Psychosocial work environment and oral health in the English Longitudinal Study of Ageing (ELSA)

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Declaration of Authorship

I, Esraa Aldalooj, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

Background: A growing body of literature shows that psychosocial work environment influences the health of employees and their quality of life. A few studies also suggest that psychosocial work environment might influence oral health. However, the evidence for an association between work stress and oral health is very limited and inconclusive in terms of temporality, as the current literature was exclusively based on cross-sectional designs. Given the increasing proportion of older adults in the population and workforce, there is a need to investigate the potential role of psychosocial work factors as a broader determinant of oral health.

Aim: The aim of this thesis was to examine whether psychosocial work environment was a determinant of oral health among older working adults, and whether this association was explained by demographic, socio-economic and behavioural factors.

Methods: Secondary analysis of data from the English Longitudinal Study of Ageing (ELSA) waves 3 (2006-07), 4 (2008-09) and 5 (2010-11) was conducted. The sample comprised a total of 1,854 adults aged 50 to 65 years in the cross-sectional analysis, and 1,542 and 1,058, respectively, in two different sets of longitudinal analyses. Two key measures of psychosocial work environment were derived from the ELSA self-report questionnaire, reflecting on the work demand-control model (work control) and the effort-reward imbalance model (work quality). Oral health outcomes were assessed using self-rated oral health, oral health-related quality of life (OHRQoL) and self-reported edentulousness. Logistic regression models were used to estimate the odds ratio of poor oral health outcomes for different psychosocial work environment exposures, sequentially adjusted for age, gender, marital status, education, income, type of work and smoking status.

Results: When compared to those with high levels of work control, those at low levels had higher odds of poor self-rated oral health (OR 1.44; 95% CI: 1.08-1.93) and poor OHRQoL (OR 1.91; 95% CI: 1.10-3.31) in the cross-sectional analysis. Similarly, low work quality was associated with poor self-rated oral health (OR 1.48; 95% CI: 1.08-2.03) and OHRQoL (OR 1.91; 95% CI: 1.15-3.15). In the longitudinal analysis, low quality of work at wave 3 also predicted poor self-rated oral health (OR 1.43; 95% CI: 1.01-2.04) and OHRQoL (OR 1.65; 95% CI: 1.06-2.57) four years later when compared to high quality of work, though the association between quality of work and OHRQoL was weaker in the longitudinal analysis compared to the cross-sectional. Some evidence was found between repeated exposure to low quality of work at waves 3 and 4 with worse OHRQoL at wave 5 with OR 2.38 (95% CI: 1.09-5.20). All associations were independent from selected covariates at wave 3.

Conclusion: The role of psychosocial work environment on poor oral health appears to be limited among older English working adults. The study found some evidence of associations between work quality and OHRQoL in the cross-sectional, longitudinal and repeated exposure analyses. There was some weak evidence for the association between work control and oral health status. This thesis contributes to the understanding of the links between psychosocial work conditions and oral health in later life.

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List of Abbreviations

ADHS	Adult Dental Health Survey
CAPI	Computer Assisted Personal Interviewing
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
95% CI	95% Confidence Interval
DMFT index	Decayed, Missing and Filled Teeth index
ELSA	English Longitudinal Study of Ageing
ERI	Effort-Reward Imbalance model
GHQ	General Health Questionnaire
HPA	Hypothalamo-Pituitary-Adrenocortical axis
HSE	Health Survey for England
JCQ	Job Content Questionnaire
JDC	Job Demand-Control model
IHD	Ischemic Heart Disease
OECD	Organisation for Economic Co-operation and Development
OHRQoL	Oral Health-Related Quality of Life
OIDP	Oral Impacts on Daily Performances
ONS	Office for National Statistics
OR	Odds Ratio
SAM	Sympatho-Adrenal-Medullary system
SRDs	Stress-Related Disorders
SROH	Self-Rated Oral Health
WHO	World Health Organisation

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This thesis is dedicated to my parents, my siblings, my husband and my beloved daughter.

Chapter 1

Introduction

1.1 Background

The increasing life expectancy of people in high-income countries has led to working lives being extended as a response to the ageing population. In the UK, the Office for National Statistics (ONS, 2012) 2012 report states that, between 1993 and 2011, the number of people at State Pension Age [a] (SPA) and above who remained in the workforce had almost doubled to a total of 1.4 million. Furthermore, according to the 2014 (ONS, 2015) report, 75.3% of people aged between 50 and SPA were participating in the labour market in the final quarter of 2014, along with 12.1% of people beyond SPA. As the participation rate in the workforce for older employees [b] has been increasing steadily since 1993, there is an increased importance in understanding the health consequences of remaining in employment at an older age. Currently, it is not clear whether changes in the demographics of the employed population will have beneficial or negative effects on the health and well-being of the elderly employees.

Work-related factors may influence the health of employees in various ways and could contribute to healthy ageing. Psychosocial work environment is one of the key components in understanding the effect of employment on health. However, evidence on the association between psychosocial work environment and oral health is very limited. Thus, the research presented in this thesis aims to investigate the role of psychosocial work environment on oral health outcomes in older adults.

1.2 Oral health of older populations

Oral health has been recognised as an essential part of general health. The interrelationship between general health and oral health is especially noticeable among older people, as oral diseases share risk factors with other chronic diseases (Gift and Atchison, 1995; Sheiham and Watt, 2000; Petersen and Ueda, 2008). Oral health remains particularly important for the health of older people, as the accumulation of prolonged exposure to risk factors throughout the life course contributes to poor oral health among older populations (Tsakos, 2011).

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[a] The state pension age is currently 65 for men and it is gradually increasing for women from 60 to 65 - it is 63 and nine months from April 2017, and 64 and six months by April 2018.

[b] Older employees are defined as those working from 50 to beyond state pension age.

Oral health status in older adults is also an important determinant of nutritional status (Mesas et al., 2010; Walls and Steele, 2004) as impaired dentition imposes dietary restriction on food selection and eating patterns (Nowjack-Raymer and Sheiham, 2007; Sheiham et al., 2001). In the UK, alongside the demographic changes, oral health status of older individuals is also changing as more adults are retaining some natural teeth and are less dependent on complete dentures for oral health functioning (Fiske, 2000; Marcenes et al., 2013). Between 1978 and 2009, the proportion of adults in England who were edentate decreased from 28% to 6% (Steele et al., 2012).

Another key indicator of oral health among older populations is periodontal status. Further findings from the 2009 Adult Dental Health Survey showed that only 17% of adults in England had a healthy periodontal status (White et al., 2012). Additionally, good periodontal health was more common among adults less than 45 years than in older age groups. For instance, 10% or less of dentate adults aged above 55 years old had healthy periodontal tissues, compared with 20% of those aged 25 to 34 and 35 to 44 years old.

Additionally, the available literature shows that dental caries is a major public health problem in older adults (Petersen, 2003; Petersen et al., 2010). A review of longitudinal studies of older adults found that older people were highly susceptible to caries (Thomson, 2004). However, the overall prevalence of caries has fallen dramatically in England, from 54% in 1998 to 31% in 2009. This reduction in caries was observed in all age groups (White et al., 2012).

1.3 Psychosocial work environment

In the late 1970s, Karasek recognised that specific work-related factors greatly increased the risk of an array of physical and mental illnesses or disorders, particularly high demand and low control or decision latitude (Karasek, 1979). Accordingly, he developed the job demand-control-support theory of job strain. Johannes Siegrist was the second key researcher in this field. He developed another model showing that an imbalance between the mental effort spent for work, and the rewards received (in terms of recognition, appreciation as well as financial) was also linked to a range of physical and mental illnesses (Siegrist, 1996).

Very few studies have suggested that psychosocial work environment might have an explanatory role in oral health outcomes (Marcenes and Sheiham, 1992). However, there has been little attempt to explore this role longitudinally. Hence, this thesis was set to examine whether psychosocial work environment is a determinant of oral health among older English adults.

Psychosocial work environment has been hypothesised as a determinant of population health that can potentially explain socioeconomic inequalities in health. Exposure to adverse psychosocial work environment tends to be socially graded and has been viewed as a factor to contribute in generating socioeconomic inequalities in health amongst working adults (Siegrist and Marmot, 2004). Based on socioeconomic position, individuals experience differences in exposure and vulnerability to health-compromising environments. These environments, such as psychosocial work environment, operate as intermediary determinants of health inequalities (Solar and Irwin, 2010). As the social determinants of health approach presents a more complete framework for explaining oral health inequalities, this thesis may provide an opportunity of advancing explanations of inequalities in oral health by psychosocial work environment. Hence, in the context of this work, psychosocial work environment has been recognised as part of the wider socio-economic determinants of oral health and it was examined as the primary predictor of oral health while taking the individual's socio-economic status into account.

This thesis focuses on older people, psychosocial work environment and oral health using the English Longitudinal Study of Ageing (ELSA). ELSA provided a unique opportunity to explore the association between psychosocial work environment and oral health, since it has rich data on psychosocial and oral health and there were very few studies that examined the association between psychosocial work environment and oral health. In fact, there has not been a single study that used longitudinal data from a large national population sample to examine whether psychosocial work environment is prospectively associated with oral health. Since oral health is an essential part of the general health and well-being of the populations, it is important to go beyond basic individual-level risk factors and understand the distal causes of the social gradients in oral diseases in order to tackle the determinants of oral health and inequalities (Watt, 2002, 2007, 2012). There have been few attempts to study the characteristics of work environment as distal risk factors that could impact oral health. Based on several gaps

identified in existing research, it was plausible to suggest that psychosocial work environment has a potential role as a determinant of oral health among adults in the workforce.

1.4   Outline of the thesis structure

The work presented throughout this thesis provides an extensive investigation into the effects of psychosocial work environment on oral health in older employees in England.

Chapter Two starts with a narrative review of the published literature on concepts of psychosocial environment and more specifically on the topic of adverse psychosocial work environment in relation to different aspects of health, including oral health. This chapter then identifies and highlights the gaps in the reviewed studies, which leads to the aims and objectives of the thesis.

Chapter Three provides a description of the ELSA dataset, the sample selection process and the variables used in the analyses. A description of the methodology to be used is also detailed, alongside the rationale for using the statistical models to examine the associations.

Chapter Four presents the preliminary research results including descriptive sample analyses using the ELSA data and assesses the association between psychosocial work environment and oral health outcomes at the baseline sample.

Chapter Five assesses the longitudinal association between psychosocial work environment and oral health at follow-up.

Chapter Six investigates the association between repeated exposure to adverse psychosocial work environment and oral health.

Finally, *Chapter Seven* draws the thesis findings together with a discussion of the key research findings, and highlights the major conclusions alongside the study limitations and relevance.

Chapter 2

Literature Review

Psychosocial Work Environment and Oral Health

2.1 Introduction

Psychosocial work characteristics are an important set of risk factors in psychosocial epidemiology. They have been linked to a number of health outcomes, including cardiovascular disease and mental health problems (Marmot et al., 2006). Additionally, psychosocial work environment has also been hypothesised as a determinant of population health, which can potentially explain socio-economic inequalities in health (Siegrist and Marmot, 2004). The growing literature that links psychosocial work environment with health outcomes is very diverse in terms of settings and methodological approaches. However, the results from different studies on psychosocial work environment are mostly not directly comparable because of the lack of consistency of measuring psychosocial work environment and/or the health outcomes.

This chapter presents a critical review of the concept of psychosocial factors in epidemiology, focusing on psychosocial work environment and its relevance to general, mental and oral health. The review is divided into four sections: first, the definitions of psychosocial factors in epidemiology and measurements of psychosocial work environment are presented. This is followed by an overview of the literature on psychosocial work environment in relation to general and mental health. The third section covers the literature on psychosocial work environment and oral health. The fourth section explores the potential pathways linking psychosocial work environment and oral health. The gaps in the literature are then identified and discussed. Finally, the conceptual framework of the study and the aims, objectives and hypotheses of the thesis are presented.

2.2 Psychosocial factors in epidemiology: concept and definitions

The first idea of the psychosocial theory was proposed in the 1970s by John Cassel (Cassel, 1974, 1976) in what is regarded as an important milestone in social epidemiology (Venkatapuram, 2013). Cassel suggested addressing psychosocial factors that influence the body's resistance to disease through investigating the social-level rather than the individual-level risk factors. At around the same time, Marmot and Syme (1976) were examining the impact of social factors on health. Their findings supported the hypothesis that health profiles are not merely determined by genetics or individual factors but also by social environments.

Since the link between psychological and social environments with disease risk was demonstrated, many theories have been developed and conceptualised to understand the nature of such associations between psychosocial factors and health risks (Berkman and Kawachi, 2000). Research has pointed out various psychosocial determinants such as control, stress and social support. In recent years, the role of psychosocial factors on population health has received considerable attention in both health research and policy (Department of Health, 2004; Tsutsumi and Kawakami, 2004; Marmot et al., 2006). Currently in social epidemiology, the psychosocial theory is one of the leading theoretical bases to explain disease distribution (Berkman & Kawachi 2000; Krieger 2001b).

The wealth of literature, however, has not rendered a clear definition of psychosocial environment. The use of the term 'psychosocial' has been very broad and diverse in the current epidemiological research. According to Martikainen et al. (2002), the concept of 'psychosocial health' may integrate with the World Health Organization's (WHO) conventional definition of health as "*a state of complete physical mental and social well-being, and not merely the absence of disease and infirmity*" (WHO 1948). Martikainen et al. defined psychosocial factors in health as "*the mediation of the effects of social structural factors on individual health, conditioned and modified by the social structures contexts in which they exist*" (Martikainen et al., 2002). This definition might have important implications for social epidemiologists and health researchers, because it implies that psychosocial factors can be viewed as either mediators or determinants of health outcomes. In the WHO theoretical framework for social determinants of health (WHO, 2008), psychosocial factors are regarded as mediators in the effects of social position on individual health. However, Martikainen and colleagues' definition did not capture the pathophysiological impact and the biological responses to individuals' interactions to the psychosocial factors. On the other hand, Hemingway and Marmot's (1999) earlier definition of a psychosocial factor did cover this aspect: "*a measurement that potentially relates psychological phenomena to the social environment and pathophysiological changes*". Hence, a psychosocial framework directs attention to both behavioural and biological responses. The effect of psychosocial environment on health can be explained by a direct pathway through biological responses or an indirect one through behavioural responses (Berkman and Kawachi, 2000; Krieger, 2001a).

In summary, psychosocial epidemiology explores the way individuals' interactions with their social environments may influence their health (Siegrist and Marmot, 2004), and psychosocial environment is a concept that serves as a bridge between individual and social structures (Egan et al., 2008; Martikainen et al., 2002). Hence, it include such factors as support from social networks, control at work or in the home, security and autonomy, and work-family conflict. The psychosocial framework focuses on development of diseases that are triggered by biological or behavioural responses to individuals' stress. Thus, the main concern in studying psychosocial environment is individuals' responses and interactions with their environments in different social settings (Egan et al., 2008; Krieger, 2001b).

2.2.1 Psychosocial factors in health contexts

A framework suggested by Martikainen et al. (2002) can help to explain the role of psychosocial factors in health (Figure 2-1), as it distinguishes between macro-, meso- and micro-level factors (Coleman and Coleman, 1994; Hertzman et al., 2001). Psychosocial factors fit into this framework as a meso-level concept, which is modified by macro-social forms that are related to property possession and welfare structures, as well as distribution of resources such as income between groups and individuals.

The meso-level psychosocial factors consist of concepts such as social support, security and autonomy, work control and effort-reward imbalance. All those concepts within the psychosocial structure are presented in forms of social relationships. Hence, the interpretation of psychosocial environment in health must be viewed as processes that are captured by multiple measures at each level (Martikainen et al., 2002).

At an individual level, psychosocial environment can lead to psychological changes which impact an individual's health directly via psychobiological methods or indirectly via changes in behaviours and lifestyle choices. These pathways are explained explicitly in Section 2.7.

