 2008](#_ENREF_304)). A systematic review conducted between SOC and different aspects of health concluded that, SOC was a predictor for health when health is measured by incorporating psychological variables such as stress, although physical health was not found to be related to SOC ([Flensborg-Madsen *et al.*, 2005](#_ENREF_143); [Myrin and Lagerström, 2008](#_ENREF_304)). An RCT confirmed that SOC helps in coping by improving manageability of available resources to find solutions for the problems ([Langeland *et al.*, 2006](#_ENREF_225)). A number of studies have reported that, SOC plays a key role in psychological adaptation ([Tang and Li, 2008](#_ENREF_418); [Wiesmann and Hannich, 2008](#_ENREF_460); [Wiesmann *et al.*, 2009](#_ENREF_461)) and is an important buffer against stress ([Pallant and Lae, 2002](#_ENREF_326)).

The present study supported the coping mechanism of SOC, as SOC exerted indirect influence on OHQoL, GHP and overall QoL via stress. Adults with greater SOC had lower stress levels and better OHQoL, GHP and overall QoL. This supports previous data indicating that, adults with higher SOC had more ability to cope with stress and felt their lives were more manageable. Again, this finding has important implications for oral health promotion interventions.

*Sense of coherence as a framework for oral health promotion*

Silva and colleagues ([2008](#_ENREF_396)) proposed the use of the salutogenic theory and its central concept of SOC as a framework for oral health promotion. Possible reasons for viewing SOC as a promising approach to oral health promotion are that it counters the pathogenic theory and focuses on pathways leading to health ([Antonovsky, 1979](#_ENREF_15)). In addition, it addresses the upstream factors such as the wider social determinants of health rather than primarily focusing on changing health behaviours, as do current oral health promotion strategies ([Watt, 2007](#_ENREF_450)). In addition, it has been suggested that SOC helps to tackle oral health inequalities by improving the understanding of what sustains health in stressful and adverse conditions ([Wallerstein, 1992](#_ENREF_442); [Wallerstein, 2002](#_ENREF_443)) along with acknowledging the idea that the way people perceive social structures, create coherence and keep everything together has an important impact on health.

In relation to oral health, the recent oral health promotion intervention based on SOC in an integrated school setting modified the school environments, enabling children to clarify and mobilise resources in order to improve and maintain their oral health ([Nammontri *et al.*, 2013](#_ENREF_309)). None of the interventions based on salutogenic theory in relation to oral health have been conducted in adults. A qualitative study conducted in Sweden among hospital employees using SOC identified work-related health enhancing resources and suggested that identifying such work-related resources might be effective for workplace health promotion ([Nilsson *et al.*, 2012](#_ENREF_317)).

Health promotion mediates the relationship between people and their environments, by mobilising personal choices and social responsibility to create health. The salutogenic idea defines heath as a movement on the axis between health-ease and dis-ease ([Antonovsky, 1987](#_ENREF_17)). This approach further suggests that a person moving towards health does not imply low exposure to risk factors, but rather that individuals can keep healthy even when exposed to risk factors for oral disease, since they are able to control their lives better. Thus, SOC is recognised as an ability of people to move towards health end by identifying and utilising health resources to improve and maintain health ([Antonovsky, 1996](#_ENREF_18)).

In the field of oral health, most oral health promotion interventions are not guided by theory ([Petersen Pe. *et al.*, 2010](#_ENREF_341)), which otherwise would help to select the factors, place, time, and processes on which to intervene. Furthermore, oral health promotion, due to this lack of theoretical underpinning, focuses on increasing knowledge to change behaviours and improve clinical outcomes, which evidence suggests is not effective in improving oral health ([Watt, 2002](#_ENREF_449); [Petersen Pe. *et al.*, 2010](#_ENREF_341)). Therefore, it is important to look beyond changing behaviours to factors which help in achieving and sustaining oral health. One way of achieving this is through incorporation of theory and conceptual frameworks such as SOC and Wilson and Cleary model, for systematic identification of pathways and underlying mechanisms to inform such interventions.

##### Stress

The primary analysis confirmed that lower stress at baseline predicted better OHQoL, GHP and overall QoL at follow-up (Fig. 4.4.2 & 4.4.3). Stress exerted direct significant influences on OHQoL, GHP and overall QoL.

Lazarus and Folkman’s ([1984](#_ENREF_230)) viewed stress as ‘the relationship between a person and the environment that is appraised by the person as taxing or exceeding his resources and endangering his well-being’. These findings are consistent with this view where psychological resources such as perceived social support, SOC and environmental factors determined the appraisal of stress, which consequently affected OHQoL, GHP and overall QoL.

Stress perceived as a result of stressful events and chronic stress influences pathogenesis by triggering negative states such as anxiety and depression, which have direct consequences on the emotional, physiological, and behavioural responses that influence susceptibility to and the course of disease ([McEwen, 1998](#_ENREF_287); [McEwen and Seeman, 1999](#_ENREF_288)). Consequently, higher levels of perceived stress are implicated in the development of both systemic and oral diseases ([Cohen *et al.*, 2007](#_ENREF_85); [Cohen and Janicki-Deverts, 2012](#_ENREF_84)). Additionally, stress is associated with reported symptoms and use of health services ([Herbert and Cohen, 1994](#_ENREF_170)).

###### Perceived stress, general and oral health

Psychological stress is a risk factor for numerous disease states including acute respiratory illnesses ([Cohen *et al.*, 1991](#_ENREF_90); [Miller and Cohen, 2005](#_ENREF_296); [Pedersen *et al.*, 2010](#_ENREF_334)), cardiovascular diseases ([Rozanski *et al.*, 1999](#_ENREF_360); [Krantz and McCeney, 2002](#_ENREF_214); [Stansfeld and Marmot, 2002](#_ENREF_409); [Dimsdale, 2008](#_ENREF_117)), HIV/AIDS ([Leserman J, 2000](#_ENREF_233); [Pereira and Penedo, 2005](#_ENREF_335)), cancer ([Chida *et al.*, 2008](#_ENREF_73); [Mundy-Bosse *et al.*, 2011](#_ENREF_302)) and autoimmune diseases such as rheumatoid arthritis ([Heijnen and Kavelaars, 2005](#_ENREF_168)). A meta-analysis concluded that psychological stress impacts on several markers of the immune system ([Segerstrom and Miller, 2004](#_ENREF_386)) and, the process of wound healing ([Marucha *et al.*, 1998](#_ENREF_274); [Kiecolt-Glaser *et al.*, 2005](#_ENREF_208); [Walburn *et al.*, 2009](#_ENREF_441)) .

People under stress engage in poor health practices such as increased smoking, drinking, reduced exercise ([Heslop *et al.*, 2001](#_ENREF_171); [Metcalfe *et al.*, 2003](#_ENREF_295)); and eating poorly ([Newman *et al.*, 2007](#_ENREF_310); [O'Connor *et al.*, 2008](#_ENREF_320)), which are risk factors for physical illnesses ([Cohen and Williamson, 1988](#_ENREF_91)).

In relation to oral health, our finding that stress predicts OHQoL is consistent with other research, although, this research has been limited. In adults, perceived stress as a result of life events (e.g. death of a spouse) has been linked to increased rate and development of dental caries ([Sutton, 1993](#_ENREF_416)) and periodontal diseases ([Croucher *et al.*, 1997](#_ENREF_100); [Hugoson *et al.*, 2002](#_ENREF_189); [Wimmer *et al.*, 2002](#_ENREF_465); [Peruzzo *et al.*, 2007](#_ENREF_338); [Rai *et al.*, 2010](#_ENREF_348)). Perceived work stress was related to bleeding gums and pockets ([Marcenes and Sheiham, 1992](#_ENREF_264)). Levels of stress are higher in patients with rapidly progressive periodontitis as compared to chronic adult periodontitis or no periodontal destruction (Monteiro da Silva, 1996). Also people with ineffective stress coping strategies were at greater risk of developing severe periodontitis ([Genco *et al.*, 1999](#_ENREF_151); [Wimmer *et al.*, 2002](#_ENREF_465)). Higher stress was a significant predictor of poorer general and oral health in ethno-racial groups in the United States ([Watson *et al.*, 2008](#_ENREF_447)). In terms of behaviour, higher perceived stress was related to less frequent tooth brushing and changing of tooth brushes, less regular visits to the dentist and more frequent drinking alcohol and smoking ([Deinzer *et al.*, 2001](#_ENREF_107); [Deinzer *et al.*, 2005](#_ENREF_106); [Spalj *et al.*, 2008](#_ENREF_407)).

Locker (2000) suggested that stress leads people to view their oral health more negatively and Sanders and Spencer ([2005b](#_ENREF_373)) found that higher perceived stress in adults was associated with low self-rated oral health.

Sander and Spencer ([2005a](#_ENREF_372)) tested perceived stress in relation to OHQoL among a nationally representative sample of 3678 aged 18-91 years and concluded that adults with higher perceived stress had worse OHQoL after adjusting for potential confounders of sex, age and household income both in bivariate and multivariate linear regression analysis. As the data were collected at one point in time causal inferences could not be drawn from the observed relationships.

This is the first study to examine longitudinally the impact of stress on OHQoL. The results suggest that stress influences SHO including OHQoL, along with suggesting various pathways through which stress and other stress buffering agents work. There is a wide literature on stress management strategies in workplaces, academic institutions and in general which suggests that such interventions can help to lower stress levels and improve health outcomes in adults ([Edwards and Burnard, 2003](#_ENREF_123); [Steed *et al.*, 2003](#_ENREF_410); [Richardson and Rothstein, 2008](#_ENREF_353)). Thus, identification of stress as a predictor of SHO and pathways through which it works can be used as empirical evidence for devising stress management interventions in relation to oral health in adults.

###### Stress pathways affecting health

*Stress and its impact on physiological pathways*

Cohen ([2007](#_ENREF_85)) suggested that stress may produce physiological consequences through activation of the sympathetic nervous system (e.g. immunosuppression which can cause periodontal tissue breakdown) and endocrine system (increased hormone production e.g. salivary cortisol). This pathway through which stress produces disease is the concept of ‘Psychoneuroimmunology’, which suggests that a person’s psychological state can influence their immune system via the nervous system leading to physiological consequences ([Cohen and Herbert, 1996](#_ENREF_83)).

A meta-analyses of prospective studies on stress and cardiovascular (CVD) disease suggested CVD arose as a result of stress from social isolation or work via adverse metabolic changes as one of the main underlying mechanisms ([Kivimäki *et al.*, 2006](#_ENREF_211); [Richardson *et al.*, 2012](#_ENREF_354)). Similarly, in relation to oral health, a systematic review provided evidence for the physiological changes to be related to a higher risk of development of periodontitis ([Peruzzo *et al.*, 2007](#_ENREF_338)).

The physiological effect of stress on clinical status was not directly explored in this study as the Wilson and Cleary model does not have a direct pathway linking individual factors with clinical status. However, a cross-sectional analysis (Table 1 appendix F) found no relationship between stress and clinical status, contrary to previous studies which reported associations between stress and oral clinical status ([Marcenes and Sheiham, 1992](#_ENREF_264); [Sutton, 1993](#_ENREF_416); [Croucher *et al.*, 1997](#_ENREF_100); [Hugoson *et al.*, 2002](#_ENREF_189); [Wimmer *et al.*, 2002](#_ENREF_465)). In this study, stress demonstrated a direct influence on OHQoL (represented by symptoms and functional status). The lack of a relationship between stress and oral clinical status (decayed teeth) suggests that the effect of stress on OHQoL is not physiologically mediated. None the less, the study provided empirical evidence that stress effects OHQoL and other SHO which might have implications for oral health promotion.

*Stress and its impact on health-related behaviours*

Stress has been linked to maladaptive behaviours such as increased smoking, drinking and reduced daily exercise ([Heslop *et al.*, 2001](#_ENREF_171); [Metcalfe *et al.*, 2003](#_ENREF_295); [Ng and Jeffery, 2003](#_ENREF_312)); and eating poorly ([Ng and Jeffery, 2003](#_ENREF_312); [Newman *et al.*, 2007](#_ENREF_310); [O'Connor *et al.*, 2008](#_ENREF_320)), which are risk factors for disease ([Cohen and Williamson, 1988](#_ENREF_91)). In relation to oral health, higher stress has been related to less frequent tooth brushing and changing of tooth brushes and less regular visits to the dentist ([Deinzer *et al.*, 2001](#_ENREF_107); [Deinzer *et al.*, 2005](#_ENREF_106); [Spalj *et al.*, 2008](#_ENREF_407)).

Although stress has been linked to unhealthy behaviours and practices, positive behaviours such as exercise which might help in coping with stress ([Ensel and Lin, 2004](#_ENREF_132)).

In this study the pathway from stress to dental behaviours and oral health beliefs was not explored within the model. However, cross-sectional analysis between them suggested a significant relationship (Table 1 appendix F).

*Stress, its interaction with other psychological factors*

People appraise stress differently depending on the availability of social and personal resources. Thus, people in comparable situations respond differently to similar stressors; e.g. one person might display depression while other person might only feel challenged rather than threatened ([Antonovsky and Sagy, 1986](#_ENREF_20)). One explanation is the difference in psychological traits among people. Psychological factors mediate the relationship between stress and health outcomes ([Pearlin and Skaff, 1996](#_ENREF_333); [Ogden, 2012](#_ENREF_321)) by easing or deflecting the detrimental impacts of stress on health ([Taylor *et al.*, 1997](#_ENREF_420)). Social support and sense of coherence as psychological mediators of stress have been discussed in previous sections (Sections 6.2.2.1.3 & 6.2.2.2.3). Other factors such as mastery, self-esteem, personal control have been cited in the literature which might mediate the effects of stress ([Ogden, 2012](#_ENREF_321)).

#### Individual factors not associated with SHO in the model

Oral health beliefs, dental behaviours and subjective SES were not predictors of SHO in the current study. The possible reasons for these non-associations are discussed below.

##### Oral health beliefs, dental behaviours and SHO

There is a paucity of studies exploring the relationship between OHB and SHO in adults. Only two studies ([Broadbent *et al.*, 2006](#_ENREF_57); [Nammontri *et al.*, 2013](#_ENREF_309)) in children found positive oral health beliefs to predict better OHQoL. No studies have been found in adults testing this relationship. Studies have found relationships between OHQoL and dental behaviours ([Tomarken and Waller, 2003](#_ENREF_427); [Thomson *et al.*, 2004](#_ENREF_425); [Savolainen *et al.*, 2005a](#_ENREF_380)). But all these studies have used different indicators of OHB and dental behaviours and moreover, standard measures do not exist for these variables. Additionally, most of these studies are cross-sectional and test single variables, not taking into account complex relationships. One possible explanation for the lack of prediction by OHB and dental behaviours can be the quality of the measures. The OHB questionnaire was adapted from Nakazono and colleagues ([1997](#_ENREF_307)), which is not a standard and validated measure of OHB. Further work could establish better measures of OHB and dental behaviours in adults.

##### Subjective SES and SHO

Several studies link subjective SES to clinical or subjective health outcomes ([Singh-Manoux *et al.*, 2003](#_ENREF_397); [Operario *et al.*, 2004](#_ENREF_323); [Singh-Manoux *et al.*, 2005](#_ENREF_398); [Cohen *et al.*, 2008](#_ENREF_89) ). Most of these associations remained significant despite adjustment for objective SES.

In the current study the pathways between subjective SES and SHO were not significant in the final SEM model. One reason might be that, SES is so well demarcated by the objective measure that subjective SES plays relatively little role. Secondly, most of the previous studies had methodological limitations, which does not allow gaining a causal insight in this relationship. Lastly, none of the studies tested this concept within a theoretical framework accounting for individual characteristics which might act as predictors or moderators of subjective SES. For example SOC which determines how a person views life/ situations as stressful can also act as a predictor of subjective SES. It is suggested that the socio-psychological processes contribute to subjective SES ([Lundberg and Kristenson, 2008](#_ENREF_257)). Thus, in order to understand how SES is perceived and assessed by individuals, it is important to understand what factors predict subjective SES. This might also suggest that the relationship between perceived SES and health simply represents a bias based on factors such as psychological traits and resources. Another reason for not finding a relationship between subjective SES and health might be because subjective SES is a concept which measures relative social status and provides explanation for the gradient in the relationship between SES and health. In the sample the distribution of the objective indicators of the socio-economic status was skewed with more people in the sample being in lower SES group. The SES ladder is able to capture the relative SES better when the objective indicators are homogenously distributed. Thus in this sample, objective SES was a better indicator of the social status. Objective SES exerted an indirect influence on OHQoL through clinical status and individual factors.

#### Environmental characteristics

##### Socio-economic status

Adults with higher SES at baseline had better OHQoL, GHP and overall QoL at follow-up (Fig. 5.5.2 & 5.5.3). SES exerted indirect significant influence on OHQoL through clinical status and individual factors, while both direct and indirect (via clinical status and individual factors) effects were exerted on GHP and overall QoL.

These findings are consistent with the view that SES is a key determinant of health, reaffirming a gradient in which individuals higher in the social hierarchy (earn more, more educated and holding more respected occupational rank) enjoy better health than those below them. Health improves and mortality decreases at each higher step of occupational grade via materialistic, behavioural and psychosocial pathways (Section 2.4.2). The current study explored and found support for all these pathways within the model.

###### Pathways linking SES and SHO

The pathways linking SES to SHO identified within the model are consistent with the material, behavioural and psychosocial explanations (Section 2.4.2) and are discussed below.

1. ***Material explanations***

The materialistic pathway embraces the role of external environment, the physical and material conditions of life determined by occupational class, income and position on health status.

The present study identified a significant direct pathway from socio-economic status to oral clinical status (decayed teeth, periodontal status), although, not to missing teeth and to OHQoL, GHP and overall QoL. Thus this study suggests that SES can impact on clinical status and SHO directly. This direct impact might be economically determined, drawing parallels to the materialistic explanation where health outcomes are determined by access to tangible resources such as food, shelter, services and amenities that are less available to people from lower socio-economic backgrounds. Thus people from low SES backgrounds eat less healthy foods or cannot afford to go to more apparent disease.