**Figure 2-1: A tentative schematic representation of psychosocial pathways
by Martikainen, Bartley and Lahelma (2002)**
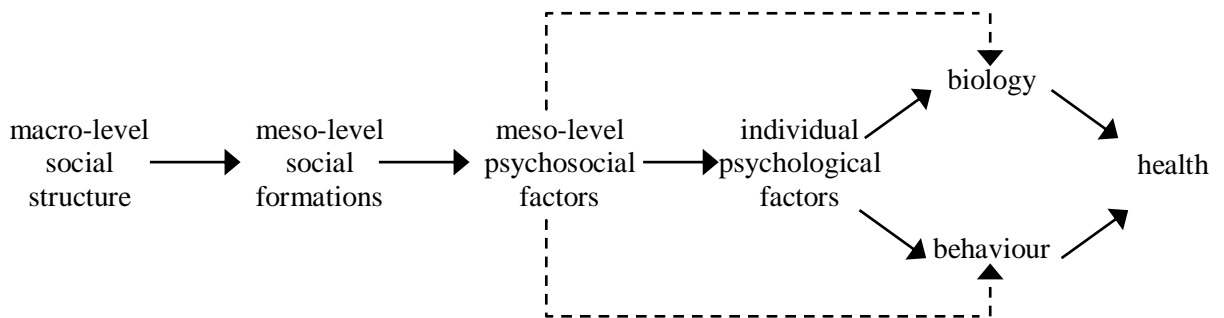
Finally, in some cases, psychosocial factors can be examined in relation to health without considering psychological factors (dashed arrows in Figure 2-1). That is, some psychosocial factors are unlikely to affect health via psychological processes. Research concerning the impacts of stressful work environment on health provides an illustration of this matter, since measures of psychosocial work conditions have been shown to be directly associated with health outcomes (Bosma et al., 1997). In the following sections, work-related psychosocial environment will be discussed in detail.

2.3   Work-related psychosocial environment

The concept of psychosocial factors at work is challenging to narrow down, since it represents and reflects several aspects of employees' experiences and perceptions. Some of these aspects are related to individual factors such as skills and personality, while others are related to the conditions of work and the work environment itself. Working conditions and the work environment include the work tasks themselves and the physical conditions in the workplace (Joint ILO/WHO Committee on Occupational Health, 1986). Therefore, psychosocial factors at work must be defined broadly enough to account for these effects and their consequences.

Research on psychosocial work factors has been primarily conducted over recent years to assess the stressful conditions in the work environment and has focused on the application of the stress concept as the most common approach in examining the relationships between the psychosocial work environment and employees' health. Hence, psychosocial factors at work have mainly been seen in an unfavourable way in

relation to health and thus are generally referred to as workplace stressors. Different aspects of the workplace environment can interact and affect the physical and mental health of employees. However, work conditions could have positive influences on health and other aspects of life and these positive aspects act as health-maintaining and health-enhancing factors (Joint ILO/WHO Committee on Occupational Health, 1986).

2.3.1   Definition and theories of psychosocial work environment

2.3.2   Definition of psychosocial work environment

Psychosocial work environment was defined by The European Commission (2000) as "*the emotional, cognitive, behavioural and physiological reactions to adverse and noxious aspects of work, work environments and work organisations. It is a state characterised by high levels of arousal and distress and often by feelings of not coping*".

Additionally, Ganster and Rosen (2013) defined work-related stress as "*the process by which workplace psychological experiences and demands (stressors) produce both short-term strains and long-term changes in mental and physical health*".

In 2010, the WHO Healthy Workplace Framework described the psychosocial work environment as "*the environment that includes the organization of work and the organizational culture; the attitudes, values, beliefs and practices that are demonstrated on a daily basis in the enterprise, and which affect the mental and physical well-being of employees*" (Burton, 2010).

In the following sections, the two psychosocial work factors related to this thesis and their influence on health are introduced. The next section provides an overview of the theoretical models and sections *2.5* and *2.6* present the evidence for the impact of psychosocial work factors on various health outcomes.

2.3.3   Theories of psychosocial work environment

Work plays a significant role for most populations in early and old adulthood, as it is generally a requirement for a regular income, an opportunity for learning and achievement, and provides a variety of other opportunities. Social status in adulthood and core social identity outside the family are mainly acquired through work and

employment. Thus, work environment in terms of prospect, security and continuity is crucial for adults' health and well-being (Siegrist and Theorell, 2006).

In addition to the primary impact of work on adults' everyday life, work and employment conditions play a vital role in research towards explaining the social gradient in health (Clougherty et al., 2010; Marmot and Theorell, 1988). Although socio-economic status is often measured by occupational characteristics, such as job status or employment grade, this information has limited explanatory power towards health, as it does not offer a refined idea of the ways in which occupational position affects health. Traditionally, physical and occupational hazards at work were considered major causes of work-related health risks that may lead to adverse health consequences. But, with the profound changes in the nature of employment and work during recent years (the technological progression and expansion of the services sector along with flexibility of work arrangements), current jobs are often sedentary rather than physically demanding. As a result, psychological and social stressors in the work environment are becoming more prevalent, and their influence on health and well-being is likely to be equivalent to or even outweigh the contribution of other traditional work-related stressors (Siegrist and Theorell, 2006). Hence, stressful psychosocial work environments are affecting large parts of the workforce (Schnall et al., 2009) and the role of adverse psychosocial work factors has become increasingly significant for health and well-being as most employees are exposed to psychological demands rather than physical hazards (Tausig and Fenwick, 2011; Siegrist and Theorell, 2006; Wainwright and Calnan, 2002).

To understand the relationship between work characteristics and health, researchers developed several work stress models to reduce the complexity of the psychosocial work environment and to build on an interaction between work exposure and individual perception of this exposure (Siegrist and Theorell, 2006). Over the last decade, research has focused on the health impacts of six domains of work organisation: job demands, control and support; effort and reward imbalance; organisational justice; non-standard work schedules, including shift and hazardous work; work and family conflict and associated supervisor and work place support; and schedule control and flexible work arrangements.

Despite some overlap of elements in the above-mentioned models, they focus on different elements of work and use different theories and examination instruments

(Antoniou and Cooper, 2005; Cartwright and Cooper, 2009). Among the previous models, two models have gained considerable attention and support and have been tested and validated with robust study designs in epidemiological research: the job demand-control model (JDC) and the effort-reward imbalance model (ERI) (Siegrist, 2010) To the extent possible, this thesis will use both the job demand-control and the effort-reward imbalance models of stressful workplace environment. This section begins with a discussion of the domains' theoretical backgrounds and frameworks, followed by the evidence related to the health impacts of each of the two models of work environment.

2.3.4   Theory and measurements of psychosocial work environment

2.3.4.1   The job demand-control model

2.3.4.1.1   Theoretical background

The job demand-control model was developed by Karasek in 1979, and it is one of the most widely used models of work stress (Karasek, 1979; Karasek and Theorell, 1989). The model provides important measures of work-related well-being and health, and has been the primary work stress model in occupational health psychology since the 1980s (De Lange et al., 2003; Lindfors et al., 2007). The model suggests that stressful experience at work results from a distinct job task profile defined by two essential aspects of work environments: job demand and job control.

According to Karasek (1979), job demands are "*the psychological stressors involved in accomplishing the workload, stressors related to unexpected tasks, and stressors of job-related personal conflict*". Job control, which is also cited as decision latitude, was defined as "*working individual's potential control over his task and his conduct during the working day*".

Karasek's concept of decision latitude (job control/autonomy) was composed of two elements: decision authority, referring to employees' authority to make job-related decisions; and skill discretion, measuring the extent of skill that employees use on the job (Karasek, 1979).

According to the job demand-control model, job strain arises from the interaction of psychological demands with decision latitude. The model is presented in a 2x2 matrix that was generated by the interaction of psychological demands and job control, which

results in four different types of job conditions. Figure 2-2 summarises the types of jobs identified in Karasek's model (Karasek, 1979). The dichotomy of job demands and job control produces:

1. Active jobs, located in the upper right quadrant; these types of jobs are characterised by high level of demands and high level of control

2. Passive jobs, located diagonally opposite to the active job quadrant; these types of jobs are characterised by low level of demand and low level of control

3. Low-strain jobs, located in the upper left quadrant; these types of jobs are characterised by low level of demand and high level of control

4. High-strain jobs, located in the lower right quadrant; these types of jobs are the most "toxic" type and are characterised by high level of demand and low level of control

Over the long term, passive jobs may result in "negative learning", or the gradual atrophy of previously learned skills. Thus, the model acknowledges that not every type of job with a low level of demand is healthy; it is the interaction with the amount of control that matters.

Figure 2-2: The job demand-control model (Karasek, 1979)
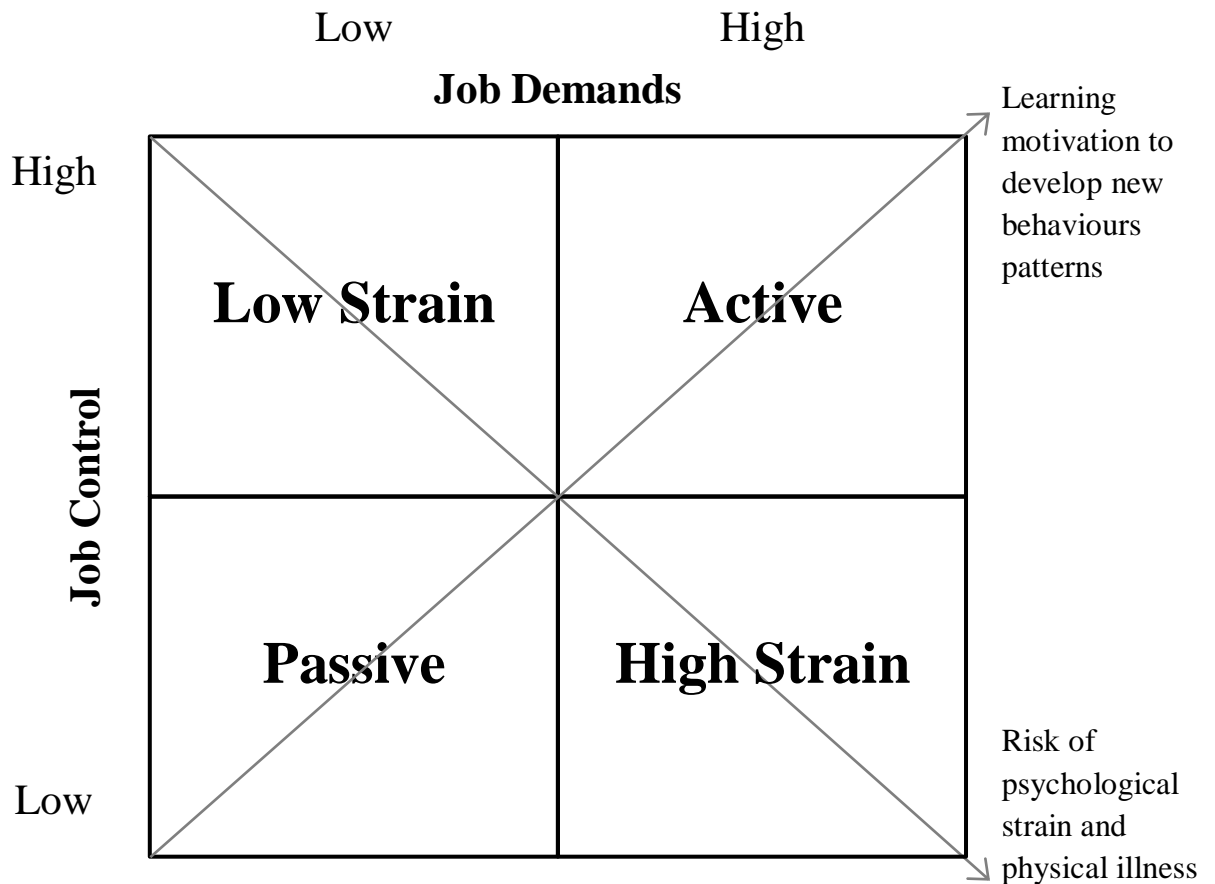
Mainly, the job demand-control model focuses on the combination of job demands on the one hand and job control on the other as determinants of employee well-being. In addition to the independent and additive impact of job demands and job control in predicting well-being, the job demand-control model also hypothesised the buffer hypothesis, which is an interactive joint effect of job demands and job control in which job control can moderate the negative effects of high job demands on health (Karasek, 1979). Additionally, Johnson and Hall (1988) added a third dimension – workplace support from supervisors and colleagues – into the original framework, because accumulating research showed that social support can buffer stress-health relationships or influence health outcomes. However, these hypotheses will not be deliberated in this thesis, as the main focus is the role of stressful work environment.

2.3.4.1.2 Measurement of the job demand-control model

Job strain in the job demand-control model is commonly measured by using individual self-reports. The most common measure is Karasek's Job Content Questionnaire, which investigates physical and psychological job demands, decision latitude and personal workplace insecurity. The self-reported measures have the benefit that the questionnaire can assess differences in an individual's perceptions within an occupational class, but the shortcoming of potential reporting bias (Theorell and Karasek, 1996).

2.3.4.2 *The effort-reward imbalance model*

2.3.4.2.1 Theoretical background

In 1986, Siegrist and his group developed a stress model related to working environment, the effort-reward imbalance model (Siegrist et al., 1986). The effort-reward imbalance is a complementary model that is concerned with stressful features of the work contract; the model argues that the work characteristics are essential to fulfil the employee's needs (Siegrist et al., 1986; Siegrist, 1996). The main idea is that work can contribute to the employee's self-efficacy (e.g. successful execution), self-esteem (e.g. appreciation) and self-integration (e.g. to a member in a group). This theory was originally based on the principle of social exchange or reciprocity, when an individual expends efforts and anticipates equal rewards in return. These rewards include money and career opportunities (promotion and job security). The effort-reward imbalance model argues that, when reciprocity at work fails (expressed by high cost and low gain), strong negative emotions and stress reactions will be produced. In the case of an imbalance, according to Siegrist et al., the imbalance may generates an "active distress" which stimulates two stress axes, i.e. the sympathetic-adrenomedullary and the pituitary-adrenal-cortical system (Henry and Stephens, 1977). Eventually, continuous stimulation of the autonomic nervous system may contribute to the increase of physical and mental illnesses.

A graphical representation of the original version of the effort-reward imbalance model is shown in Figure 2-3 below.

Figure 2-3: The effort-reward imbalance model (Siegrist, 1986)
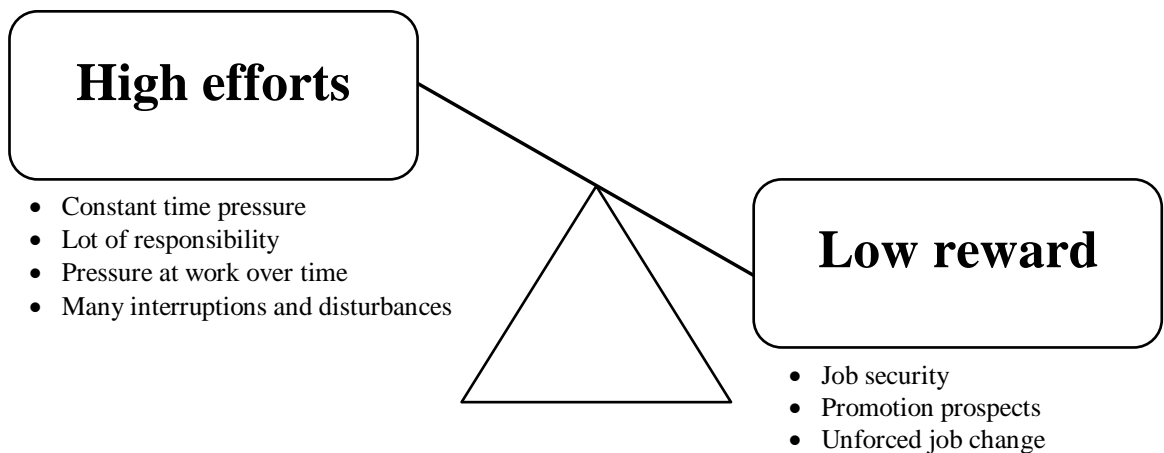
Generally, the imbalance condition at work occurs among employees with low socio-economic status or low skills level and, more general, in an extremely competitive workplace environment (Siegrist et al., 2009).