However, several authors have questioned the solo role of the materialistic arguments in explaining the link between SES and health, arguing that despite the increase in life expectancy as a result of better standards of living, inequalities still persist ([Wilkinson, 1992](#_ENREF_462); [Wilkinson, 1996](#_ENREF_463); [Richard, 1997](#_ENREF_352)). This is further supported by the current study where other explanations and pathways were evident.

1. ***Behavioural and Cultural pathways***

In line with previous studies, this study did not support the relationship between SES and health via behaviours ([Lantz *et al.*, 1998](#_ENREF_226); [van Oort *et al.*, 2005](#_ENREF_437); [Skalická *et al.*, 2009](#_ENREF_400); [Rongen *et al.*, 2013](#_ENREF_358)). Although the model supported the pathways from SES to behaviours, behaviours did not mediate the relationship between SES and clinical status and SHO. This finding is similar to a previous study where adding behaviours as mediating mechanism to SEM model led to a relatively small change when compared to psychological factors ([Mulatu and Schooler, 2002](#_ENREF_301)). The addition of the psychological factors to the model produced a larger reduction suggesting that a notable proportion of the overall SES-health relationship is mediated by the psychological factors and possibly other factors which were not included in the study such as social capital, and other psychosocial factors ([Mulatu and Schooler, 2002](#_ENREF_301)). The SES-health relationship was not mediated by behaviours might be due to the questionnaires used to assess behaviours and beliefs.

***3 Psychosocial pathways***

The differences in the psychological traits and resources between socioeconomic groups have often been suggested to mediate the SES-health relationship ([Marmot, 2004](#_ENREF_268)). Individuals from lower socioeconomic backgrounds or living under relative socio-economic disadvantage are hypothesized to experience more psychosocial stress ([Marcenes and Sheiham, 1992](#_ENREF_264)), receive less social support ([Gore, 1978](#_ENREF_156)), and have lower sense of coherence (Bernabé, 2009) than individuals from higher groups.

Several models integrate psychosocial factors into the SES-health relationship ([Matthews and Gallo, 2011](#_ENREF_278)). One such model proposed that environmental factors shape psychological processes, health related-behaviours, and neuroendocrine responses to stress as intermediary pathways to physical disease ([Adler and Snibbe, 2003](#_ENREF_9)). Matthews and colleagues ([2010](#_ENREF_279)) explain why people from lower socio-economic groups are more reactive to stress using the term ‘reserve capacity’. Reserve capacity refers to the bank of resources; –tangible, interpersonal and intrapersonal which directly or indirectly assist a person to deal with stressful conditions. People belonging to the lower SES groups have fewer resources to cope with stress compared to their higher counterparts. The reserve capacity diminishes as people succumb to greater situations where such resources need to be used with little scope of replenishment.

Such models are useful as they provide specific and theory driven hypotheses. However, most of the research has focussed on testing isolated tenets rather than complete models. The lack of integrative testing and sophisticated analytical approaches leads to paucity of longitudinal data sequentially examining temporal relationships and causal influences. In an attempt to overcome these gaps, a study of the reserve capacity model in women with metabolic syndrome ([Matthews *et al.*, 2008](#_ENREF_280)) suggested two pathways: direct from SES to metabolic syndrome risk and indirect from, via reserve capacity (reflected by optimism, social support and self-esteem) and negative emotions. In present study stressful life events were not included in the final SEM model due to the lack of association with SES in the preliminary analysis. This can be attributed to other types of stress such as perceived stress due to daily life hassles which might have been more tied to SES gradients rather than stressful life events.

These models bring together psychosocial pathways which can affect SES-health relationship. However most of these models link psychosocial pathways with physical rather than subjective health. The reserve capacity theory is supported by the current study with the final model delineating pathways from SES to individual characteristics (representing interpersonal and intrapersonal resources in the reserve capacity theory). The study provides evidence that SES determines levels of resources such as social support, SOC which mediate stress, leading to health outcomes. Thus, the model in this study provides support for the SES- health relationship via the psychosocial pathway.

###### Summary for SES-health pathways

This study provides support for the psychosocial pathways and does not support the behavioural pathway. Although, SES was seen to predict health behaviours, behaviours were unrelated to health outcomes.

However, the explanations for SES-health relationship are not mutually exclusive; but may work together to produce inequalities. A study in which structural equation modelling allowed exploration of reciprocal relationships between SES and health status and found evidence for the causal path from SES to health ([Mulatu and Schooler, 2002](#_ENREF_301)). One third of the mediating mechanisms between SES involved health-related lifestyles/behaviours and psychosocial distress. However, the effect of SES on health was greater due to the differences in psychological distress. Psychosocial factors played a stronger role when compared to health-related behaviours. This has important implications for oral health promotion strategy.

### Methodological limitations of the present research

As in any project, this research has methodological limitations that should be considered while interpreting the results.

***Sample composition***

Women were under-represented in the study sample. Given the very small proportion of women (4%), gender differences could not be explored. Mc Grath and Bedi ([2000](#_ENREF_284)) found that social and psychological impacts of oral health were greater in women than men. These differences should be explored in future studies. Due to the nature of the research site, women were only employed for office work. Therefore these findings should be generalised to women only with care. However, the relative gender homogeneity within the sample will have restricted the sample affording greater power to analyse other relationships.

The study sample was unequally distributed with respect to SES with more participants with lower income, lower occupational grade and lower education. This is expected given the nature of an automobile parts manufacturer, which consists of more labourers than in managerial positions.

The sample had some people who were illiterate, which could have produced bias in the responses, as these participants were interviewed. However, comparing responses between the literate and illiterate group revealed differences only in the oral health beliefs and general health perceptions (Table 2, Appendix F).

All the clinical variables suggested by the WHO were recorded in this study and three clinical variables decayed teeth, periodontal status and missing teeth were included in the final analysis. The population sample had low caries and treatment experience levels (DMFT= 2.1) with greater periodontal problems which might have affected the results. Repeating the study in a population with more common and severe disease might produce stronger relationships.

***The follow-up period***

The sample was followed over a period of 3-months. Although this period allowed inferences about the direction of the relationships, relationships should be tested in future studies with longer follow-up. However, this is the first longitudinal study exploring determinants of OHQoL in adults, and thus can serve as a basis for future studies.

***Cultural issues and quality of the questionnaires***

Most measures used in the current study were developed in western countries and applied cross-culturally. OHIP-14, has been translated and widely used in various countries, demonstrating its applicability and validity worldwide ([Walter *et al.*, 2007](#_ENREF_444); [Gabardo *et al.*, 2013](#_ENREF_150)). Similarly, the SOC questionnaire has been used in at least 33 languages and 32 countries (Eriksson and Lindstrom, 2005). The Perceived Stress Scale ([Cohen, 1994](#_ENREF_81)) and multidimensional social support scale ([Dahlem *et al.*, 1991](#_ENREF_102)) have been used in several languages and cultural settings. Whilst all questionnaires were translated to Hindi, translated and adapted versions may not be successful because of differences in expectations and culture (Touze *et al*., 2006). For example, the word ‘Self-conscious’ in OHIP-14 was not congruent in direct translation to Hindi. The translational word for self-conscious in Hindi means ‘shy’. Instead, a Hindi word which is not used in common practice was considered. In another example, the OHB scale enquired about the use of fluoridated water and products, and dental floss, which most participants did not know about, so a fifth category of ‘don’t know’ was added to the responses.

To overcome these difficulties, rigorous translation procedures were performed. Back translations were repeated until the measures achieved high quality. Simple language was used for ease of interpretation. Pre-tests were conducted in 20 adults to test their validity and reliability. However, these difficulties may have restricted the psychometrics of the questionnaires.

Although all questionnaires were tested in the pilot study, there were limitations of the mathematical properties of the questionnaires. Their internal reliability varied. The social support, OHB, social network, OHIP-14, GHP scales had high internal consistency (ranging from α = 0.88-0.75) whereas the SOC scale had moderate internal consistency (α > 0.7). However, the stress scale was less reliable (α = 0.30-0.46), which is related to the small number of items in the scale (4 items) (Reliability increases with more items). Conversely, many previous studies on OHQoL have used single item GHP questionnaires, but this study used a multi-item questionnaire which might have affected the results.

The questionnaire was long which might have led to respondent fatigue/burden with participants responding to items in the same sequence or leaving questions unanswered. In order to avoid this, the researcher (EG), checked for sequences and/or missing data before accepting the completed questionnaires. If any questionnaires had missing data, the participants were asked to complete them.

Despite these limitations, this study has contributed to oral health research by being the first longitudinal study to explore factors which determine OHQoL in adults. It will be worthwhile to further study the influence of individual and environmental factors on SHO in other groups. Future studies should consider whether same findings can be detected in different groups of populations (demographically), with different pattern of disease and longer follow-up periods.

## CONCLUSIONS AND RECOMMENDATIONS

### Summary of the findings

This longitudinal clinical and self-report questionnaire study intended to identify determinants of OHQoL adults in a workplace in India. The theoretical model by Wilson and Cleary (1995) guided the research and helped to identify variables using structural equation modelling as the primary analytical approach. Data included demographic factors, clinical factors, individual factors (SOC, social support, stress, OHB, dental behaviours, subjective SES), environmental factors (SES and social network) and SHO (OHQoL, GHP and overall QoL). Data for all the variables were collected at baseline and at 3-month follow-up, except for clinical data which were collected at baseline only.

This study has contributed to current knowledge by identifying predictors of OHQoL in adults. It is the first study which has explored the determinants of OHQoL in adults using an explicit theoretical model, longitudinal design and robust analytical techniques.

This chapter summarises the findings and recommendations arising from this study:

***Conclusions:***

1. Clinical factors (decayed and missing teeth) directly predicted OHQoL, and indirectly were related to other SHO (GHP and overall QoL).
2. Sense of coherence an important predictor of adults’ OHQoL. Two pathways were identified; direct form SOC at baseline to OHQoL and GHP at follow-up and indirect, from SOC at baseline to SHO at follow-up (OHQoL, GHP, overall QoL) via its mediating effect on stress.
3. Social support at baseline predicted OHQoL directly at follow-up, whilst predicting OHQoL, GHP and overall QoL at follow-up indirectly through SOC and stress at baseline.
4. Similarly, perceived stress (at baseline) was another factor which directly predicted SHO (OHQoL, GHP and overall QoL) at follow-up.
5. Other individual factors tested in the model; oral health beliefs, dental behaviours and subjective SES did not predict SHO.
6. Among the environmental factors, SES was a strong predictor of SHO. SES at baseline predicted OHQoL via clinical status. SES predicted GHP and overall QoL both directly and indirectly via clinical status and OHQoL. Thus SES operated through SOC and stress.
7. Social network another environmental factor which indirectly predicted SHO via social support and stress.

### Recommendations

The recommendations based on the findings are as follows:-

#### Recommendations for policy

* Scientific evidence should be used to inform social policies and programs explicitly by considering social support and sense of coherence as mechanisms for enhancing population health and well-being.
* Psychosocial mechanisms in SES-health relationship were found important in this study again suggesting important policy implications.

#### Recommendations for research

* Based on the results of this study and previous evidence, psychosocial factors need further exploration as a possible framework for oral health promotion.
* Theory should be used to guide, develop and evaluate oral health promotion interventions as it provides a bridge from findings in one study to another. This helps to systematically define constructs allowing for comparisons and evaluations across studies. Similarly, interventions informed by well-developed and tested theories also may be more effective in achieving their aim than those not based on theory.
* Longer follow-up periods (i.e. at least 6 months) are required to further confirm and explore the stability of these findings.
* Psychological resources as a framework for health promotion and in particular Salutogenesis comprising of SOC, warrant further research as a framework for oral health promotion in adults as they focus on pathways leading to health ([Antonovsky, 1979](#_ENREF_15)). SOC addresses the upstream factors such as the wider social determinants of health rather than primarily focusing on changing health behaviours in line with current oral health promotion strategies ([Watt, 2007](#_ENREF_450)). GRR is recognised as an ability of people to move towards health by identifying and utilising health resources to improve and maintain health ([Antonovsky, 1996](#_ENREF_18)). In addition, SOC may help to tackle oral health inequalities by improving the understanding of what sustains health in stressful and adverse conditions ([Wallerstein, 1992](#_ENREF_442); [Wallerstein, 2002](#_ENREF_443)) along with acknowledging the idea that the way people perceive social structures, create coherence and keep everything together has an important impact on health.
* Similarly, resources like perceived social support and concepts of social capital might prove instrumental in devising future oral health promotion strategies. Social support as a health enabling resource rests on the idea that health promotion is not only individual responsibility but also of their families and communities. Thus, social support instils a sense of belonging and intimacy and empowers people to be more competent and self-efficacious. Therefore, devising social support interventions in relation to oral health in adults might prove to be an innovative gateway for achieving oral health.
* In relation to the present research workplace health interventions can be devised incorporating components of social support and sense of coherence which were found to be important predictors of subjective oral health.
* Such a workplace oral health promotion intervention might include health education through health coaching (e.g. peer-led, online/telephonic) with changes in the physical and social workplace environment (group health activities, incentives for achieving health goals, workplace screenings). These interventions need to be underpinned by participant ownership, such as through creation of health wellness teams and appointment of wellness ambassadors from amongst the employees who integrate health goals of the employees with the business goals of the worksite. Such initiatives aim to improve both social support and sense of coherence of the participants consequently improving employee absenteeism and productivity, reducing employer health costs, and increasing employee job satisfaction.
* This research should be repeated among populations with both men and women to identify any gender based group differences in the current findings.
* This research should be repeated among demographically heterogeneous populations (nationally representative samples) in order to identify different phenomena behind these conceptual ideas.
* Research is required to demonstrate SOC, social support as a personal asset in oral health promotion especially its usefulness in oral health interventions in adults.
* Further validating the pathways found in this study by replicating it in the form of another study or by devising an intervention based on these pathways.

# APPENDICES

**Appendix A:** Employee Information Sheet

Participant Consent Form

Approval Letter from Company Management

**Appendix B:** Clinical Examination Form

**Appendix C:** Questionnaires Booklet

**Appendix D:** Significant specific indirect effects for the statistically parsimonious Wilson and Cleary model with decayed teeth as the clinical factor

**Appendix E:** Fit indices and statistically parsimonious Wilson and Cleary model with missing teeth and periodontal status as the clinical factor

**Appendix F:** Cross-sectional analysis for psychosocial factors and clinical factors not explored within the statistically parsimonious Wilson and Cleary model

1. Employee Information/ Participant Consent Form/ Approval Letter from Company Management



**School of**

**Clinical**

**Dentistry**

**Title of Study: Adult Oral Health**

**Employee Information Sheet**

You are being invited to take part in a research study. Before you decide it is important that you understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

**What is the purpose of the study?**

With the help of this study we would like to identify what things might influence adult’s quality of life. We hope our findings will help us gain a better understanding of adults’ experiences of their oral health. Before you decide to take part it is important for you to know what the study will involve.

**Why have I been asked to take part?**

We are asking adults over 18 years of age employed at Friends Auto Ltd. to take part. This is because we are interested in oral health and quality of life in adults

**Do I have to take part?**

It is completely up to you to decide whether or not to take part. You are free to withdraw from the research at any time and do not have to give a reason.

**What will happen to me if I take part? What do I have to do?**

If you decide to take part you will have to-

1. Undergo a whole mouth check-up
2. Complete a series of questionnaires which will ask about what you think about yourself and the world around you and about your oral health.
3. Answer the same questionnaires again 3 months later

**What are the possible disadvantages and risks of taking part?**

There are no known risks. We will just ask you to fill in some questionnaires and let us examine your mouth. We can assure you, we will not administer any treatment. If there are any questions you find upsetting or personal, please feel free not to answer them.

**What are the possible benefits of taking part?**

There might be no immediate or direct benefits to you. However, this research will help us gain a better understanding of adult’s experiences of their oral health. This help from you will enable us to find better ways of providing oral health care to people like you.

If you do decide to take part in this study the time you will need to commit to completing the questionnaires will be recognised and you will receive an incentive for completing the questionnaire at each stage. These incentives will be given to you at the end of each session. For both the stages of the study you will be entered into a free prize draw to win X and Y respectively.

**Will my taking part in this study be kept confidential?**

All information that you provide us for this study will be kept **strictly confidential**. To protect your privacy, your **name** will **not** appear on any questionnaire. You will be allocated an identification number which will be used as an identifier. Only you and the research team will know your name and identification number.

**Did anyone else check the study is ok to do?**

The study’s protocol has been reviewed and approved by the University of Sheffield Research Ethics Committee, UK. They make sure the research is ok to do. The management of the Friends Auto Ltd has also given permission to do this research in their company.

****What if I wish to complain about the way in which the study has been conducted?****

**If you have any cause to complain about any aspect of the way in which you have been approached or treated during the course of this study please contact-**

**Dr Ekta Gupta**

**Phone number-0129-4064868**

**Email:ekta0709@gmail.com**

**Contact details at the University of Sheffield:**

**Dr Sarah Baker**

**Academic Unit of Dental Public Health**

**School of Clinical Dentistry**

**Claremont Crescent**

**Sheffield, UK**

**S10 2TA**

**Telephone: 0044 114 271788**

**Email:s.r.baker@sheffield.ac.uk**



**School of**

**Clinical**

**Dentistry**

Participant Code: ……………………………………………..