2.3.4.2.2   Measurement of the effort-reward imbalance model

According to Siegrist (2012), there are various appropriate approaches to measure effort-reward imbalance. To a certain degree, background work information can be used (e.g. job description, salary, job promotion). However, the model's fundamental aspects concern perceptions of the employees; therefore, it is essential to use self-reported data. In large-scale social epidemiological research the most cost-effective measure is a standardised questionnaire (Siegrist et al., 2004). Thus, the effort-reward imbalance model used a standardised 23-item self-report questionnaire consisting of two psychometric scales: effort and reward. A shorter version of 16 items from the original questionnaire was also developed and tested (Siegrist and Peter, 1996).

2.3.5   Differences in psychosocial work environment models

Although there is an overlap between the demand-control model and the effort-reward imbalance model with respect to the demand component, their emphasis differs. One important difference is that the demand-control model focuses entirely on the organisation's structure and is restricted to the situational aspects of the psychosocial

work environment, whereas the effort-reward imbalance model examines the individual's fit within the environment, which includes both extrinsic (situational) and intrinsic (person) characteristics.

Evidence suggests that the key difference between the job demand-control model and the effort-reward imbalance model is that the latter combines situation-specific and person-specific components (Toivanen, 2007). The control aspect in the effort-reward imbalance model is extended to include income and other rewards derived from work (for example appreciation, career opportunities and job security). By focusing on salaries, promotion prospects and job security, the effort-reward imbalance model more explicitly links stressful experience at work with broader labour market conditions. The model focuses on the balance between efforts put into work and rewards received; consequently, it combines psychosocial working conditions and labour market conditions. On the other hand, the job demand-control focuses exclusively on job task (high demands and low control), and consists only of situational characteristics. Therefore, evidence derived from the two models may capture a broader range of stressful experiences at work and thus result in an improved estimation of the risk of developing stress-related diseases.

However, there is some evidence that the decision-latitude component of the demand-control model contributes independently to the prediction of episodes of coronary heart disease (Bosma et al., 1998). This finding suggests that the models might be related to different psychosocial mechanisms linking work conditions to health outcomes. Both models share psychological demands in terms of extrinsic effort only, but control (decision-latitude) and reward are noticeably distinctive.

Furthermore, the two models also differ in terms of type of threats they reflect: the job demand-control captures threats to personal control, whereas the effort-reward imbalance model focuses on threats to social rewards (e.g. esteem). The job demand-control has two hypotheses: first, health conditions result from adverse psychosocial working conditions (the strain hypothesis) and, second, increased level of active work is due to beneficial psychosocial working conditions (the active learning hypothesis). The effort-reward imbalance model has three hypotheses, which combine situation-specific and person-specific components. First, an imbalance between high effort and low reward increases the risk of poor health greater than the risk associated with each component independently. Second, overcommitted employees are at higher risk of poor

health and, third, the highest risk of poor health is likely to be among employees in the previous two situations (Toivanen, 2007).

Together, these psychological work models are valuable for describing how events in the work environment generate stressful situations, yet they are based on the premise that psychosocial stressors influence individuals' mental and physical well-being through intervening physiological processes. Unfortunately, such processes are typically not clearly described by work stress pioneers.

2.4 Psychosocial work environment among older adults

In the UK, with older adults becoming a larger proportion of the population, the presence of older employees in the workforce has increased. The UK labour market has been significantly affected by globalisation and related financial and economic issues. This demographic transition creates the need to offer older employees chances to sustain healthy, productive and less stressful working conditions. According to the Office of National Statistics' most recent findings on the labour market (ONS, 2012; Penfold and Foxton, 2015), additional relevant changes concern the age composition of the workforce. Between the second quarter of 1992 and the first quarter of 2011 the age group with the largest increase in employment rates was the 50-64 group. The employment rate of people aged 50 and over has increased steadily since 1992. For those aged 50 to state pension age (at the time, this was 64 for men and 59 for women), the rate increased by 8.7% and for those individuals of state pension age and above, the increase was 3.6%. This resulted in an increasing number of older people in the workforce. Additionally, in the final quarter of 2014, 75.3% of people aged between 50 and State Pension Age were participating in the UK labour market (ONS, 2012; Penfold and Foxton, 2015).

Older employees differ from their younger counterparts in a variety of physical, mental and social aspects. In some cases these reflect common changes of ageing and in others they represent age-dependent increases in the likelihood of developing various abnormal conditions (e.g. cardiovascular disease). In some cases these age-related changes (whether normative or pathologic) are unfavourable to the older employees because their work performance is reduced compared with that of younger employees (National Research Council, 2004). Studies showed that adverse psychosocial work

exposures later in life might alter the trajectories of age-related change in terms of accelerating the decrements in function with and without a prior history of such exposures.

Regarding the psychosocial work measures, there is no robust evidence that the relationship between psychosocial working environment and health differs by age. It has been reported from Sweden that control at work tends to increase with age and peaks at age 55. That could be because of increasing seniority in the job. Thereafter, the degree of control may decline (National Research Council, 2004). Additionally, previous studies have shown that, during the first years of their working career, men can expect rising levels of decision latitude (Beilin and Puddey, 1993). However, when men are approaching retirement age, this expectation is diminished and such a loss of status may not be perceived as equally threatening (Theorell et al., 1998).

Older employees working in stressful jobs may be at risk for increasing stress-related morbidity and mortality rates, paired with the accumulative effects of stress-related behaviours, such as smoking, alcohol consumption and poor nutrition (Pearlin et al., 2005). This study was consistent with the hypothesised effect of cumulative lifetime exposure to work stressors (represented by age) (National Research Council, 2004). Edler Jr et al. (2003) argued that that ageing process should be treated in the life course perspective as a process that unfolds throughout life, reflecting each individual's social context and cumulative experiences. Thus, poor physical health can be a consequence of long-term exposure to stressful work conditions among older adults. On the other hand, other research has suggested that an accumulation of difficulties throughout life might offer opportunities for resilience among older populations (Hamarat et al., 2002; Bowling and Iliffe, 2011; Gaffey et al., 2016).

In addition, evidence indicates that there are specific characteristics of work that are regarded as particularly problematic by older employees and which are therefore likely to be particularly stressful for them (Griffiths, 1997, 2000). These are namely: increased exposure to certain psychosocial risks at work; less training over a similar period of time; decreased prospects to gain further knowledge, expertise and professional development to develop new skills; fewer opportunities for task rotation, less support from supervisors; and redundancy (Chiu et al., 2001; Molinié, 2003; Leka et al., 2008).

One important aspect that can be used to interpret the work stress in older individuals is to recognise different coping strategies in their reactions to dealing with stress at work compared to younger employees, especially when most research that has focused on work stress has mainly used younger samples (Hansson et al., 2001). Some research has argued that older employees tend to have a greater range of coping resources and strategies that they have learnt over their career span when compared to their younger colleagues (Aldwin and Levenson, 2001; Barnes-Farrell et al., 2002).

Shultz and colleagues examined data from 15 European countries on how the demand-control model may operate differently for older compared to younger employees (Shultz et al., 2010). The results indicated that older and younger employees reported similar effects of job demands and control. However, among older employees high work control showed a buffering effect against different types of job demands, whereas for younger employees, only one element of the job control (having enough time to get the job done) buffered stressful experience associated with work demands. However, these observed interaction effects were fairly small (Shultz et al., 2010). In another investigation, employees between the ages of 45 years and retirement age reported twice as many cases of psychological ill health (stress, depression and anxiety) when compared with their younger counterparts. However, very few cases were found in the post-retirement population (Edwards et al., 2002).

There was some research that suggested a greater likelihood of reporting work-related stress and work-related health problems as employees get older (Jain et al., 2010). However, this has been shown to decrease following retirement; as for the group of employees post-retirement the prevalence of work-related health problems decreases (Leka et al., 2008). Research has speculated that this observed trend can be explained by the fact that only healthier employees are more likely to remain in the workforce after reaching retirement age (aged 65 and over) (Griffiths, 2007).

2.5 Psychosocial work environment and health: evidence from systematic reviews

The role of stressful psychosocial work environment on employees' health and well-being has been the topic of many studies over the past years. Studies of psychosocial work environment and health have mainly focused on cardiovascular disease, chronic

diseases, mental health outcomes and musculoskeletal disorders (Siegrist and Theorell, 2006). Not only primary studies, but also numerous reviews and a few systematic reviews have highlighted the association between psychosocial work environment and various health outcomes. The next sections present the results from the published systematic reviews on the links between psychosocial work environment and health problems.

2.5.1   Psychosocial work environment and general health

Concerning general health, a substantial body of evidence from systematic reviews documented a higher odds ratio of cardiovascular incidents (mostly coronary heart disease) among individuals reporting high job strain or effort-reward imbalance. The reviews presented below showed a fairly consistent positive moderate association between psychosocial work stress and cardiovascular morbidity or mortality (Fishta and Backé, 2015).

One of the earliest reviews on the association between job strain and cardiovascular disease by Belkic et al. (2004) included a total of 34 studies published between 1966 and 2002: 17 longitudinal studies, 9 case-control and 8 cross-sectional studies. Both the job demand-control model and effort-reward imbalance model were considered as psychosocial work stress predictors. A total of 18 studies showed significant positive results. Men showed strong, consistent evidence of an association between exposure to job strain and cardiovascular disease, while less data was available on women and the findings were inconsistent. Explanations of causal pathways, particularly biological plausibility, confirmed that job strain is a major risk factor for cardiovascular disease. Additionally, the review found a dose-response effect for work control alone (namely decision latitude) and risk of a cardiovascular disease incident, but no dose-response relationship was found for cardiovascular mortality (Belkic et al., 2004).

Netterstrøm and Kristensen (2005) reviewed 35 studies that investigated the relationship between psychological workload and ischemic heart disease. The review included 18 cohort and 17 case control studies published between 1992 and 2003. Although most of the studies included used the job demand-control model (19 publications), a total of 23 studies confirmed a positive and strong association between psychosocial workload and ischemic heart disease (Netterstrøm and Kristensen, 2005).

Over a decade ago, Kivimäki et al. (2006) meta-analysed studies that examined the link between work stress and coronary heart disease (CHD), focusing on 14 prospective cohort studies published between 1979 and 2006. Eleven out of the 14 studies found a positive association between work stress and cardiovascular disease. The meta-analysis showed that the association between work-related stress and cardiovascular diseases significantly decreased after adjustment for covariates, such as socio-economic position, body mass index, blood pressure, cholesterol concentration, smoking and sedentary lifestyle. Nonetheless, the paper found an average of 50% excess risk for CHD among employees with work stress (Kivimäki et al., 2006).

Eller et al. (2009) reviewed 33 studies of men and women (26 prospective cohort and 7 case control studies). The review included studies from 1985 to 2008. They concluded that, for males, there was moderate evidence for high psychological demands, low social support and iso-strain (high demands and low control in conjunction with low social support) being risk factors for ischemic heart disease (IHD). As a number of studies in the review did not find influence at work to be a risk factor for IHD, they suggested that the demands dimension of job strain could explain the association between job strain and IHD. Additionally, the review found that there was a significant positive association between effort-reward imbalance, job insecurity and long working hours as risk factors for IHD. However, this evidence was insufficient due to the limited number of studies. Among women, the review was inconclusive regarding psychosocial risk factors as too few studies had been carried out (Eller et al., 2009).

In another review, Kivimäki et al. (2012) analysed published and unpublished data on the relation between job strain and coronary heart disease. The analysis was conducted on both men and women from 13 European cohort studies between 1985 and 2006. It included the job demand-control model, but not the effort-reward imbalance model. The findings suggested that job strain was associated with increased risk of cardiovascular disease; this association was independent from socio-economic status.

In the same year, Backé et al. (2012) reviewed 26 prospective cohort studies from 1977 to 2010 that examined the association between work stress and cardiovascular disease indicators (myocardial infarction, stroke, angina pectoris and high blood pressure). Work stress was defined in 17 publications by using the job demand-control model, 3 publications used the effort-reward imbalance model and the rest applied other measures for work stress. After including additional data, the findings were consistent

with the previous systematic reviews or meta-analyses confirming the association between work stress and cardiovascular disease. In addition, the review found that the effort-reward imbalance model was a consistent predictor of cardiovascular diseases, especially in men (Backé et al., 2012).

Kivimäki and Kawachi (2015) reviewed 27 cohort studies in Europe, the USA and Japan. The authors included three exposures, namely job strain, long working hours and job insecurity. For all of those, the review suggests that work stressors, such as job strain and long working hours, were associated with a moderately elevated risk of incident coronary heart disease and stroke.

In the same year, a review by Pejtersen et al. (2015) was intended to update an earlier one by Eller et al. (2009). The earlier review included a total of 33 papers and the updated review added a further 11 studies. The results confirmed that the control dimension of job strain seems to explain excess risk for myocardial infarction. The review did not find that high work demand was a risk factor. This might have to do with the complexity of demands as defined by Karasek (1979), where work pace, quantitative demands, role clarity, conflicting demands and physical demands constitute the demands scale. For example, different types of demands do not occur in the same occupations and do not have the same effects on health (Kristensen et al., 2004).

The latest systematic review on psychosocial work stress and cardiovascular diseases was conducted by Theorell and colleagues, who reviewed a number of publications between 1985 and 2014 (Theorell et al., 2016). Studies included in this review used a variety of occupational exposures as psychosocial factors at work and ischaemic heart disease as an outcome. They included a total of 96 studies, most of which were based on population samples and a few were from companies and occupational groups. The review results provided evidence for several work conditions being linked to a higher risk of ischaemic heart disease. Moderately strong evidence was shown for both job strain and low decision latitude. Furthermore, limited evidence was found for effort-reward imbalance, low support at work, low workplace justice, poor skill discretion, insecure employment, night work, long working week and noise.

To summarise, the association between job strain and coronary heart disease has been shown to be consistent across studies initiated at different time periods and from different geographical regions. In contrast, findings on job control are heterogeneous:

some studies suggest that job control is more important than job demands while other studies report that job demands are more important. This could be expected because the confounding structure, including the distribution of socio-economic status, tends to vary between studies, producing heterogeneous findings for confounded associations.

On the other hand, the evidence linking effort-reward imbalance with cardiovascular diseases and cardiovascular diseases' risk factors seems to be more consistent in comparison to the evidence linking the job demand-control to cardiovascular disease.

2.5.2   Psychosocial work environment and mental health

There have been on-going efforts to examine the links between psychosocial work characteristics and mental health. In the field of mental health, depression was the most widely reported outcome in epidemiological research in relation to stressful work environment (Stansfeld and Candy, 2006; Bonde, 2008; Siegrist, 2008a; Nieuwenhuijsen et al., 2010). Some reviews have also included stress-related disorders (SRDs), psychologically-related sick leave and suicide or combinations as outcomes (Michie and Williams, 2003; Nieuwenhuijsen et al., 2010; Freire and Koifman, 2013).

Over a decade ago Stansfeld and Candy (2006) conducted a systematic review and met-analysis of published literature from 1994 to 2005. They included 11 cohort studies investigating the association between psychosocial work stressors and common mental disorders. The review found evidence that the effects of job strain and effort-reward imbalance were significantly higher among individuals with depression and anxiety. The summary statistics indicated that an employee's risk of common mental disorders could be predicted by: low work control (OR 1.23), high psychological demands (OR 1.39), high job strain (OR 1.82), low occupational social support (OR 1.32), effort-reward imbalance (OR 1.84) and job insecurity (OR 1.33).

Bonde (2008) reviewed the evidence from 1966 to 2007 on the links between psychosocial factors at work and the risk of depression. The review included 16 follow-up studies. With a few exceptions, these studies suggested a higher risk of depressive disorder or symptoms in relation to psychosocial work factors in both men and women.

Another review published in the same year, by Netterstrøm et al. (2008), made a similar conclusion in their systematic review of 14 studies from 1960 to 2007. The paper found moderate evidence for an association between psychological job demands and

depression development. Additionally, effort-reward imbalance was shown to be significantly associated with higher risk of anxiety and depression in both men and women.

A third review in the same year, published by Siegrist (2008a), investigating the link between chronic psychosocial work stress and depression. Siegrist reviewed 12 prospective studies (8 studies on job demand-control and 4 studies on effort-reward imbalance) published between 1998 and 2008. The review confirmed the findings from previous literature on the association between psychosocial work stress and increased risk of depression.

Nieuwenhuijsen et al. (2010) identified 7 studies published from 1950 to 2008 on the effects of psychosocial work environment on risk of SRDs assessed by the general health questionnaire. The studies reviewed used a variety of 10 different measures as indicators of psychosocial work environment – this comprises: job demands, job control, co-worker and supervisor support, career perspective, task variation/skill discretion, emotional demands, procedural justice, relational justice and effort-reward imbalance. The review findings suggested strong evidence that six of the psychosocial work environment measures examined predicted the incidence of SRDs; these include high job demands, low job control and a high effort-reward imbalance.

Theorell et al.'s (2015) review covered the literature from 1990 to 2013 and identified 59 prospective studies on psychosocial factors at work in relation to depressive symptoms. The authors found moderate evidence that high job strain, low job control and workplace bullying have a significant impact on the development of depressive symptoms. Limited evidence was found for high job demands, effort-reward imbalance, low workplace social support, low workplace justice, workplace conflicts, job insecurity and long working hours in relation to depressive symptoms.

Recently, Harvey et al. (2017) conducted a comprehensive systematic meta-review of the evidence from 1990 to 2016 on the association between work-related stress and common mental health problems, namely depression, anxiety and/or work-related stress. They included 7 studies that assessed various types of work-related risk factors including: high job demand, low job control, low workplace social support, effort-reward imbalance, low organisational procedural justice, low organisational relational justice, organisational change, job insecurity, temporary employment status, atypical

working hours and workplace conflict/bullying. The meta-review suggested that high strain and effort-reward imbalance in the workplace were associated with increased risk of developing depression, anxiety and common mental disorders.

Similarly, Rugulies et al. (2017) reviewed the evidence on the association between effort-reward imbalance at work and the risk of depressive disorders. The systematic review and meta-analysis included eight prospective cohort studies published until 2016[c] from Europe, Canada and the US. All the included studies, except for one, suggested that effort-reward imbalance was associated with a 1.5-fold increase in risk of depressive disorders.

It is important to note that, in addition to health outcomes, health-adverse behaviours were also shown to be related to stressful psychosocial work environment. This association is discussed in section *2.7.2*.

2.6   Psychosocial work environment and oral health

Oral health is essential to the general health and well-being of individuals and the population. Dental diseases are chronic diseases that have common risk factors with other major chronic diseases (Marcenes and Sheiham, 1996; Sheiham and Watt, 2000; Sheiham, 2005). Hence, it can be argued that psychosocial characteristics that are related to general health could also be linked to oral health. However, there has not been any systematic review on the association between psychosocial work environment and oral health. In fact, a systematic review of the available literature is hampered because of a number of difficulties. The most critical to highlight are: the very limited research available to review, the different measures of psychosocial work environment and oral health used in studies, and the different populations and settings studied. Since the main focus of this thesis relates to oral health outcomes, this section narratively appraises the four published pieces of literature on the association between psychosocial work environment and oral health. Then, the following section will review studies on additional psychosocial factors in relation to oral health outcomes.

Table 2-1 below presents the key characteristics and findings from these studies listed chronologically by the year of publication.

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[c] The beginning of the search period for the systematic review was not stated in the publication.

Table 2-1: Studies on psychosocial work environment and oral health

Authors (years)	Population sample and size (N)	Age and gender (%)	Psychosocial work environment measures	Oral health measures	Covariates included	Summary of findings
Yoshino et al. (2016)	Financial workers in Japan (N=950)	Age 25-46 years old 100% males	The Brief Job Stress Questionnaire	Subjective oral health: - number of present teeth, tooth loss - presence of untreated tooth - frequent stomatitis, frequent pain in teeth/gingiva - pain when consuming something cold, - gingival bleeding, - gingival swelling, - gingival recession, - frequently get food stuck between teeth, - loose teeth, - cannot eat certain foods, - dry mouth, - slimy feel inside mouth, - bad breath, - jaw makes clicking sound, - jaw pain, - difficulty opening mouth, - teeth are worn down	Age, annual income, total work stress score, smoking, diabetes, hypertension and body mass index	- Oral health problems that were significantly associated with some of the work stress indicators were: frequent stomatitis, gingival swelling, gingival recession, slimy feel in the mouth, bad breath, clicking sound in the jaw and worn-down teeth

Table 2-1, continued: Studies on psychosocial work environment and oral health

Authors (years)	Population sample and size (N)	Age and gender (%)	Psychosocial work environment measures	Oral health measures	Covariates included	Summary of findings
Scalco et al. (2013)	The cohort Pró-Saúde Study (1999-2001) of employees of Rio de Janeiro State University (N=2,770)	Mean age 42.5 years 44.1% males	The Demand- Control-Support Questionnaire (high strain, passive job, active job and low strain)	Self-rated oral health	Age, sex, household income, education, smoking, self-perceived general health, social support at work, self-reported tooth loss, dental pain in the last two weeks and frequency of dental visit	-Employees exposed to high strain and to passive work had higher chances of self-perception of worse oral health. The association was explained by health behaviours -No association between active work and self-perceived oral health
Acharya and Pentapati (2012)	Industry employees in four mid-sized IT companies in south India (N=134)	Mean age 25.97 years 71.6% males	Work Stress Questionnaire	- DMFT scores - Community Periodontal Index of Treatment Needs (CPITN) - Oral Impact on Daily Performance (OIDP) - Self-reported oral health	Age and sex	Work stress was a significant predictor for OIDP

Table 2-1, continued: Studies on psychosocial work environment and oral health

Authors (years)	Population sample and size (N)	Age and gender (%)	Psychosocial work environment measures	Oral health measures	Covariates included	Summary of findings
Marcenes and Sheiham (1992)	Fathers from a family study conducted in Belo Horizonte, Brazil (N=164)	Mean age 41.2 years 100% males	- Work-related mental demands - Work control - Work variety	- DMFS scores - Periodontal pockets - The presence of gingival bleeding on probing	Age, sex, socio-economic status, marital quality, sugar consumption, tooth brushing frequency, type of toothpaste, dental attendance and years of residence in Belo Horizonte (fluoridated) city	Only the low work-related mental demands measure was significantly associated with better periodontal health status

The first study to examine whether clinical oral health status is associated with work stress was conducted by Marcenes and Sheiham (1992). The sample consisted of 35-44 year-old male employees in Brazil. Psychosocial work factors were collected by a questionnaire, which includes five psychosocial variables: work-related mental demand, work control, work variety, socio-economic status and marital quality. Work stress variables were based on the Karasek job strain model (Karasek and Theorell, 1989). Oral health outcomes were measured by clinical examination for both dental caries and periodontal disease. The decayed, missing and filled surfaces (DMFS) index was used for caries assessment and the presence or absence of teeth either with gums bleeding on probing or with pockets were used for periodontal disease examination. The questionnaire used in the study also included data on behavioural risk factors involving: frequency of dental attendance, tooth brushing frequency, sugar consumption and type of toothpaste. The analysis found a significant association between poor periodontal status and high work mental demand and low marital quality, and this relationship was independent from selected risk-related behaviours (Marcenes and Sheiham, 1992). However, the analysis investigated only one dimension of psychosocial work characteristics and the sample consisted of male employees only. Additionally, smoking had not been taken into account in this study, although it is considered to be in important risk factor in the relation between work-related stress and health.

In 2012, Acharya and Pentapati assessed the relationships among work stress, oral health and oral health-related quality of life in information technology professionals in India (Acharya and Pentapati, 2012). The sample consisted of 134 employees from two different companies, and the mean age of the participants was 25.9 years. Work stress exposure was assessed by a 25-item modified version of the Work Stress Questionnaire (Cooper et al., 1988). Oral health was measured by a self-administered questionnaire containing the eight-item Oral Impact on Daily Performance (OIDP) scale alongside objective assessment involving clinical examinations for caries using the decayed, missing and filled teeth (DMFT) index and an examination of periodontal health status using the Community Periodontal Index of Treatment Needs (CPITN). The study found higher levels of work stress among those who reported bleeding gums and sensitive teeth, and no association between work stress and oral health-related quality of life. This analysis used a work stress measure that is mainly used to support investigations identifying the primary sources of workplace pressure and stress, and hence the

exposure measure in this study did not reflect the psychosocial aspect of work stress. Additionally, the sample was not shown to be representative of the defined population.

A cross-sectional Brazilian study examined the link between occupational stress and a single-item self-rated oral health question (Scalco et al., 2013). The study measured work stress by using 17 items from the Karasek Demand-Control-Support Questionnaire (Karasek, 1979). Data was collected from 2,770 employees through a self-administered questionnaire in the Rio de Janeiro State University. The analysis included both men and women with a mean age of 42.5 years. This study found that individuals exposed to higher levels of job stress reported worse self-rated oral health. However, the extent of this finding decreased after adjusting for socio-demographic status, and lost statistical significance after adjusting for health behaviours. In this study, only one dimension of job stress was explored, that is job strain. In addition, the independent influence of work demands, control and social support at work on oral health has not been described, which could be important to support the findings of the analysis (Sanders et al., 2007). However, the analysis considered a reliable and validated measure of work stress and controlled for a wide range of related covariates.

The most recent study by Yoshino et al. (2016), assessed the link between subjective oral health symptoms and work stress in male financial employees in Japan. The data was collected using an internet-based survey from a group of people who registered with a research company online. The study used seven items in the Brief Job Stress Questionnaire[d] in Japanese (Shimomitsu, 2000) to assess the following three areas: psychological stressors, psychological and physiological stress reactions, and buffering factors such as social support in the workplace. Four items measured subjective oral health outcome: the number of present teeth, tooth loss, presence of untreated tooth, and presence or absence of 16 oral problems[e]. The authors found an association between reporting work stress and tooth loss, presence of untreated decay and at least three oral problems (Yoshino et al., 2017). However, the study relied on an internet survey for

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[d] The Brief Job Stress Questionnaire items used were: "I have an extremely large amount of work to do", "I can't complete my work in the required time", "I have to work as hard as I can", "I have to pay very careful attention", "My job is difficult in that it requires a high level of knowledge and technical skill", "I need to be constantly thinking about work throughout the working day" and "My job requires a lot of physical work". The response choices were "very much so", "moderately so", "somewhat" and "not at all".

[e] Subjective oral health outcome items were: the number of present teeth, tooth loss (reason for tooth loss categorised as caries, periodontitis, or fracture), presence of untreated tooth with a cavity, and presence or absence of the following symptoms: frequent stomatitis, frequent pain in the teeth or gingiva, pain when consuming something cold, gingival bleeding, gingival swelling, gingival recession, frequently get food stuck between teeth, loose teeth, cannot eat certain foods, dry mouth, slimy feel inside the mouth, bad breath, jaw makes clicking sound, jaw pain, difficulty opening the mouth, and teeth are worn down.

recruitment and data collection, which creates the possibility of selection bias, and overlooked the assessment of the duration or the intensity of a given exposure. Such evaluation cannot be obtained by means of internet-based questionnaires alone. This method, in addition, contains a risk for information bias, especially as skilled employees in Japan tend to work longer hours than those in other developed countries (Bannai et al., 2015) and thus may have higher levels of stress (Kawaharada et al., 2007). Furthermore, studies have shown that Japanese employees generally report greater psychological distress and lower job satisfaction compared to employees from the US (Lincoln and Kalleberg, 1992). However, studies by Iwata et al. (1995, 1998) suggested that this pattern is attributed to a response bias due to Japanese culture, i.e. the suppression of expression of positive emotions by Japanese employees. Additionally, the scale used for measuring work stress consisted of few items that were not validated or tested to be reliable. Therefore, the reliability and validity of the data obtained is possibly weak due to the fact that the study used non-validated measures for the work stress variables. The assessment of work stress exposure measures could also be improved by characterisation of specific working conditions that might contribute to the increased risk for development of oral disease. In addition, the analysis only includes financial employees and did not account for differences in oral health by job classification. Current studies in Japanese populations acknowledge occupational status as a risk factor in periodontal health (Morita et al., 2007). In a recent Japanese study of 1,078 employees aged 19-70 years, Zaitsu et al. (2017) investigated the role of various workplace variables and oral health behaviours on tooth decay, periodontal disease and the number of present teeth. Workplace measures included occupational classification and work schedule. Oral health status was measured by oral examination assessing periodontal health (namely the Community Periodontal Index). The study found that managers showed significantly poorer oral health in terms of periodontal disease when compared to employees in other types of jobs. Night-time shifts were also significantly associated with poorer periodontal condition. The findings were confirmed in another recent study by Irie et al. (2017), who found a significant association between occupational status and developing periodontal disease over five years among employees in Japan.

2.6.1 Additional psychosocial factors and oral health: associations between different psychosocial measures and oral health outcomes

Since there were only four published studies linking psychosocial work-related stress to oral health outcomes. Evidence from studies that have investigated the role of psychosocial factors on oral health outcomes was identified and reviewed to strengthen the knowledge on the association between psychosocial environment in general and oral health. In the oral health literature, psychosocial factors were defined by several means including: life satisfaction, stressful life events, loneliness, self-esteem, sense of coherence, social support and locus of control. A narrative review of studies linking various psychosocial factors with oral health outcomes is presented below, separated by the nature of oral health outcome measures.

2.6.1.1 Subjective oral health measures and self-reported oral health outcomes

Sanders and Spencer (2005) explored the relationship between a single-item self-rated oral health question and a range of psychosocial measures. Data was collected using a cross-sectional survey together with information from a questionnaire for adults aged 18-34 years. Psychosocial factors included were: life satisfaction, personal constraint and perceived stress; they were evaluated with standard psychometric scales. The study found that higher rates of life dissatisfaction, personal constraint and perceived stress were associated with low self-rated oral health. However, this study did not adjust for some important factors, apart from household income, that can influence oral health outcomes (for example, health-related behaviours), especially that the low sense of control may impact health indirectly through behavioural pathways.

Finlayson et al. (2010) examined the association between psychosocial stressors and resources with self-rated oral health among 3,570 American adults. Psychosocial stressors measured in the analysis included: depression, marital hardships, employment status, discrimination, chronic and financial stress, neighbourhood crime and drug problems. The analysis found significant associations between three psychosocial stressors (namely, depression, material hardships and chronic stress) and the dependent variable of self-rated oral health after controlling for income, age, education and household size. However, oral health-related behavioural variables were not considered in this study.

2.6.1.2 Clinical oral health outcomes

There was only one review examining the evidence on the effect of stress and psychological factors on periodontal disease (Peruzzo et al., 2007). The review covered the years from 1990 to 2006 and included 14 papers from case-control, cross-sectional studies and prospective clinical trials. A number of psychological factors were considered including: stress, distress, loneliness, depression, anxiety and daily strain. Periodontal disease outcome was defined as: clinical attachment level, probing depth, attachment loss, alveolar bone loss, bleeding on probing, recession level, remaining periodontal support and missing teeth. Eight of the studies analysed showed a positive association between stress/psychological factors and periodontal disease. Four studies observed some positive outcome for selected characteristics and a negative outcome for others, and two studies found a negative outcome between psychosocial factors/stress and periodontal disease.

With regard to empirical studies, Hugoson et al. (2002) examined the relationship between negative life events and periodontal disease using clinical oral health measures. The investigation used a sample of individuals aged 50-80 year old in Sweden. Data was collected by clinical and radiographic examinations in addition to a questionnaire concerning socio-economic status, life events, and psychological and stress-related factors. The results showed that the loss of a spouse and coping poorly with stressful life events were related to severe periodontal disease. However, the small sample size (298 participants) and the cross-sectional design of this study obstruct any causal conclusions. However, the study findings complement Beck et al.'s (1987) findings in relation to negative life events and root caries in an elderly population.

Solis et al.'s (2004) cross-sectional study used a range of psychosocial measures such as anxiety, depression, stress, psychiatric symptoms and hopelessness. The analysis comprised a total of 160 Brazilian adults aged 19 to 67 years. No evidence was found for an association between the psychosocial factors analysed and established periodontitis (assessed by probing depth and clinical attachment level). Similarly, Castro et al. (2006) analysed an identical set of psychosocial factors in relation to periodontitis among 169 adults in Porto Alegre, southern Brazil. The analysis found no significant association between periodontitis and the psychosocial factors.