**CONSENT FORM**

**ADULT ORAL HEALTH**

**Title of Research Project:** Determinants of oral health related quality of life in adults

**Name of Researchers:** Dr. Ekta Gupta, Dr Sarah Baker, Prof. Peter. G. Robinson

1. I confirm that I have read and understood the information sheet dated………………… explaining the above research project and I have had the opportunity to ask questions about the project.
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences on my employment. In addition, should I not wish to answer any particular question or questions, I am free to decline.
3. I understand that my responses will be kept strictly confidential. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research.
4. I agree for the data collected from me to be used in future research
5. I agree to take part in the above study.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

**Name of Participant Signature Date**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

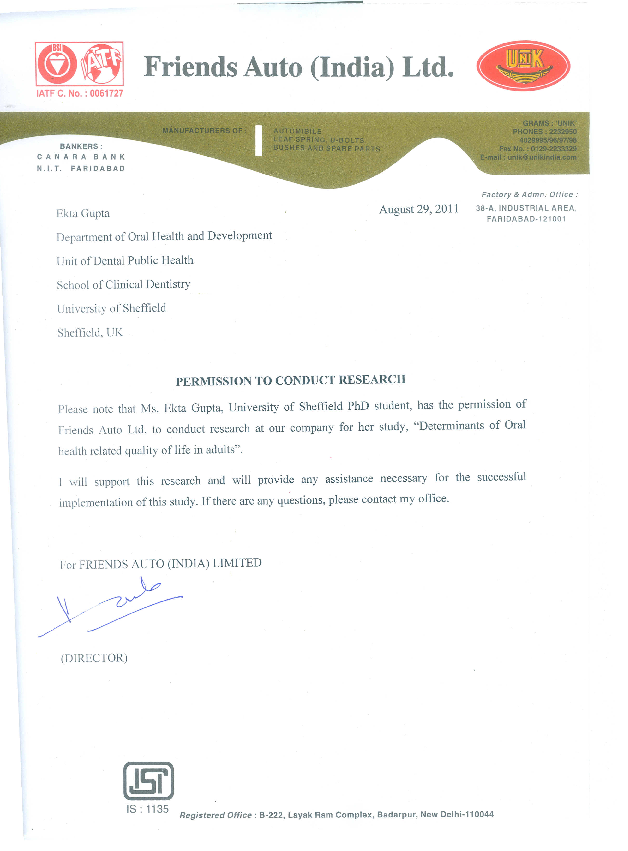
**Dr Ekta Gupta (Researcher) Signature Date**

**Copies:** Please sign both copies of this consent form.

You will need to keep **one copy** of this consent form for your own records and **hand in one** to the research team.

**Fair Processing Notice**

Your personal data will be used only in accordance with Thesis Research (PhD) at the University of Sheffield United Kingdom under the Data Protection Act 1998 and in compliance with the Freedom of information act 2000. The researcher will not disclose any personal information to any other third parties without your express concern.

**Approval to Conduct Research**

1. Clinical Examination Form

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| --- |
| **CLINICAL EXAMINATION FORM** |
| 1. **PERSONAL DETAILS**   **Name………………………………………….** Date: \_\_/\_\_/2012    Identification Number   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |      |  | | --- | | Date of Birth: …………………… Age (years): ………Sex (M=1, F=2): ………….. |   (dd/mm/yy) (last birthday) |
| 1. **CARIES STATUS AND TREATMENT NEED**  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 17 | 16 | 15 | 14 | 13 | 12 | 11 | |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 21 | 22 | 23 | 24 | 25 | 26 | 27 | |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 47 | 46 | 45 | 44 | 43 | 42 | 41 | |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 31 | 32 | 33 | 34 | 35 | 36 | 37 | |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |   **Caries Status** (Codes 0-9) **Treatment Need** (Codes0-9)  0=Sound 0=None, no Treatment required  1=Decayed 1=Filling needed, one surface only  2=Filled, with Decay 2=Filling needed, two or more surface  3=Filled, No Decay 3=Crown for any reason  4=Missing, as a result of Caries 4=Veneer or Laminate  5=Missing, any other reason 5=Pulp Care or Restoration  6=Bridge Abutment, Special Crown 6=Extraction needed  or Veneer/Implant  7=Unexposed Root 7=Fissure Sealant present  8=Trauma (Fracture) 8=Need for other care (specify)……  9=Not recorded 9=Not recorded |



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**Dentistry**

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| --- | --- | --- | --- | --- | --- | --- |
| 1. **PERIODONTAL INDEX (CPI)**   16  11  26  46  31  36   |  |  |  | | --- | --- | --- | | **0 1 2 3 4 5 9** | **0 1 2 3 4 5 9** | **0 1 2 3 4 5 9** | | **0 1 2 3 4 5 9** | **0 1 2 3 4 5 9** | **0 1 2 3 4 5 9** |   **Codes**  0=Healthy  1=Bleeding  2=Calculus  3=Pocket 4-5 mm (Black band on probe partially visible)  4=Pocket 6mm or more (Black band on probe not visible)  5=Excluded sextant  9=Not recorded |
| 1. **MALOCCLUSION- DENTAL AESTHETICS INDEX** 2. Missing Teeth   Number of missing incisor Max………. Man…………….  Number of missing canine Max………. Man…………….  Number of missing Max………. Man…………….   1. Crowding   0 - no crowding  1 – One segment crowded  2 - Two segments crowded   1. Spacing   0 - no spacing  1 – One segment spaced  2 - Two segments spaced   1. Diastema   Space (in mm) between maxillary incisors…………..   1. Largest anterior mandibular irregularity……………………… 2. Largest anterior mandibular irregularity……………………………… 3. Anterior maxillary overjet…………………. 4. Anterior mandibular overjet………………….. 5. Vertical anterior openbite…………………… 6. Antero-posterior molar relation   0 - Normal,  1 -Half cusp  2 - Full cusp |

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| 1. **ORAL MUCOSA**   **Mucosal Disease**  1-Yes (please specify type)……………………………………………….  2-No |
| 1. **PROSTHETIC STATUS**     0=No prosthesis Upper Lower  1=Bridge  2=More than one bridge  3=Partial denture  4=Both denture and partial denture  5=Full removable denture  9=not recorded   1. **PROSTHETIC NEED**   0=No prosthesis needed Upper Lower  1=Need for one-unit prosthesis  2=Need for multi-unit prosthesis  3=Need for a combination of 1& 3  4=Need for full prosthesis  9=not recorded |

1. Questionnaire Booklet

I. D. Number: …………………….

**A STUDY OF THE DETERMINANTS OF ORAL HEALTH RELATED QUALITY OF LIFE IN ADULTS**

**QUESTIONNAIRE BOOKLET**



Ekta Gupta

Email: mdp08eg@sheffield.ac.uk

Tel: 0114 2717885

Supervisors: Dr Sarah Baker & Professor Peter.G.Robinson

Unit of Dental Public Health

School of Clinical Dentistry

Claremont Crescent

Sheffield, UK (S10 2TA)

**ADULT ORAL HEALTH**

* Thank you for agreeing to help us with this study.
* This study aims to identify the determinants of oral health related quality of life in adults.
* This study is being done so that there will be more understanding about the problems adults encounter because of their teeth, mouth, lips or jaws. By answering the questions you will help us learn more about individual’s experience of their oral health.

Please remember:

* Don’t write your name on the questionnaire.
* This is not a test and there are no right and wrong answers.
* Don’t talk to anyone about the questions when you are answering them.
* Read each question carefully and think about the experiences you have had in the past few weeks.
* When answering the questions think about your daily life and answer as honestly as you can.
* Please put a 🗹 in the box next to your answers.

**Date** \_\_\_/\_\_\_/\_2012\_\_\_

***Please answer the following questions:***

1) **Your age** \_\_\_\_\_\_\_\_\_\_\_

2) **Your marital status**:

* Married
* Single
* Divorced
* Widowed

3) **What is your Occupation or Profession?**

* Manager
* Supervisor
* Operator
* Helper

4) **What is your approximate monthly salary?**

Indicate your salary

5) **What is the level of education attained by you?**

* Primary
* High School
* Graduate
* Post Graduate
* Professional
* Other (please specify)

6) **What is your religion?**

* Hindu
* Muslim
* Sikh
* Christian
* Other (please specify)

**QUESTIONS ABOUT ORAL PROBLEMS**

**In the last 3 months**, how often have you experienced the following difficulties because of **problems with your teeth, mouth or dentures**? (Tick one answer)

1. **Have you had trouble *pronouncing any words* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you felt that your *sense of taste* has worsened because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you had *painful aching* in your mouth?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you found it *uncomfortable to eat any foods* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you been *self-conscious* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you *felt tense* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Has your *diet been unsatisfactory* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you had to *interrupt meals* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you found it *difficult to relax* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you been a bit *embarrassed* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you been a bit *irritable with other people* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you had *difficulty doing your usual jobs* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you felt that life in general *was less satisfying* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

1. **Have you been *totally unable to function* because of problems with your teeth, mouth or dentures?**