Around a decade ago, a cross-sectional study in Hong Kong was conducted by Ng and Keung Leung (2006). The study comprised 1,000 dentate participants aged 25-64 years who presented for treatment in three general dental practices. The analysis aimed to investigate the association between periodontal disease in terms of clinical attachment level and psychosocial stress in terms of stress, daily strains, depression, anxiety and hostility. The study found evidence of a higher odds ratio of clinical attachment level associated with depression, anxiety, job strain and financial strain. In addition, there was evidence of more severe periodontal attachment loss among participants with job strain or financial strain who used more emotion-focused coping strategies.

Additionally, in a cross-sectional study of 1,302 Brazilian school students aged 14-15 years from two cities of the Distrito Federal, Pattussi et al. (2007) assessed the association between social, psychosocial and clinical factors with poor self-rated oral health. Psychosocial variables included were: self-rated health, behaviour problems, social support and family structure. The study showed that good self-rated oral health was associated with socio-economic factors, perceived general health and mouth appearance, and on objective clinical factors such as presence of untreated dental decay. However, social support was not associated with self-rated oral health (Pattussi et al., 2007)

A life course study by Nicolau et al. (2007) aimed to examine the association between psychosocial factors at two periods of life and periodontal diseases. The study used data from 13-year-old children who attended private and public primary schools and their mothers (n=224) in Cianorte, Brazil. The psychosocial factors measured were social support and emotional support in adulthood. Clinical oral examinations of participants were the presence and absence of plaque, calculus, bleeding gums on probing, pocket depth and loss of attachment. The study found that women who reported no emotional support in adulthood were more likely to experience high levels of periodontal attachment loss. However, no association was found between social support at childhood and the risk of periodontal disease. The strength of the results of this study might be compromised because the sample consists of women only, which makes the cases not representative of the defined population.

A cross-sectional analysis aimed to assess the association between two psychosocial measures, social network and social support, with periodontal disease among older

American adults (Sabbah et al., 2011). Data was obtained from the National Health and Nutrition Examination Survey 2001-2004 for individuals aged 60 years and over. Periodontal disease was measured clinically by two variables (extent of loss of periodontal attachment and moderate periodontitis). Social support and networks were measured by questionnaire, and were indicated by the need for emotional support, number of close friends and marital status. The findings indicated that the widowed and those with the lowest number of friends had higher rates of periodontal attachment loss – although widowed individuals were generally older than the rest of the sample, which would imply that the observed relationship might be influenced by the accumulative effect of age. In addition, the findings suggested that marital status and number of friends were not significantly associated with moderate periodontitis when adjusting for behavioural factors. However, the analysis lacked information on important measures of oral health behaviour, such as tooth brushing, which could have influenced the results.

López et al. (2012) found evidence of an association between periodontitis and psychosocial distress – measured by the General Health Questionnaire (GHQ) – among adolescents in Santiago, Chile. The case-control study analysed data from 87 cases and 73 controls aged 13-20 years. Oral health was assessed by using clinical examinations of clinical attachment levels, probing pocket depth and bleeding on probing. The age- and sex-adjusted analysis found a positive association between periodontal disease cases and higher values for the total GHQ score.

2.6.1.3 *Combination of self-report and clinical outcomes*

A study by Armfield et al. (2013) explored the link between psychosocial measures and oral health, by analysing data from the National Survey of Adult Oral Health in Australia. The analysis was conducted in adults aged 18 years or older. Oral health measures included were self-rated oral health, untreated decayed teeth and number of decayed, missing and filled teeth (DMFT). Psychosocial measures were perceived constraints, personal mastery and social support. The results indicated that perceived stress and perceived constraints were related to self-rated oral health, and no psychosocial variables were associated with either untreated decayed teeth or DMFT. These associations were explained after adjusting for tooth brushing and dental visiting. However, some relevant behavioural variables were not included in the analysis, for

example, smoking, which is considered important potential oral health behaviour that may contribute to the association between psychosocial factors and oral health.

Another study was conducted in 2013 to assess the role of social relationships as a psychosocial determinant of oral health in older adults (Tsakos et al., 2013). In this investigation, data was analysed on adults aged 60 years or older from the US National Health and Nutrition Examination Survey (1999-2004). Oral health outcomes were edentulousness, number of decayed teeth, root decay, number of sound or filled teeth, and self-rated oral health. Psychosocial factors were social relationships measured by social networks (marital status, number of close friends) and social support (emotional support need, provision of financial support). The analysis results showed that emotional support need was associated with a higher risk of root decay and reporting poor oral health. Lack of financial support was associated with having more decayed teeth. However, edentulousness was not related to psychosocial indicator. In this analysis, social support was not fully assessed because the need for emotional support referred to the perceived need only; even though some individuals might be actually receiving such support. The assessment of social networks was also limited to the size of the networks but does not cover the aspect of the quality of relationships.

Finally, among a sample of 439 adolescents aged 12 and 13 years old drawn from five schools in Malaysia, sense of coherence was shown to be an important psychosocial predictor for oral health (in terms of fewer symptoms, functional impacts, and better health perceptions and quality of life) (Baker et al., 2010). In addition, Lenčová et al. (2006) and Savolainen et al. (2005) suggested that a weak sense of coherence increases the likelihood of having poor oral hygiene. Others found that a stronger sense of coherence was associated with regular dental attendance (do Carmo Matias Freire et al., 2001; Savolainen et al., 2004).

2.7 The links between psychosocial factors and oral health: potential pathways

The available literature supports the relationship between psychosocial work environment and poor self-rated health, mental health, physical health and oral health outcomes. However, the way that psychosocial work characteristics affect general and oral health outcomes is partially unexplored (Brunner and Marmot, 1999; Chandola et

al., 2008; Vasiliou et al., 2016). The available literature has suggested that stressful psychosocial work environment begins as a 'psychological' problem concerning employees' appraisals of work (Cox, 1993). Employees' perceptions of their own working conditions are necessary in understanding any associations between those conditions and health outcome. There are at least two mechanisms that are considered as potential mediators of the relationship between psychosocial work environment and health (Jain et al., 2010). The first mechanism is a direct pathway through biological changes, whilst the second is an indirect stress-induced pathway that is mediated by health-related behaviours (Cox et al., 2000). These two pathways can help in understanding the link between psychosocial work environment and oral health.

Sheiham and Nicolau (2005) stated that "*the most important psychosocial risk factors for poor health in modern populations could be grouped under lower social status, weak social networks, job strain and stress in early and later life*". While an extensive analysis of the pathways between psychosocial stressors and oral health goes beyond the scope of the thesis, it is important to consider and review the evidence basis of these two mechanisms. A summary of the evidence that has investigated the pathways linking psychosocial work environment to general and oral health is presented in the next section.

2.7.1   Biological pathways

Long-term or repeated exposure to an adverse work environment may trigger the body's stress response, which is a biological mechanism that addresses in what way the adverse effects of work-related stressors "get under the skin" (Taylor et al., 1997; Lundberg, 2005). Several studies have shown that psychological stress could affect the immune response through the stress response, also known as the fight-or-flight response, which helps humans to react to emergencies and to cope with change. Severe prolonged exposure to stress eventually leads to tissue damage and disease (Selye, 1936). When the stress response is activated chronically or dysregulated, the process of adaptation or 'allostasis'[f] (McEwen, 2001) can increase the risk for a range of diseases. The two main systems of the stress response are the sympatho-adrenal-medullary (SAM) system and the hypothalamo-pituitary-adrenocortical (HPA) axis (McCarty, 2002).

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[f] 'Allostasis' refers to the body's inherent ability to adapt to stressors and change, and to maintain homeostasis (achieve stability) via fluctuating or heightened physiological responses, and as such it is crucial to survival.

Adrenaline is the main hormone of the SAM system and cortisol is the main hormone of the HPA axis (McEwen and Lasley, 2002). The accumulative exposure to stressors can increase physiological stimulation over time, which results in "wear and tear" on the body, and can accelerate disease by contributing to 'allostatic load'[g] (McEwen and Stellar, 1993; McEwen, 1998), which consequently increases the susceptibility to disease.

In two cross-sectional investigations using NHANES (1998-1994 and 1999-2004) data, Sabbah et al. (2008) and Borrell and Crawford (2008) found a positive association between allostatic load, assessed with 7 biomarkers, with periodontitis in US adults. High levels of allostatic load independently predicted gingival inflammation, clinical attachment loss and periodontal pocketing (Borrell and Crawford, 2008; Sabbah et al., 2008). In addition, allostatic load was also positively associated with ischemic heart disease, suggesting a common stress pathway for both conditions (Sabbah et al., 2008).

The immunosuppressive effect of stress has been documented as a possible mechanism that contributes to the development of chronic inflammatory periodontal disease, and few reviews have suggested that there are multiple biologic pathways involved in the association between psychosocial stressors and oral health outcomes (Gomaa et al., 2016; Goyal et al., 2013; Peruzzo et al., 2007; Sheiham and Nicolau, 2005).

Literature that investigated the association between psychosocial stress with the extent and severity of periodontal disease has suggested a few possible mechanism that lead to inflammatory periodontal diseases, including: alteration in salivary flow and components (Giannopoulou et al., 2003; Vettore et al., 2003; Ishisaka et al., 2007; Johannsen et al., 2006, 2007), worse immune functioning (da Silva et al., 1995; Gomaa et al., 2016), lower host resistance (Gomaa et al., 2016; Goyal et al., 2013) and increases in the possibility of infection, particularly periodontal disease (Sheiham and Nicolau, 2005; Peruzzo et al., 2007; Salazar, 2013). Additionally, the associations between immunological responses to stressors and periodontitis were found in populations who are 50 years and over (Genco et al., 1998; Hilgert et al., 2006).

With regard to the psychosocial work environment models (specifically the job demand-control and the effort-reward imbalance) and biological risk factors for oral diseases,

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[g] 'Allostatic load' is the 'wear and tear' of the body in order to adapt to adverse psychosocial or physical conditions. It is the accumulative effect of the physiological response to stress, and represents the chronic dysregulation of the stress hormone response system (SAM system, HPA axis, the cardiovascular, metabolic and immune systems).

associations were not explored in the literature. It remains unclear to what extent the association between work stress and oral health risk is due to biological mechanisms – and if so which ones. However, plausible associations identified in the literature between the social and the biological factors in oral disease can be drawn to identify the links between psychosocial work stress and oral disease.

2.7.2 Behavioural pathways

Work stress has been found to predict psychological distress which encourages people to engage in risky health behaviour (emotion-focused coping) to temporarily reduce their psychological distress and to distract their attention from stressful situations (Siegrist and Rödel, 2006; Chen and Cunradi, 2008). Empirical evidence has supported the association between the job demand-control and effort-reward imbalance models with adverse health behaviours, namely: alcohol consumption (Heikkilä et al., 2012a), smoking (Ng and Jeffery, 2003; Albertsen et al., 2006; Heikkilä et al., 2012b), diet (Kivimäki et al., 2006; Tsutsumi et al., 2003) and physical activity (Tsutsumi et al., 2003; Kirk and Rhodes, 2011; Fransson et al., 2012). A study by Chandola et al. (2008) that aimed to determine biological and behavioural factors linking work stress to cardiovascular diseases among male and female civil servants of the Whitehall II study, estimated that 32% of the effect of work stress on CHD can be explained via the effect of work stress on health behaviours (particularly low physical activity and poor diet), and a clustering of biological risk factors collectively termed as metabolic syndrome. However, this association was stronger among individuals under the age of 50 (Chandola et al., 2008). Siegrist and Rödel (2006) reviewed 46 studies published between 1989 and 2006 on the associations between psychosocial work stress models (job demand-control and effort-reward imbalance) and health risk behaviour, in particular cigarette smoking, alcohol consumption and overweight. Overall, the review found that the association between work stress and health risk behaviour was not consistent. The relatively strongest relationships were found with regard to heavy alcohol consumption among men, overweight and the clustering of several health risk behaviours. The evidence for an association between work stress and smoking was generally inadequate.

With regard to oral health, among the many harmful health-related behaviours, smoking, unhealthy eating habits and tooth brushing are possibly the most significant in

relation to dental caries and periodontal status (Haber, 1994; Sisson, 2007). Work stress may indirectly influence poor oral health through increased risk of adopting health-risk behaviours, such as smoking and poor diet, and worsening or neglecting oral hygiene (Abegg et al., 1999; Matthews et al., 2010; da Silva and Castellanos, 2001; Aurer et al., 1999; Breivik et al., 1996). It has been reported in some studies that psychological distress can lead individuals to neglect oral hygiene and that will lead to accumulation of plaque, which affect the periodontal tissue (Deinzer et al., 1999; Hildebrand et al., 2000; Thomson et al., 2012; Deinzer et al., 2005; Sanders et al., 2007; Reners and Brecx, 2007).

Earlier, in 1999, Abegg et al. investigated the association between work flexibility and the pattern of tooth cleaning behaviour. From this study, the authors aimed to find how work characteristics were related to increasing risk of poor oral health via worsening health-related behaviours. The study found that employees who had a less routinised and more flexible work had higher tooth cleaning frequency than those who had a less flexible and more routinised working schedule. People who have a more flexible work cleaned their teeth more effectively than those who have a less flexible work (Abegg et al., 1999).

In another study, in 2000, Abegg et al. attempted to further explain the relationship between day flexibility and tooth cleaning behaviour. The findings confirmed that individuals with less flexible daily schedules presented a lower frequency of tooth cleaning and higher levels of dental plaque compared to those with more flexible schedules (Abegg et al., 2000).

Hugo et al. (2006) provided some evidence for a significant association between stress and the risk of increased levels of plaque and gingivitis in a sample of individuals aged 50 years and over in Brazil. Their findings point out that these relations can also be mediated by a disinterest in performing oral hygiene (Trombelli et al., 2005; Deinzer et al., 2001).

In a recent systematic review and meta-analysis of people aged 9 to 19 years that covered psychosocial correlates of oral hygiene behaviour, Scheerman et al. (2016) showed that self-efficacy and social influences are considered as potential psychosocial determinants of tooth brushing. However, limited or no association was found between

some psychosocial factors and tooth brushing; these include locus of control, self-esteem and sense of coherence (Scheerman et al., 2016).

Additionally, Gomaa et al. (2016) in their recent review provided some evidence for the role of behaviours such as smoking in the pathway through which social and psychosocial conditions can lead to oral disease. They suggested that the association between psychosocial factors, inflammatory biomarkers and periodontal disease can be explained by smoking (Genco and Borgnakke, 2013), indicating that health-related behaviour is a mediator that can explain how psychosocial environment can result in oral disease.

To summarise, psychosocial stress results from the socio-economic position, social and work environment, which consequently leading to biological and behavioural modifications that impair the body's defence mechanisms against oral disease. Exposure to chronic stress, including adverse psychosocial environment, can contribute to the development of progressive, long-term oral disease through at least two distinct pathways. First, work stress can have indirect effects on oral health through motivating individuals to adopt unhealthy health-related behaviours that promote oral disease (e.g. alcohol consumption, cigarette smoking, poor diet and worsening oral hygiene). Hence, health-related behaviours are considered as mediators of stress that lie on the pathway through which psychosocial stress translates into oral disease Second, chronic stress contributes to high allostatic load, which can lead to changes in the body's physiological systems and therefore contribute to the development of inflammatory oral diseases (Cox et al., 2000; LeResche and Dworkin, 2002; Akcali et al., 2013; Vasiliou et al., 2016). This direct pathway through which psychosocial factors can affect biological systems can occasionally operate independently of health behaviours (Roux, 2007; Gomaa et al., 2016). However, it is important to note that a key characteristic of the association between stress and biological process is acknowledging that the perceived stress differs between individuals. It differs on the number of psychosocial resources available such as coping skills, social support, personalities and the quality of social networks (Sheiham and Nicolau, 2005). In addition, individuals' perception of stress may also relate to factors such as health behaviours, and the belief of internal versus external locus of control. Socio-economic position can effect individuals' susceptibility to psychosocial stressors and also determine whether individuals adopt damaging health-related behaviour and whether they have the essential resources and

the opportunities to cope with stressful situations and to maintain good oral and overall health (Solar and Irwin, 2010). Hence, although health is critically determined by behaviours, it is important to consider behaviours as mediators of the psychosocial factors that are affected by stress and can be reduced by coping skills (Solar and Irwin, 2010).

2.8 Limitations of studies on psychosocial work environment and oral health

So far, there have been a limited number of studies on the impact of psychosocial work stressors as risk factors of oral health among working adults. In section *2.6*, the review of studies on the association between psychosocial work environment and oral health has highlighted a number of issues and limitations, which are explained in the following sections.

2.8.1 Studies used different measurements of psychosocial work environment

The totality of the evidence available has provided very limited theoretical support for the association between psychosocial work environment and oral health. Multiple definitions and measurements have been used in the current literature. Hence, it is important to be cautious when interpreting the findings from the published studies.

Only two out of the four studies used a well-defined assessment of psychosocial work environment (Marcenes and Sheiham, 1992; Scalco et al., 2013). Both of the studies used the job demand-control model or selected a few items from the model. The remaining two studies used non-validated indicators to assess psychosocial work environment. Although such measures do not capture the psychosocial aspect of work stress, they provide some information on the level of stress in the workplace. As very limited literature is available on the link between psychosocial work environment models and oral health, it is of value to investigate this topic more comprehensively.

2.8.2 Studies used different categorisations of variables for the psychosocial work environment

Another limitation is the use of different categorisations of the work stress exposure, which could result in misclassification bias. For example, one of the studies categorised

job strain in quadrants (Scalco et al., 2013). These quadrants categorise participants as unexposed to job strain (low demands, low control), passive (low demands, high control), active (high demands, high control) or high strain (high demands, low control). Another study used a dichotomous exposure variable, comparing a group of individuals with high work stress to a group without (Acharya and Pentapati, 2012). Another study used continuous work stress scores for each dimension of the work-related variable (Marcenes and Sheiham, 1992). Finally, the fourth one used a score based on level of work stress and classified the score into four groups (Yoshino et al., 2017). Such categorisation could lead to a dilution of the adverse effect of high job strain.

2.8.3   Studies used different measurements of oral health

A limitation that prevents a comparison of the findings from the available studies is the use of different measures of oral health outcomes. The studies collectively covered a range of clinical and subjective measurements of oral health and one of the studies considered both clinical and self-reported oral health outcomes.

Clinical measurements comprised: the validated DMFS and DMFT index, which was expressed by the number of decayed (D), missing (M) and filled (F) surfaces (S) or teeth (T) and the Community Periodontal Index of Treatment Needs (CPITN). Although the DMFT index has been used as a continuous outcome, some studies have considered all components of the dental caries index (Marcenes and Sheiham, 1992) and others have considered them separately (Acharya and Pentapati, 2012), such as current dental caries experience and missing teeth (due to previous caries experience). Additionally, Marcenes and Sheiham (1992) clinically assessed dental status by the presence or absence of teeth either with gums bleeding on probing or with pockets.

Subjective measures of oral health include self-rated oral health (Scalco et al., 2013), self-reported number of natural teeth present, periodontal health, untreated decay and symptoms of oral disease (Yoshino et al., 2017). Additionally, Acharya and Pentapati (2012) have used the Oral Impact on Daily Performance (OIDP) measure as an indicator of oral health-related quality of life.

2.8.4   Lack of longitudinal analysis

The longitudinal associations between psychosocial work environment and oral health remain largely unexplored. The available studies used exclusively cross-sectional data,

therefore not being able to look at the changes in work environment during late working life. The cross-sectional methodology employed in the current literature prevents the establishment of a temporal order and limits the ability to make causal interpretations. Therefore, using longitudinal data with repeated psychosocial work measures is needed to understand how psychosocial work environment is associated with oral health status.

2.8.5 Lack of control of confounding factors

One of the most important concerns to address in studies on psychosocial work environment and oral health is the potential confounding bias. Confounding might be present in some studies due to lack of control for oral health risk factors. For example, socio-economic position and health-related behaviours are two of the key covariates in the association between psychosocial work measures and oral health, but some studies did not account for them (Acharya and Pentapati, 2012; Yoshino et al., 2017).

2.8.6 Heterogeneity of the sample and populations

The populations investigated in the four available studies in the current literature were very different between them and mostly non-representative of the working older population. Studies included populations from different cultures with different norms concerning work environment. Additionally, the samples included populations of different age groups. Psychosocial work environment can be perceived differently according to individuals' age and work position; combining data on psychosocial work environment from adults of different ages and cultures prevents the drawing of conclusions. Although one of the studies recruited a large representative sample (Scalco et al., 2013), the employees selected for analysis were derived from a restricted working area (i.e. university employees). Such a sample selection could limit the external validity of the results. Thus, results from available literature cannot be generalised to working populations.

2.8.7 Gaps in the literature

The term 'psychosocial' has taken many different explanations and been used as an umbrella term to cover a wide range of definitions in the literature. Psychosocial factors have been used and interpreted and measured differently in the oral health literature. There is little similarity in how psychosocial is measured; therefore, this non-

consistency has left the role of psychosocial work environment in oral health unexplained. The following is a summary of the gaps that need to be addressed in further research:

1. There is a need to expand the literature investigating the link between psychosocial work and measures of oral health status. The vast majority of the available literature has focused on the association between psychosocial work environment and general health (including both physical and mental health outcomes).

2. To date, there are only four individual studies that have investigated the role of psychosocial work influences in oral health. However, these studies were not comparable because they used different exposures, outcomes, populations and settings.

3. Studies linking psychosocial work environment with oral health were limited to investigating only the job strain aspect of work characteristics (the job demand-control model). No research has examined the relationship between the effort-reward imbalance model and oral health.

4. Psychosocial work characteristics and oral health has been mainly studied in groups of young adults for short periods of time. Thus, cumulative effects of stressful work experiences that have occurred through older ages have not been previously considered in the oral health literature.

5. The available research linking psychosocial work environment with oral health has relied exclusively on cross-sectional designs, which do not rule out the possibility of reverse causation. Longitudinal studies are needed to determine the direction of the association between long exposure to psychosocial work stress and oral health outcomes.

6. None of the studies sufficiently accounted for work-related confounding factors. Different types of work contracts had not been taken into account in the existing oral health literature.

7. None of the studies used a large dataset and representative population sample. The link between psychosocial work factors and oral health needs to be examined in a representative sample of working adults using validated instruments and approaches.

8. None of the studies examined interactions between psychosocial work environment and risk factors of oral health, although theoretically psychosocial work

environment may interact with other factors that influence oral health. Effect modification has not been considered in oral health literature.

2.9   Proposed conceptual framework

The present study focuses on providing better insight into the effects of work control and work quality on oral health among older English adults. The job demand-control model and the effort-reward imbalance model will be used as theoretical bases to understand the relation between psychosocial work environment and oral health.

Drawing on the literature on psychosocial work environment and health, the assumption of the thesis conceptual framework is that psychosocial work environment contributes indirectly to oral health. The model in Figure 2-4 presents the framework of the present study, based on the Cwikel et al. (1988) path model which was constructed in order to represent mechanisms for psychosocial effects on health. The model shows the indirect effect of the psychosocial work characteristics on oral health outcomes and hypothesises that negative psychosocial work environment acts as a stressor that can influence oral health. The association between psychosocial work and oral health is hypothesised to be mediated through relevant pathways, namely, biological and behavioural processes, which have direct effects on oral health.

Figure 2-4 presents the conceptual model used in the thesis for the analysis of the association between psychosocial work environment and oral health. It started with the range of demographic and socio-economic factors that act as a broader influence and can affect both psychosocial work environment and oral health (represented by a dashed line). Hence, demographic and socio-economic factors are considered as potential confounders of the association between psychosocial work environment and oral health. Biological and behavioural factors are potential mediators in the association. Thus, if the association between psychosocial work environment and oral health remains after taking into account these potential confounding variables, then this is clear evidence that psychosocial work environment may influence oral health. Therefore, based on previous research and theories, the hypothesis of this research is that adults with poor psychosocial work conditions would have poor oral health and this association might be mediated by behavioural and biological factors.

Figure 2-4: Conceptual model of demographic, socio-economic, psychosocial, health-related factors and oral health outcomes
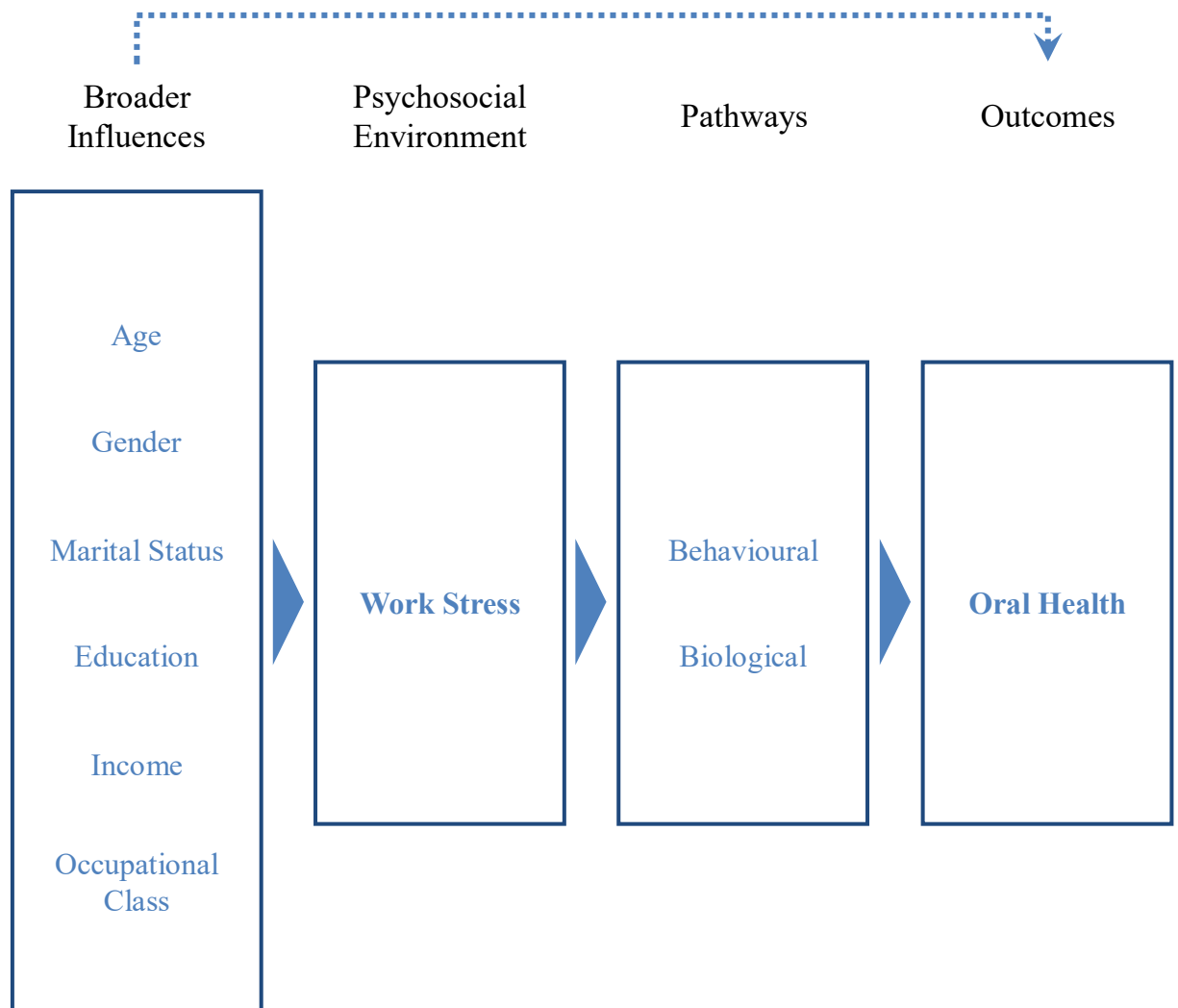
2.10 Aims, objectives and hypotheses

2.10.1 Aims of the study

1. To investigate the cross-sectional association between psychosocial work environment and oral health in a national sample of older adults in England.

2. To investigate the longitudinal association between psychosocial work environment and oral health in a national sample of older adults in England.

2.10.2 Specific objectives and hypotheses

Aim 1: To investigate the cross-sectional association between psychosocial work environment and oral health in a national sample of older adults in England.

Objectives:

1.1 To define and describe the characteristics of the cross-sectional analytical sample

1.2 To describe the characteristics of the potential confounders or mediators in the association between psychosocial work environment and oral health

1.3 To assess the unadjusted and adjusted association between work control and oral health

1.4 To assess the unadjusted and adjusted association between work quality and oral health

1.5 To examine effect modification on the association between psychosocial work environment and oral health

Hypotheses:

1.1 Lower levels of work control were associated with poorer oral health

1.2 Lower levels of work quality were associated with poorer oral health

1.3 The association between psychosocial work environment and oral health remained statistically significant after adjusting for demographic, socio-economic and work-related risk factors

1.4 Oral health risk factors contributed to the association between psychosocial work environment and oral health

Aim 2: To investigate the longitudinal association between psychosocial work environment and oral health in a national sample of older adults in England.

Objectives:

2.1 To define and describe the characteristics of the longitudinal analytical sample

2.2 To assess the unadjusted and adjusted association between baseline work control and oral health at follow-up

2.3 To assess the unadjusted and adjusted association between baseline work quality and oral health at follow-up

2.4 To examine the association between repeated exposure to psychosocial work environment on oral health at follow-up

2.5 To examine effect modification on the association between baseline psychosocial work environment and oral health at follow-up

Hypotheses:

2.1 Adverse psychosocial work environment measures were associated with poor oral health four years later

2.2 After adjusting for covariates at baseline, psychosocial work environment remained associated with oral health at follow-up

2.3 Repeated exposure to adverse psychosocial work environment was associated with poor oral health two years later

Chapter 3

Methodology

3.1   Introduction

This study will be based on a secondary data analysis of longitudinal data from the English Longitudinal Study of Ageing (ELSA). This chapter presents a summary of the survey methodology and then outlines in detail the data used and the analytical approach that was adopted to address the objectives of the thesis. The summary of the survey includes a brief explanation of the study population, the data collection methods and the variables used in the analysis. It provides information on data selection and an overview of the relevant wave of ELSA. The derived variables used for the psychosocial work environment measurements and oral health status are described, along with other covariates included in the analysis. The final section of this chapter outlines the analytical strategy adopted to achieve the study objectives, including the rationale for the thesis, sample restrictions and statistical analysis approaches.

3.2   The data

3.2.1   Background overview of the English Longitudinal Study of Ageing (ELSA)

The English Longitudinal Study of Ageing (ELSA) is a biannual longitudinal study of a cohort of men and women living in England aged ≥50 years and their partners. The study was designed to recruit a nationally representative sample of the population living in private residential addresses in England. The sample has been drawn from households that previously participated in the Health Survey for England (HSE) between 1998 and 2006. ELSA was set up to capture the experience of growing old amongst the English population. It offers high-quality panel data that can be used to explore changes in economic circumstances, social status, physical and mental health, social relationships, cognitive function and biology, as people prepare for and move into retirement and old age (Steptoe et al., 2012). ELSA has a specific focus on the associations between different aspects of ageing and on data that is relevant to policies about ageing.

3.2.2   Sample source: Health Survey for England (HSE)

The HSE is an annual cross-sectional household survey that collects a wide range of health data and biometric measures from a representative sample of the English population living in private residential addresses. The original ELSA cohort at wave 1

(persons born on or before 29 February 1952) was selected from three survey years of the HSE (1998, 1999 and 2001), with the 'core'[h] samples from each HSE year being nationally representative.

Each of the main HSE samples had originally been drawn in two stages. First, postcode sectors were selected from the Postcode Address File, stratified by health authority and proportion of households in the non-manual socio-economic groups. Addresses were then selected systematically from each postcode sector and a specified number of adults and children in each household were deemed eligible for interview.

3.2.3   Baseline sampling and recruitment – Wave one (2002-03), ELSA Cohort 1

The first survey of ELSA was carried out in 2002-03, and is referred to as wave 1. All participants who are known as Cohort 1 were those recruited for the first wave or have, since the HSE 1998, 1999 and 2001 interviews, become partners of core members. Core members are defined as age-eligible sample members who had earlier participated in the HSE before joining ELSA. They represent the core element of the longitudinal ELSA sample.