* Never (1)
* Hardly Ever (2)
* Occasionally (3)
* Fairly Often (4)
* Very Often (5)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **QUESTIONS ABOUT YOUR LIFE**  We would like to know what thoughts you have about your life. Below are five statements that you may agree or disagree with. Tick the number next to each statement to show how much you agree or disagree with each statement. For example, if you strongly agree that “I am satisfied with life” you would tick box 🗹under number 7 next to that statement. Please be open and honest in your responding.  **PLEASE TICK ONLY ONE ANSWER FOR EACH ITEM** | | | | | | | |
|  |  | Strongly Disagree  (1) | Disagree  (2) | Slightly Disagree  (3) | Neither Agree nor Disagree  (4) | Slightly Agree  (5) | Agree  (6) | Strongly Agree  (7) |
| 1 | In most ways my life is close to my ideal |  |  |  |  |  |  |  |
| 2 | The conditions of my life are excellent |  |  |  |  |  |  |  |
| 3 | I am satisfied with life |  |  |  |  |  |  |  |
| 4 | So far I have gotten the important things I want in life |  |  |  |  |  |  |  |
| 5 | If I could live my life over, I would change almost nothing |  |  |  |  |  |  |  |

|  |  |
| --- | --- |
|  | **QUESTIONS ABOUT YOUR FEELINGS AND THOUGHTS**  The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate *how often* you felt or thought a certain way. Although some questions are similar, there are differences between them and you should treat each one as a separate question. For each question tick🗹the number which you feel is appropriate.  **PLEASE TICK ONLY ONE ANSWER FOR EACH ITEM** |
| **1** | **In the last month, how often have you felt that you were unable to control the important things in your life?**  (0) Never (1)Almost Never (2)Sometimes (3)Fairly Often (4)Very Often |
| **2** | **In the last month, how often have you felt confident about your ability to handle your personal problems?**  (0) Never (1)Almost Never (2)Sometimes (3)Fairly Often (4)Very Often |
| **3** | **In the last month, how often have you felt that things were going your way?**  (0) Never (1)Almost Never (2)Sometimes (3)Fairly Often (4)Very Often |
| **4** | **In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?**  (0) Never (1)Almost Never (2)Sometimes (3)Fairly Often (4)Very Often |

|  |  |
| --- | --- |
|  | **QUESTIONS ABOUT THE WORLD AROUND YOU**  These questions ask about the world around you. Each question has seven possible answers. Please mark the number for your answer. If the words under 1 are right for you, circle 1, if the words under 7 are right for you, circle 7. If you feel differently, circle the number which expresses your feeling.  **PLEASE CIRCLE ONLY ONE ANSWER FOR EACH ITEM** |
| **1** | **Do you have the feeling that you don’t really care about what goes on around you?**  1 2 3 4 5 6 7  Very seldom Very often  or never |
| **2** | **Has it happened in the past that you were surprised by the behaviour of people you thought you knew well?**  1 2 3 4 5 6 7  Never happened Always happened |
| **3** | **Has it happened that people whom you counted on disappointed you?**  1 2 3 4 5 6 7  Never happened Always happened |
| **4** | **Until now your life has had:**  1 2 3 4 5 6 7  No clear goals or Very clear goals  no purpose at all and purpose |
| **5** | **Do you have the feeling that you’re being treated unfairly?**  1 2 3 4 5 6 7  Very often Very seldom or never |
| **6** | **Do you have the feeling that you are in an unfamiliar situation and don’t know what to do?**  1 2 3 4 5 6 7  Very often Very seldom  or never |
| **7** | **Doing the things you do every day is:**  1 2 3 4 5 6 7  A source of deep A source of pain  pleasure and satisfaction and boredom |

|  |  |
| --- | --- |
|  | **QUESTIONS ABOUT THE WORLD AROUND YOU**  These questions ask about the world around you. Each question has seven possible answers. Please mark the number for your answer. If the words under 1 are right for you, circle 1, if the words under 7 are right for you, circle 7. If you feel differently, circle the number which expresses your feeling.  **PLEASE CIRCLE ONLY ONE ANSWER FOR EACH ITEM** |
| **8** | **Do you have very mixed-up feelings and ideas?**  1 2 3 4 5 6 7  Very often Very seldom  or never |
| **9** | **Does it happen that you have feelings inside you would rather not feel?**  1 2 3 4 5 6 7  Very often Very seldom  or never |
| **10** | **Many people – even those with a strong character – sometimes feel like sad sacks (losers) in certain situations. How often have felt this way in the past?**  1 2 3 4 5 6 7  Never Very often |
| **11** | **When something happened, have you generally found that:**  1 2 3 4 5 6 7  You overestimate You saw things  or underestimated its importance in the right proportion |
| **12** | **How often do you have the feeling that there’s little meaning in the things you do in your daily life?**  1 2 3 4 5 6 7  Very often Very seldom  or never |
| **13** | **How often do you have feelings that you’re not sure you can keep under control?**  1 2 3 4 5 6 7  Very often Very seldom  or never |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **QUESTIONS ON SUPPORT FROM FRIENDS AND FAMILY**  We are interested in how you feel about the following statements. Indicate how you feel about each statement. Tick🗹 the box to show how much you agree or disagree with each statement. | | | | | | | |
|  |  | Strongly Disagree  1 | Disagree  2 | Slightly Disagree  3 | Neither Agree nor Disagree  4 | Slightly Agree  5 | Agree  6 | Strongly Agree  7 |
| **1** | There is a special person who is around when I am in need |  |  |  |  |  |  |  |
| **2** | There is a special person with whom I can share my joys and sorrows |  |  |  |  |  |  |  |
| **3** | My family really tries to help me |  |  |  |  |  |  |  |
| **4** | I get the emotional help and support I need from my family |  |  |  |  |  |  |  |
| **5** | I have a special person who is a real source of comfort to me |  |  |  |  |  |  |  |
| **6** | My friends really try to help me |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **QUESTIONS ON SUPPORT FROM FRIENDS AND FAMILY**  We are interested in how you feel about the following statements. Indicate how you feel about each statement. Tick🗹 the box to show how much you agree or disagree with each statement. | | | | | | | |
|  |  | Strongly Disagree  1 | Disagree  2 | Slightly Disagree  3 | Neither Agree nor Disagree  4 | Slightly Agree  5 | Agree  6 | Strongly Agree  7 |
| **7** | I can count on my friends when things go wrong |  |  |  |  |  |  |  |
| **8** | I can talk about my problems with my family |  |  |  |  |  |  |  |
| **9** | I have friends with whom I can share my joys and sorrows |  |  |  |  |  |  |  |
| **10** | There is a special person in my life who cares about my feelings |  |  |  |  |  |  |  |
| **11** | My family is willing to help me make decisions |  |  |  |  |  |  |  |
| **12** | I can talk about my problems with my friends |  |  |  |  |  |  |  |

|  |  |
| --- | --- |
| **SOCIAL SUPPORT FROM FAMILY AND FRIENDS**  We are interested in how much support you feel is available to you when you deal with problems. Please read the following questions and tick 🗹 the response that most closely describes your current situation. | |
| **FAMILY: Considering the people to whom you are related either by birth or marriage**   1. **How many relatives do you see or hear from at least once a month?**  * none * one * two * three or four * five to eight * nine or more  1. **How many relatives do you feel at ease with that you can talk about private matters?**  * none * one * two * three or four * five to eight * nine or more  1. **How many relatives do you feel close to such that you could call on them for help?**  * none * one * two * three or four * five to eight * nine or more | **FRIENDSHIPS: Considering all of your friends including those who live in your neighborhood**   1. **How many of your friends do you see or hear from at least once a month?**  * none * one * two * three or four * five to eight * nine or more  1. **How many friends do you feel at ease with that you can talk about private matters?**  * none * one * two * three or four * five to eight * nine or more  1. **How many friends do you feel close to such that you could call on them for help?**  * none * one * two * three or four * five to eight * nine or more |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **HOW YOU FEEL ABOUT YOUR HEALTH**  We are interested in how you feel about your health in general. Read each statement carefully. Indicate how you feel about each statement. Tick 🗹 the box to show how true or false each statement is for you. | | | | | |
|  |  | Definitely True  5 | Mostly True  4 | Don’t Know  3 | Mostly False  2 | Definitely False  1 |
| **1** | **According to the doctors I’ve seen, my health is now excellent** |  |  |  |  |  |
| **2** | **I feel better now than I ever have before** |  |  |  |  |  |
| **3** | **I’m somewhat ill** |  |  |  |  |  |
| **4** | **I’m not as healthy now as I used to be** |  |  |  |  |  |
| **5** | **I’m as healthy as anybody I know** |  |  |  |  |  |
| **6** | **My health is excellent** |  |  |  |  |  |
| **7** | **I have been feeling bad lately** |  |  |  |  |  |
| **8** | **Doctors say that I am now in poor health** |  |  |  |  |  |
| **9** | **I feel about as good now as I ever have** |  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **ORAL HEALTH BELIEFS**  Read each statement carefully. Please place a in the box tick 🗹 to show how much you agree or disagree with each statement. | | | | | |
|  |  | Strongly Agree  1 | Agree  2 | Disagree  3 | Strongly Disagree  4 | Don’t  Know  5 |
| **1** | **Tooth decay can make people look bad** |  |  |  |  |  |
| **2** | **Dental problems can be serious** |  |  |  |  |  |
| **3** | **Poor teeth will affect people's work or other aspects of their everyday life** |  |  |  |  |  |
| **4** | **Having dental problems can cause other health problems** |  |  |  |  |  |
| **5** | **I place great value on my dental health** |  |  |  |  |  |
| **6** | **It is important to keep natural teeth** |  |  |  |  |  |
| **7** | **Dental disease is as important as other health problems** |  |  |  |  |  |
| **8** | **I am not afraid of dental visits because of possible pain** |  |  |  |  |  |
| **9** | **Dentists are available when I have dental problems** |  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **ORAL HEALTH BELIEFS**  Read each statement carefully. Please place a in the box tick 🗹 to show how much you agree or disagree with each statement. | | | | | |
|  |  | Strongly Agree  1 | Agree  2 | Disagree  3 | Strongly Disagree  4 | Don’t  Know  5 |
| **10** | **I will visit the dentist when I have dental problems no matter how busy I am** |  |  |  |  |  |
| **11** | **Brushing teeth with fluoride toothpaste helps prevent tooth decay** |  |  |  |  |  |
| **12** | **Using fluoride is a harmless way of preventing tooth decay.** |  |  |  |  |  |
| **13** | **Using dental floss helps prevent gum disease.** |  |  |  |  |  |
| **14** | **Going to the dentist will keep me from having trouble with my teeth, gums, or dentures.** |  |  |  |  |  |
| **15** | **Dentists are able to cure most dental problems that patients have** |  |  |  |  |  |
| **16** | **Drinking fluoridated water helps prevent tooth decay** |  |  |  |  |  |
| **17** | **Brushing teeth helps prevent gum problems** |  |  |  |  |  |
| **18** | **Eating sweet food causes tooth decay** |  |  |  |  |  |

|  |
| --- |
| **Q QUESTIONS ABOUT DENTAL BEHAVIOURS**  **ORAL HYGIENE PRACTICES**   1. **How often do you clean your teeth?**  * Once a day * Twice a day * Don’t clean everyday   **TOBACCO SMOKING AND CHEWING HABITS**   1. **Have you ever smoked tobacco?**  * Yes, I smoke now * I used to smoke * I have never smoked (if No, please go to question 3)  1. **How many times in a day you generally smoke?**  * Up to 5 times * 5-10 times * 10-20 times * More than 20 times  1. **Do you chew Pan/Pan masala with tobacco?**  * Yes * No * Don’t Know   **PATTERN OF DENTAL ATTENDANCE**   1. **In general do you go to the dentist for**  * A regular check up * Only when you're having trouble with your teeth/dentures? * Never been to the dentist  1. **About how long ago was your last visit to the dentist?**  * Within the last 6-12 months * More than 5 years * Never |

**WORST OFF PEOPLE**

**BEST OFF PEOPLE**

**Imagine this ladder pictures how Indian society is set up**

* ***At the top of the ladder are the people who are best off*** –they have the most money, the highest amount of schooling, and the jobs that bring the most respect
* ***At the bottom are the people who are worst off***-they have the least money, little or no education, no jobs or jobs that no one wants or respects

Now think where you would place yourself on the ladder in relation to other people around you.

**Place “X” on the rung which best represents your position.**

Thank you very much for completing this questionnaire.

We are interested in how your mouth, teeth and dentures have an impact on your life and wellbeing over a period of time. Therefore, we would like to contact you again in approximately 3 months’ time to hear about your experiences.

**Thank you for your time**

If you have any comments you would like to make either about your oral health or on the study then please write these below.

1. Significant Specific Indirect Effects for the Statistically Parsimonious Wilson and Cleary Model with Decayed Teeth as the Clinical Factor

Table D- I Significant specific indirect effects with decayed teeth as the clinical factor

|  |  |  |  |
| --- | --- | --- | --- |
| **Effect** | ***β*** | **Bias-corrected 95% CI** | **Possible pathways** |
| **Crossectional**  **SES (T1)**  Social support (T1)  Sense of coherence (T1)  Stress(T1)  Dental behaviours (T1)  **Social network (T1)**  Sense of coherence (T1)  Stress (T1)  **Social support (T1)**  Stress (T1)  **OHQoL (T2)**  Overall QoL (T2) | 0.037  0.044  0.168  0.067  0.026  0.009  0.047  0.038 | 0.015/0.070\*\*  0.019/0.074\*\*  0.118/0.227\*\*  0.017/0.135\*  0.009/0.056\*\*  0.003/0.019\*\*  0.018/0.084\*\*  0.018/0.067\*\* | SES-SN-SS  SES-SS-SOC (*β* = 0.04)#  SES-SN-SS-SOC (*β* = 0.005)  SES-SOC-Stress (*β* = 0.12)#  SES-SN-Stress (*β* = 0.03)  SES-SS-SOC-Stress (*β* = 0.1)  SES-SN-SS-SOC-Stress (*β* = 0.04)  SES-OHB-DB  SN-SS-SOC  SN-SS-SOC-Stress  SS-SOC-Stress  OHQoL (T2)-GHP (T2)-Overall QoL (T2) |

*Note: \*\*P<0.01, \*P<0.05,* ***β*** *= boot strapped standardised estimate, CI = confidence interval, T1 = baseline, T2 = 3 months follow-up, OHQoL = oral health related quality of life, GHP = General health perception, Overall QoL = Overall quality of life, SS =Social support, SOC = Sense of coherence, DB = Dental behaviour, SN = Social Network, # likely pathway*

|  |  |  |  |
| --- | --- | --- | --- |
| **Effect** | ***β*** | **Bias-corrected 95% CI** | **Possible pathways** |
| **Prospective (T1-T2)**  **SES (T1)**  OHQoL (T2)  GHP (T2) | 0.154  0.148 | 0.113/0.198\*\*  0.104/0.208\*\* | SES-SOC-OHQoL (T2) (*β* = 0.04)#  SES-SS-OHQoL (T2) (*β* = 0.04)#  SES-Stress-OHQoL (T2) (*β* = 0.03)#  SES-SOC-Stress-OHQoL (T2) (*β* = 0.02)#  SES-Decayed teeth-OHQoL (T2) (*β* = 0.01)#  SES-SN-SS-OHQoL (T2) (*β* = 0.004)  SES-SS-SOC-OHQoL (T2) (*β* = 0.004)  SES-SN-Stress-OHQoL (T2) (*β* = 0.003)  SES-SS-SOC-Stress-OHQoL (T2) (*β* = 0.002)  SES-SN-SS-SOC-Stress-OHQoL (T2) (*β* = 0.0006)  SES-SN-SS-SOC-Stress-OHQoL (T2) (*β* = 0.0002)  SES-SOC-GHP (T2) (*β* = 0.05)#  SES-Stress-GHP (T2) (*β* = 0.03)#  SES-SOC-Stress-GHP (T2) (*β* = 0.02)#  SES-SOC-OHQoL (T2)-GHP (T2) (*β* = 0.009)  SES-SS-OHQoL (T2)-GHP (T2) (*β* = 0.007)  SES-Stress-OHQoL (T2)-GHP (T2) (*β* = 0.006)  SES-SS-SOC-GHP (T2) (*β* = 0.005)  SES-SN-Stress-GHP (T2) (*β* = 0.004)  SES-Decayed teeth-OHQoL (T2)-GHP (T2) (*β* = 0.003)  SES-SS-SOC-Stress-GHP (T2) (*β* = 0.002)  SES-SN-SS-OHQoL (T2)-GHP (T2) (*β* = 0.001)  SES-SN-Stress-OHQoL (T2)-GHP (T2) (*β* = 0.0007)  SES-SN-SS-SOC-Stress-GHP (T2) (*β* = 0.0002)  SES-SN-SS-SOC-OHQoL (T2)-GHP (T2) (*β* = 0.0001)  SES-SN-SS-SOC-Stress-OHQoL (T2)-GHP (T2) (*β* = 0.000005) |

*Note: \*\*P<0.01, \*P<0.05,* ***β*** *= boot strapped standardised estimate, CI = confidence interval, T1 = baseline, T2 = 3 months follow-up, OHQoL = oral health related quality of life, GHP = General health perception, Overall QoL = Overall quality of life, SS =Social support, SOC = Sense of coherence, DB = Dental behaviour, SN = Social Network, # likely pathway*

|  |  |  |  |
| --- | --- | --- | --- |
| **Effect** | ***Β*** | **Bias-corrected 95% CI** | **Possible pathways** |
| **Prospective (T1-T2)**  **SES (T1)**  Overall QoL (T2) | 0.126 | 0.084/0.181\*\* | SES-GHP (T2)-Overall QoL (T2) (*β* = 0.04)#  SES-Stress-Overall QoL (T2) (*β* = 0.02)#  SES-SOC-Stress-Overall QoL (*β* = 0.02)#  SES-SOC-GHP (T2)-Overall QoL (T2) (*β* = 0.01)#  SES-Stress-GHP (T2)- Overall QoL (T2) (*β* = 0.005)  SES-SN-Stress-Overall QoL (T2) (*β* = 0.004)  SES-SOC-Stress-GHP (T2)-Overall QoL (T2) (*β* = 0.003)  SES-SS-SOC-Stress-Overall QoL (T2) (*β* = 0.002)  SES-Stress-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.001)  SES-SOC-OHQoL (T2)-GHP (T2)- Overall QoL (T2) (*β* = 0.001)  SES-SS-OHQoL (T2)-GHP (T2)- Overall QoL (T2) (*β* = 0.001)  SES-SS-SOC-GHP (T2)-Overall QoL (T2) (*β* = 0.001)  SES-SN-Stress-GHP (T2)-Overall QoL (T2) (*β* = 0.0008)  SES-SOC-Stress-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.0006)  SES-Decayed teeth-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.0005)  SES-SN-SS-SOC-Stress-Overall QoL (T2) (*β* = 0.0003)  SES-SS-SOC-Stress-GHP (T2)-Overall QoL (T2) (*β* = 0.0003)  SES-SS-SOC- OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.0001)  SES-SS-SOC-Stress-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.0001)  SES-SN-Stress- OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.0001)  SES-SN-SS- OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.0001)  SES-SN-SS-SOC-GHP (T2)-Overall QoL (T2) (*β* = 0.0001)  SES-SN-SS-SOC- OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.00002)  SES-SN-SS-SOC-Stress-GHP (T2)-Overall QoL (T2) (*β* = 0.00001)  SES-SN-SS-SOC-Stress-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.00001) |