At wave 1 of ELSA sample recruitment, 12,099 interviews were conducted. The majority (94%) of these interviews were Cohort 1 core members (n=11,391) and some (6%) of the interviewed were with young and new partners (n=708). Young partners were under the age of 50 at the time of interview. These partner interviews were conducted to supplement the data collected from the core members and to understand behaviour within a couple or household. Interviews with Cohort 1 core members and their partners were repeated every two years following wave 1 (Taylor et al., 2007). An overview of the structure of the ELSA sample studied in waves 1 to 7 is presented in Figure 3-1 (Marmot et al., 2002; Banks et al., 2006; Steptoe et al., 2012).

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[h] The core sample is a general population sample. In recent years, the core sample has also been augmented by an additional boosted sample from a specific population subgroup, such as children, older people or, as in 1999 and 2004, those from the largest minority ethnic groups in England.

Figure 3-1: An overview of data collection in ELSA waves 1 to 7
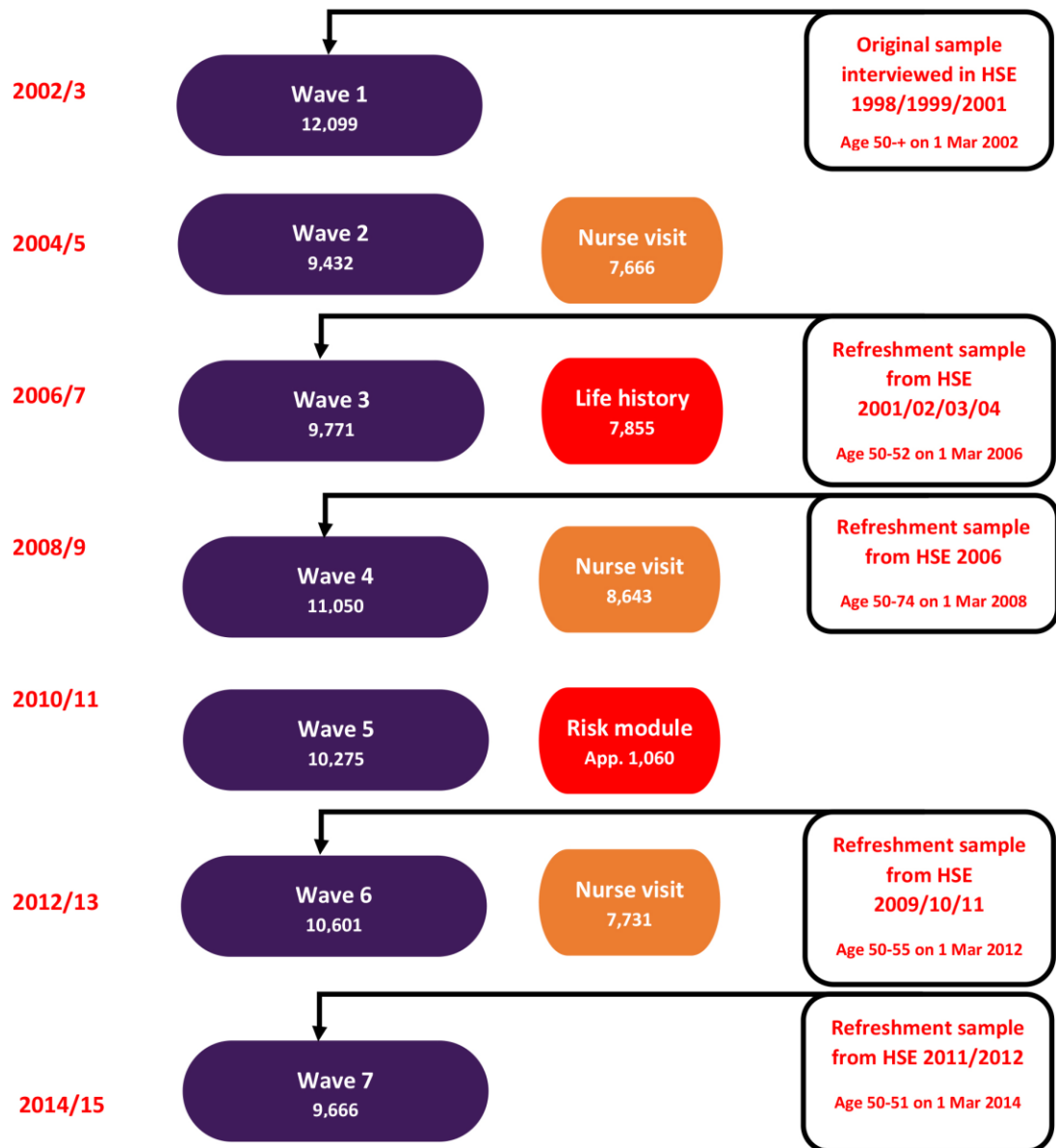
(*Source*: http://www.elsa-project.ac.uk/timetable)

3.2.4 Follow-up phases

3.2.4.1 Wave two (2004-05)[i]

In the second wave of ELSA, only responding core members in wave 1 were followed up for interview in wave 2 (unless they had since died, moved out of Britain, moved

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[i] There is no "Cohort 2" or "Cohort 5" in ELSA because no new sample was issued at wave 2 or at wave 5.

into a nursing care home or institution or had explicitly asked at the end of the wave 1 interview not to be re-contacted). The fieldwork period for wave 2 was carried out between June 2004 and July 2005. Over this period, a total of 9,433 main interviews were conducted. As in wave 1, the majority of the interviews (93%) were with Cohort 1 core members (n=8,780) and 7% (n=652) with Cohort 1 partners (Banks et al., 2006; Scholes et al., 2009).

3.2.4.2   Wave three (2006-07): Refreshment sample, ELSA Cohort 3

In the third wave, as the study progressed, the youngest people (between 50-54 years old) were no longer represented in the ELSA sample. In order to cover a full range of age groups in the sample, a 'refreshment' cohort of people who were just entering their 50s (born between 1 March 1952 and 29 February 1956 inclusive) was introduced to wave 3. This sample is referred to as Cohort 3 and it was selected from four survey years of the HSE (2001 to 2004). At wave 3, a total of 9,771 interviews were completed. The majority of the interviews 77% (n=7,535) were conducted with Cohort 1 and 13% (n=1,275) were conducted with Cohort 3 core members (Scholes et al., 2009). The remaining 960 (10%) were with partners.

3.2.4.3   Wave four (2008-09): Refreshment sample, ELSA Cohort 4

At wave 4, a new refreshment sample (Cohort 4) of people who were born between 1 March 1933 and 28 February 1958 inclusive was added to the ELSA panel. This cohort covers age groups between 50 and 74 years old. The sample was selected from HSE 2006. The fieldwork for wave 4 began in early May 2008 and finished in August 2009. Over the course of the fourth wave, a total of 11,050 interviews were completed; 60% of these interviews were conducted with Cohort 1 core members (n=6,623), 9% with Cohort 3 core member (n=972) and 20% with Cohort 4 core members (n=2,291). The remaining (n=1,164) were with partners (Banks et al., 2010; Cheshire et al., 2012).

3.2.4.4   Wave five (2010-11)

At wave 5, three cohorts (Cohorts 1, 3 and 4) made up the sample. From all three cohorts, a total of 10,274 main interviews were completed. Fieldwork for the fifth wave of ELSA began in July 2010 and finished in June 2011. More than half of the interviews (61%) were with Cohort 1 core members from the original wave 1 sample (n=6,242), a

small number (9%) were with core members from Cohort 3 (n=936) and 19% were with core members from Cohort 4 (n=1,912). The remaining interviews were with partners of core members (Banks et al., 2012).

3.2.4.5   Wave six (2012-13): Refreshment sample, ELSA Cohort 6

At wave 6, the sample was made up of four cohorts (Cohorts 1, 3, 4 and 6) of people. This included a further refresher cohort (Cohort 6), which was selected from HSE 2009, 2010 and the first half of 2011. This refreshment sample's core members were added to boost the ELSA sample participants aged 50–55 at the time of sampling (those who were born between 1 March 1956 and 28 February 1962). A total of 10,601 main interviews were completed at wave 6 across all four cohorts. Fieldwork for the sixth wave of ELSA started in May 2012 and was completed in June 2013. At wave 6, a total of 53% of the interviews were conducted with Cohort 1 core members (n=5,659), an overall 8% were with Cohort 3 core member (n=888), and 17% with Cohort 4 core members (n=1,796). Cohort 6 core members represented 8% of all issued cases at wave 6 (n=826). The remaining 15% of the interviews were with partners (Bridges et al., 2015).

3.2.4.6   Wave seven (2014-15): Refreshment sample, ELSA Cohort 7

In wave 7, information was collected from a total of 9,666 ELSA participants including 8,249 core members. New participants were added again to supplement the study sample for wave 7 and to ensure that an adequate representation of people aged 50–52. Participants of the refreshment sample had taken part in HSE 2011 and 2012 and were born between 1 March 1962 and 28 February 1964.

3.2.5   Data collection methods

At every point of data collection, the main ELSA questionnaire was completed by computer aided personal interviewing (CAPI) together with a self-completion questionnaire. Depending on respondents' individual circumstances, the pen-and-paper self-completion questionnaire could either be completed during the main ELSA interview or earlier/later than the main interview. On alternate waves (every four years), a health examination was conducted by a nurse visit during which clinical, anthropometric information as well as blood samples were collected. Additional

modules have been added at different stages of ELSA to address extra topics such as life history and risk module in addition to many others. However, all of the variables analysed in this thesis are covered in the CAPI interview and the self-completion questionnaire.

3.2.5.1 Computer-assisted personal interviewing (CAPI)

The main interview takes the form of a personal interview using CAPI and contains various modules, each covering a different topic, such as: household demographics, individual demographics, health, social participation, work and pension, income and assets, housing, cognitive function, expectations, psychosocial health and walking speed. A full description of the subjects covered by the CAPI interview is provided in *Appendix A*.

3.2.5.2 Self-completion questionnaire

Every respondent was requested to fill in the main self-completion questionnaire. This questionnaire asks about the participants' quality of life, social participation, control at work, quality of work, life satisfaction, social network, dietary habits and alcohol consumption. An example (from wave 3) is provided in *Appendix B*.

3.2.6 Data selection: waves of ELSA used in this thesis

This study uses both cross-sectional and longitudinal individual-level data from the ELSA study wave 3 (2006-07), wave 4 (2008-09) and wave 5 (2010-11). Selection of waves was based on the availability of data. Wave 3 (2006-07) was the baseline for the thesis as the oral health outcome measures (self-rated oral health, Oral Impacts on Daily Performance (OIDP) and edentulousness) were included for the first time at this wave of ELSA. The oral health measures were not included at wave 4 but were repeated at wave 5. Therefore, the cross-sectional analysis and part of the longitudinal analysis used data from waves 3 and 5 exclusively. The psychosocial work environment exposure variables (work control and effort-reward imbalance) were available in all ELSA waves. In this analysis, these measures were obtained from waves 3, 4 and 5. The confounding and mediating variables were derived from wave 3. A detailed description of all the measurement of variables is presented in the following sections of this chapter.

3.2.7   Thesis samples: participants and population

This thesis analyses individual-level data for all eligible ELSA participants defined as ELSA core members at wave 3 (2006-07) who were aged 50-65 years and in paid employment at the time of wave 3. Participants who were over 65 (the State Pension Age for men) at the time of wave 3 were excluded because evidence from pre-retirement age individuals may not necessarily generalise to those who work beyond the state pension age, as the latter group have a greater choice about whether to work because they receive a basic income from the state and, in some cases, occupational pensions (Farrow and Reynolds, 2012). Mainly three samples derived from ELSA were analysed in this thesis. The study baseline sample included Cohort 1 and Cohort 3 core members. From the ELSA sample at wave 3 of 8,810 core members, 6,956 participants were excluded from the analysis because they were non-employed or older than 65 years at the time of wave 3 or did not return the self-completion questionnaire or did not provide relevant information on either the self-completion questionnaire or the main interview (CAPI). The eligible sample of 1,854 respondents constitutes the analytical sample for the cross-sectional analysis (*Chapter 4*). For the purpose of this study, this analytical sample at wave 3 is referred to as 'baseline' and the wave 5 analytical sample (*Chapter 5*) as the 'four-year follow-up', since the ELSA data was collected at biennial intervals.

In the longitudinal analyses, the sample was smaller because the baseline sample (wave 3) was decreased due to attrition (by wave 5). Therefore, a total of 312 respondents who were present at baseline had missing values on oral health outcome measures at wave 5 (2010-11). From the follow-up sample of 1,542 respondents, the two subsamples for the longitudinal analyses were derived. First, for the longitudinal analysis that assessed the association between baseline psychosocial work environment and oral health at wave 5, the complete follow-up sample of 1,542 formed the analytical sample (*Chapter 5*). Then, the second part of the analysis assessed the repeated exposure to adverse psychosocial work environment in waves 3 and 4 and its association with oral health status at wave 5. At this stage, other than excluding the respondents who did not provide information on oral health at wave 5, those who did not provide data on psychosocial work environment measures at wave 4 were also excluded from the analysis (n=484). This resulted in a total of 1,058 respondents for this analysis. Figure 3-2 displays a flow chart mapping the origin of all three aforementioned samples. A

more detailed description of the analytical samples and missing respondents is presented at the beginning of each results chapter (*chapters 4-6*).

Figure 3-2: The origin of the ELSA study sample and the analytical samples used in this thesis – after exclusion criteria and loss to follow-up, ELSA waves 3 (2006-07), 4 (2008-09) and 5 (2010-11)
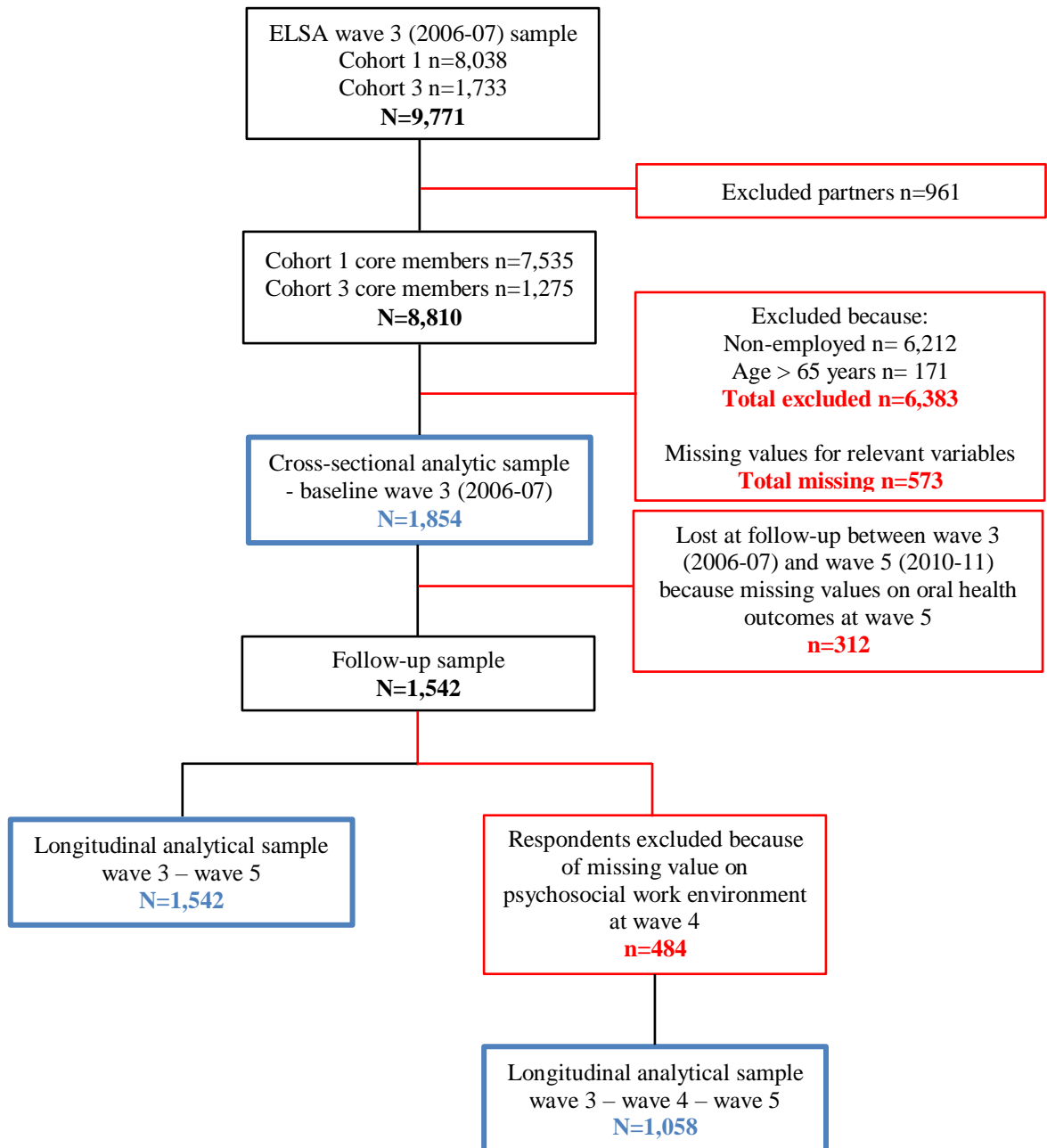
3.3 Variables of interest

A description of all variables used in this thesis as well as the origin of the derived variables is presented in the following sections.