*Note: \*\*P<0.01, \*P<0.05,* ***β*** *= boot strapped standardised estimate, CI = confidence interval, T1 = baseline, T2 = 3 months follow-up, OHQoL = oral health related quality of life, GHP = General health perception, Overall QoL = Overall quality of life, SS =Social support, SOC = Sense of coherence, DB = Dental behaviour, SN = Social Network, # likely pathway*

|  |  |  |  |
| --- | --- | --- | --- |
| **Effect** | ***Β*** | **Bias-corrected 95% CI** | **Possible pathways** |
| **Social network (T1)**  OHQoL (T2)  GHP (T2)  Overall QoL (T2)  **Social support (T1)**  OHQoL (T2)  GHP (T2)  Overall QoL (T2) | 0.048  0.038  0.031  0.023  0.059  0.018 | 0.025/0.082\*\*  0.019/0.070\*\*  0.012/0.063\*\*  0.008/0.048\*\*  0.031/0.092\*\*  0.009/0.032\*\* | SN-Stress-OHQoL (T2) (*β* = 0.02)#,  SN-SS-OHQoL (T2) (*β* = 0.02)#  SN-SS-SOC-OHQoL (T2) (*β* = 0.003)  SN-SS-SOC-Stress-OHQoL (T2) (*β* = 0.001)  SN-Stress-GHP (T2) (*β* = 0.02)#  SN-Stress-OHQoL (T2)-GHP (T2) (*β* = 0.004)  SN-Stress-Over QoL (*β* = 0.02)#  SN-Stress-GHP (T2)-Overall QoL (T2) (*β* = 0.004)  SN-Stress-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.0007)  SS-SOC-OHQoL (T2) (*β* = 0.02)#  SS-SOC-Stress-OHQoL (T2) (*β* = 0.006)  SS-OHQoL (T2)-GHP (T2) (*β* = 0.03)#  SS-SOC-GHP (T2) (*β* = 0.02)#  SS-SOC-Stress-GHP (T2) (*β* = 0.007)  SS-SOC-OHQoL (T2)-GHP (T2) (*β* = 0.003)  SS-SOC-Stress-OHQoL (T2)-GHP (T2) (*β* = 0.001)  SS-SOC-Stress-Overall QoL (T2) (*β* = 0.007)#  SS-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.004)#  SS-SOC-GHP (T2)-Overall QoL (T2) (*β* = 0.004)#  SS-SOC-Stress-GHP (T2)-Overall QoL (T2) (*β* = 0.001)  SS-SOC-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.0006)  SS-SOC-Stress-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.0003) |

*Note: \*\*P<0.01, \*P<0.05,* ***β*** *= boot strapped standardised estimate, CI = confidence interval, T1 = baseline, T2 = 3 months follow-up, OHQoL = oral health related quality of life, GHP = General health perception, Overall QoL = Overall quality of life, SS =Social support, SOC = Sense of coherence, DB = Dental behaviour, SN = Social Network, # likely pathway*

|  |  |  |  |
| --- | --- | --- | --- |
| **Effect** | ***Β*** | **Bias-corrected 95% CI** | **Possible pathways** |
| **Sense of coherence (T1)**  OHQoL (T2)  GHP (T2)  Overall QoL (T2)  **Stress (T1)**  GHP (T2)  Overall QoL (T2)  **Decayed teeth (T1)**  GHP (T2) (T2)  Overall QoL (T2) | 0.048  0.090  0.098  0.029  0.034  0.029  0.005 | 0.021/0.083\*\*  0.055/0.132\*\*  0.061/0.148\*\*  0.013/0.054\*\*  0.013/0.064\*\*  0.007/0.066\*\*  0.001/0.014\*\* | SOC-Stress-OHQoL (T2)  SOC-Stress-GHP (T2) (*β* = 0.05)#  SOC-OHQoL (T2)-GHP (T2) (*β* = 0.03)#  SOC-Stress-OHQoL (T2)-GHP (T2) (*β* = 0.01)#  SOC-Stress-Overall QoL (T2) (*β* = 0.05)#  SOC-GHP (T2)-Overall QoL (T2) (*β* = 0.03)#  SOC-Stress-GHP (T2)-Overall QoL (T2) (*β* = 0.009)  SOC-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.004)  SOC-Stress-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.002)  Stress-OHQoL (T2)-GHP (T2)  Stress-GHP (T2)-Overall QoL (T2) (*β* = 0.03)#  Stress-OHQoL (T2)-GHP (T2)-Overall QoL (T2) (*β* = 0.005)  Decayed teeth-OHQoL (T2)-GHP (T2)  Decayed teeth-OHQoL (T2)-GHP (T2)-Overall QoL (T2) |

*Note: \*\*P<0.01, \*P<0.05,* ***β*** *= boot strapped standardised estimate, CI = confidence interval, T1 = baseline, T2 = 3 months follow-up, OHQoL = oral health related quality of life, GHP = General health perception, Overall QoL = Overall quality of life, SS =Social support, SOC = Sense of coherence, DB = Dental behaviour, SN = Social Network, # likely pathway*

1. Statistically Parsimonious Wilson and Cleary Model with Missing Teeth and Periodontal Status as the Clinical Factor

Table E- 1 Fit indices for structural equation model

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Clinical Variable** | ***χ2/df*, *p.*** | **SRMR** | **RMSEA** | **90% CI for RMSEA** | **GFI** | **CFI** |
| Missing teeth (figure 3) | 1.420, p = 0.017 | 0.0324 | 0.029 | 0.013-0.042 | 0.976 | 0.984 |
| Periodontal status  (figure 4) | 1.371, p = 0.028 | 0.0310 | 0.027 | 0.010-0.041 | 0.976 | 0.986 |

Figure 6.2.1 SEM model showing significant direct effects with missing teeth as the clinical factor

0.19\*\*

0.29\*\*

0.12\*

0.13\*\*

0.55\*\*

0.12\*

0.18\*\*

0.21\*\*

0.16\*\*

0.16\*\*

0.14\*\*

0.15\*\*

0.19\*\*

0.50\*\*

0.30\*\*

0.20\*\*

0.36\*\*

0.35\*\*

0.14\*\*

0.13\*\*

0.23\*\*

0.75\*\*

0.14\*\*

**SOC**

**Stress**

**Social support**

**Missing teeth**

**OHQoL**

**(T2)**

**DB**

**Education**

**Social Network**

**QoL (T2)**

**SSES**

**OHB**

**GHP (T2)**

**Occupation**

**Income**

Note: \* p < 0.05, \*\* p < 0.01, β= bootstrapped standardised estimate. Solid line = direct effect; T2 = 3 months follow-up, the error terms are omitted for ease of interpretation. Except those variables indicated in the model, all others are at baseline.

Figure 6.2.2 SEM model showing significant direct effects with periodontal status as the clinical factor

0.12\*

0.29\*\*

0.19\*\*

0.12\*

0.18\*\*

0.21\*\*

0.16\*\*

0.16\*\*

0.14\*\*

0.15\*\*

0.13\*\*

0.19\*\*

0.50\*\*

0.29\*\*

0.55\*\*

0.21\*

0.20\*\*

0.36\*\*

0.35\*\*

0.14\*\*

0.23\*\*

0.75\*\*

0.14\*\*

**SOC**

**Stress**

**Social Support**

**Periodontal status**

**OHQoL (T2)**

**DB**

**Education**

**Social Network**

**QoL (T2)**

**SSES**

**OHB**

**GHP (T2)**

**Occupation**

**Income**

Note: \* p < 0.05, \*\* p < 0.01, β= bootstrapped standardised estimate. Solid line = direct effect; T2 = 3 months follow-up, the error terms are omitted for ease of interpretation. Except those variables indicated in the model, all others are at baseline.

1. Cross-Sectional Analysis for Psychosocial Factors and Clinical Factors Not Explored Within the Statistically Parsimonious Wilson and Cleary Model

Table F-1 Relationships between individual, environmental, and OHQoL at baseline and OHQoL at follow-up in lagged analyses

*\*\*Pearson’s correlation is significant at the 0.01 level (2-tailed).*

*\* Pearson’s correlation is significant at the 0.05 level (2-tailed).*

|  |  |
| --- | --- |
| **Independent variables**  **(Baseline)** | **r-value** |
| **Sense of coherence**  Clinical status  Oral health beliefs  Dental behaviours  **Social support**  Clinical status (decayed teeth)  Oral health beliefs  Dental behaviours  **Stress**  Clinical status  Oral health beliefs  Dental behvaiours | 0.092\*  0.188\*\*  0.219\*\*  0.067  0.292\*\*  0.250\*\*  0.065  0.115\*  0.174\*\* |

Table F- 2 Comparison between illiterate and literate (significant variables)

|  |  |  |
| --- | --- | --- |
| Clinical status | Mean Ranks | p |
| **OHB literate**  **illiterate** | **238.29**  317.07 | <.001 |
| GHP literate  illiterate | 242.95  283.91 | **<0.05 (0.036)** |

*+ (Mann-Whitney U test) (p=0.00), + + (Kruskal-Wallis test) (p=0.004)*

*## Spearman’s correlation is significant at the 0.01 level (2-tailed)*

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