3.3.1 Main outcome variables: oral health

Oral health status was measured in this study using three self-reported oral health outcomes: Edentulousness (the presence of natural teeth), self-rated oral health and the Oral Impacts on Daily Performance (OIDP).

3.3.1.1 Edentulousness

Being edentulous is relatively common in older people. According to the 2009 Adult Dental Health Survey (ADHS), the proportion of edentulousness in England was 5% among 55 to 64 year olds and 48% of adults over 65 years (Steele et al., 2012; ONS, 2012). Edentulousness was measured through self-assessment of the presence of natural teeth and/or dentures. Edentulousness is a crude and cumulative oral health indicator that reflects the accumulation of oral disease and experience of dental treatment throughout the life course. It is a robust measure of total tooth mortality (Tsakos et al., 2013). Oral health literature confirmed that tooth loss is an on-going problem among older adults (Thomson, 2014). A number of reports have demonstrated a significant association between being edentate and poor oral function and perceived oral and general health status (Sheiham et al., 2001; Kandelman et al., 2008; Griffin et al., 2012).

In the CAPI questionnaire, an overall assessment of presence of natural teeth and dentures was assessed by a single question, "In relation to dental health, which of the following applies to you…?", with four response categories:

- o Both natural teeth and denture(s)
- o Only natural teeth
- o No natural teeth and wear dentures
- o Neither natural teeth nor denture

A dichotomised variable was created to allow a crude categorisation of oral health status: dentate versus edentate. Dentate refers to respondents who have either natural teeth and dentures or natural teeth only. Edentate refers to respondents who have no natural teeth and wear dentures or those with neither natural teeth nor dentures.

3.3.1.2   Self-rated oral health

Self-rated oral health provides more information about how a certain disease affects an individual's life, rather than the objective measurements of this disease, and constitutes a valid, reliable and cost-effective tool to assess oral health status (Locker and Miller, 1994; Gilbert et al., 1998). This incorporates a broader multidimensional subjective assessment of oral health, rather than just clinical morbidity (Benyamini et al., 2004; Locker et al., 2005).

Several studies have shown that self-rated oral health is an important summary indicator of overall oral health status, especially at old age (Matthias et al., 1995). Poor self-rated oral health has been associated with missing teeth (Locker et al., 2000), dental pain, untreated dental caries (Pattussi et al., 2007), reduced functional ability (Idler and Kasl, 1995), lower self-esteem and lower life satisfaction (da Silva and Castellanos, 2001; Benyamini et al., 2004; Martins et al., 2010; Pattussi et al., 2010; Finlayson et al., 2010; Tsakos et al., 2011; Kojima et al., 2013; Armfield et al., 2013). Self-rated oral health is also linked with clinical oral health status, for example, dentition status, coronal caries, and mobile teeth (Atchison et al., 1993; Jones et al., 2001; Locker et al., 2005).

In the ELSA dataset, self-rated oral health was assessed by a single question, "Would you say dental health (mouth, teeth and/or dentures) is…?", with five responses categories:

- o Excellent
- o Very good
- o Good
- o Fair
- o Poor

It has been a common practice to dichotomise the responses into two categories of "good" versus "poor" health, as it provided a logical distinction of groups and adopting this approach did not lead to fundamental loss of data (Manor et al., 2000). In this study, a very small proportion of participants were in the "poor" category (less than 3%); thus, to ensure there would be sufficient numbers when comparing groups and to facilitate the data analysis and interpretation of the findings, the responses were dichotomised into excellent/very good/good versus fair/poor, in line with previous oral health studies in many populations (Pattussi et al., 2010; Turrell et al., 2007; Sabbah et al., 2009; Locker, 2009; Tsakos et al., 2011)

3.3.1.3   Oral Impacts on Daily Performance (OIDP)

Oral health-related quality of life (OHRQoL) was measured in ELSA as the prevalence of oral impacts assessed through the simplified version of the Oral Impacts on Daily Performance (OIDP) questionnaire for elderly populations (Tsakos et al., 2001). The OIDP is an internationally well-known OHRQoL measure which was developed to assess the serious oral impacts on an individual's ability to perform daily activities (Adulyanon et al., 1997). Its theoretical background is based on the WHO conceptual framework for classification of impairment, disability and handicap as was adapted by Locker (1988) for assessing oral health. The OIDP items specifically focus on the disability and handicap dimensions of Locker's model.

Previous studies have shown that older populations experience difficulties in daily activities because of conditions affecting their mouth and dentition (Steele et al., 2004; Petersen and Yamamoto, 2005). Additionally, measuring oral impacts in working individuals is particularly relevant because poor oral conditions may lead to consequences on an employee's daily life, such as taking time off work (Petersen et al., 2005).

Tsakos et al. (2001) developed a modified version of OIDP and it was shown to be a valid and reliable measure of OHRQoL among the elderly population in the UK. The modified version of OIDP for elderly people consists of the following 10 performances:

- o   eating food
- o   speaking clearly
- o   cleaning teeth and dentures
- o   doing light physical activities such as household activities
- o   going out, for example, to shop or visit someone
- o   sleeping
- o   relaxing
- o   smiling, laughing and showing teeth without embarrassment
- o   becoming more emotional or more easily upset than usual (mood affected)
- o   enjoying contact with other people, e.g. relatives, friends or neighbours.

The OIDP provides an overall score that combines the measurements of both the frequency and the severity of each reported oral impact on any of these performances in the last six months. The frequency and severity are assessed on five-point ordinal scales.

The prevalence of oral impacts is determined according to the proportion of individuals that has experienced at least one OIDP item affected due to oral conditions.

In the ELSA CAPI questionnaire, OHRQoL was assessed by a simplified version of the OIDP index that consists of assessing the prevalence of five common items, by asking the following question, "In the past 6 months, have any problems with mouth, teeth or dentures caused to have any of the following...?", with six possible answers:

- o difficulty eating food
- o difficulty speaking clearly
- o problems with smiling, laughing and showing teeth without embarrassment
- o problems with emotional stability, for example, becoming more easily upset than usual
- o problems enjoying the company of other people such as family, friends and neighbours
- o none of these

Experiencing oral impacts was derived as a binary variable differentiating between respondents who reported at least one oral impact against respondents who reported none. The OIDP dichotomisation produced the categories: (0) no daily performance affected (including score 0) and (1) at least one daily performance affected (including scores 1 to 5) (Tsakos et al., 2001).

3.3.2 Main exposure variables: psychosocial work environment as predictor of oral health

Items to define individual-level work environment were selected from the short version of the Job Content Questionnaire (JCQ) in the ELSA self-completion questionnaire. The questionnaire was derived from the standardised original JCQ by Karasek et al. (1998), measuring both the job demand/control and the effort/reward imbalance. However, in this study, selection of the items measuring the theoretical core dimension of the two work models was based on the abbreviated, psychometrically validated version of the job content questionnaire (Leineweber et al., 2010).

With regard to the job demand-control model, the measurement was restricted to the control dimension. This decision was mainly data-driven, as the short version of the JCQ in ELSA only covers the key items of the control dimension of the model. In

addition, studies found that the predictive power of 'control' exceeded the power of 'demand' aspect (Siegrist, 1996; Karasek et al., 1998; Schnall et al., 2000; Ostry et al., 2003; Marmot and Wilkinson, 2005; Banks et al., 2006).

The following instruction was used in the ELSA self-completion questionnaire: "Here are some statements people might use to describe their work. We would like to know how strongly you think these apply to the paid employment you did in the last month". Responses were recorded using a four-point Likert-type scale with answers ranging from 1 (strongly agree) to 4 (strongly disagree). To ensure that all item responses were in the same direction, some items were reversed coded (Table 3-1) so that the most negative response was scored as 4 and the most positive response as 1. To create a scale for each individual, responses for each item were summed to form a score. As recommended in previous studies, items were selected on the basis of factor loadings and item-total correlations on core scales of the original measures (Siegrist et al., 2012). For the selected items, all item-total correlations were beyond the established threshold of 0.30 (Nunnally et al., 1967), ranging from 0.39 to 0.55. The high values obtained for the internal consistency indicated that both scales used are reliable (Dragano et al., 2011; Siegrist and Wahrendorf, 2011; Siegrist et al., 2012).

Derived psychosocial work environment indicators used in this thesis (job control and effort-reward imbalance) are explained in the next two subsections. The items used to assess both the low control and the effort-reward imbalance variables are presented in Table 3-1.

3.3.2.1 Job control

Job control was measured by using two items from JCQ in the self-completion part of the ELSA study, by asking participants to indicate how strongly they think these apply to their job:

- o Having very little freedom to decide how to perform their work
- o Having an opportunity to develop new skills

The two items had internal consistency based on Cronbach's α coefficient 0.39. To assess job control, the total control was calculated by the sum score of the two Likert-scaled items (ranging from 2 to 8), with higher scores indicating lower control at work. As established in previous studies (Dragano et al., 2011; Siegrist and Wahrendorf,

2011; Siegrist et al., 2012), the total score was divided into tertiles. The upper tertile (scores 6 to 8) was considered to indicate stressful work in terms of low control, with the middle tertile (score 5) indicating medium control and the lower tertile (scores 2 to 4) showing high control at work.

3.3.2.2   Effort-reward imbalance

The effort-reward imbalance indicator consists of a total of seven items from JCQ in the self-completion ELSA questionnaire. Two items were used to measure 'effort' and five items measured 'reward'. Effort items asked participants about physical demands and heavy workload, while reward items asked participants about recognition, salary/earnings, job promotion prospects/prospects, job security and support in difficult situations at work (Table 3-1). All scales used had a sufficient internal consistency of Cronbach's α coefficient 0.31 for effort and 0.55 for reward.

The variable used in this analysis was based on the ratio of the sum score of the effort over the sum score for reward, adjusted for the unequal number of items. According to the theoretical formulation, a ratio of effort (nominator) and reward (denominator) was calculated, and the correction factor was 0.4 since the nominator contains two items and the denominator contains five. The overall effort-reward imbalance score ranged from 0.25 to 3.5, with higher values representing a higher imbalance. To derive the variable of imbalance, the ratio was transformed into tertiles, where the values in the upper tertile identified an exposure to psychosocial stress at work (imbalance in terms of a high amount of effort spent that is not met by the rewards received). In the context of the thesis, this variable was categorised into the following tertiles: (1) high quality of work (including scores 0.25 to 0.71); medium quality of work (including scores 0.72 to 1); and low quality of work (including scores 1.01 to 3.5) (Dragano et al., 2011; Siegrist and Wahrendorf, 2011; Siegrist et al., 2012). The different levels of exposure to an imbalance were referred to by 'work quality' in the analyses.

Table 3-1: The Job Content Questionnaire items used from the ELSA self-completion questionnaire

Psychosocial work environment items	Categories
Job control o I have very little freedom to decide how I do my work* o I have an opportunity to develop new skills	strongly agree agree disagree strongly disagree
Effort-reward imbalance *Effort* o My job is physically demanding o I am under constant time pressure due to a heavy workload *Reward* o I receive the recognition I deserve for my work o Considering all my efforts and achievements, my salary/earnings is/are adequate o My job promotion prospects/prospects for job advancement are poor* o My job security is poor* o I receive adequate support in difficult situations	 strongly agree agree disagree strongly disagree

* Items reverse coded for scoring

3.3.3 Measuring repeated exposure to psychosocial work environment

The repeated exposure to an adverse psychosocial work environment in waves 3 and 4 for each psychosocial work environment indicator resulted in a new categorical variable with a different three categories. The cumulative measure of psychosocial work environment was created by adding together the number of times the participant reported any level of work stress (in terms of medium/low control and medium/low quality of work) at waves 3 and 4 (range 0 - 2), creating a new variable on the duration of exposure to work stress, as described below.

3.3.3.1   Categories of repeated exposure to work control (waves 3 and 4)

To capture the measurement of work control in both wave 3 and wave 4, a derived work control variable was created. Response categories from the work control in both waves were merged to construct a cumulative predictor variable that assesses exposure to poor work control at two time points. The information from the cumulative work control variable reflects the period of exposure to low control at work. The categories of the cumulative variable were defined as follows:

1) High work control – which included participants who were in the highest category of work control at wave 3 and wave 4. (i.e. those with high work control at wave 3 and high work control at wave 4);

2) Single exposure to low work control – included participants who were in the lowest two categories of work control (either medium or low) at one wave (either wave 3 _or_ wave 4); and

3) Repeated exposures to low work control – included participants who were in the lowest two categories of work control (medium or low) at both waves (wave 3 _and_ wave 4).

3.3.3.2   Categories of repeated exposure to work quality (waves 3 and 4)

Similarly, the categories of work quality derived from waves 3 and 4 were categorised as:

1) High work quality – which included participants who were in the highest category of work quality at wave 3 and wave 4. (i.e. those with high work quality at wave 3 and high work quality at wave 4);

2) Single exposure to low work quality – included participants who were in the lowest two categories of work quality (either medium or low) at one wave (either wave 3 _or_ wave 4); and

3) Repeated exposures to low work quality – included participants who were in the lowest two categories of work quality (medium or low) at both waves (wave 3 _and_ wave 4).

3.3.4 Covariates

Additionally, variables were identified as important potential covariates in line with previous studies linking psychosocial work environment and health and the WHO social determinants of health framework (Solar and Irwin, 2010). Available literature acknowledges that demographic, socio-economic and behavioural factors are important predictors of oral health status (Sanders and Spencer, 2005; Sabbah et al., 2007; Finlayson et al., 2010; Marmot and Bell, 2011; Sheiham et al., 2011; Tsakos et al., 2011). Additionally, socio-economic factors are not only recognised as being associated with oral health, they are also linked to occupational status and psychosocial work conditions (Marmot et al., 1998; Pikhart et al., 2001; Kristensen et al., 2002). The literature has also provided some evidence on the associations between psychosocial work environment and health behaviours (Abegg et al., 1999; Head et al., 2004). Therefore, it is important to take into consideration the potential confounders when examining the association between psychosocial work environment and oral health. The confounders include demographic, socio-economic and behavioural factors. However, socio-economic and behavioural factors could be on the causal pathway between psychosocial work environment and oral health, so they are considered as 'covariates' generally in this analysis. All selected covariates for this study were obtained from the ELSA main questionnaire (CAPI). A full description of the variables is provided in this section.

3.3.4.1 Demographic factors

Age

Since the analysis in this thesis is interested in work stress in late midlife, samples are restricted to participants aged 50-65 years reporting that they do any paid work. Consistent with previous studies of older people, age was used as a categorical variable. It was categorised into three groups to reflect different periods of working life: 50-54 years; 55-59 years; and 60-65 years (Siegrist et al., 2012).

Gender

Participant's gender was used in this analysis rather than the biological sex. According to the WHO, gender refers to "*the socially constructed norms, roles and relations that a given society considers appropriate for men and women*" (WHO, 2011).

The variable was coded as: (0) male; and (1) female.

Marital status

Participants were asked about their current legal marital status. The answers were categorised into three groups: (1) single, (2) married or in a legally recognised civil partnership; or (3) legally separated, divorced or widowed.

3.3.4.2 Socio-economic factors

Educational status

In ELSA, participant's highest educational qualification was measured using a seven-point scale: 1) NVQ4/NVQ5/university degree or equivalent; 2) higher education below university degree; 3) NVQ3/GCE A-level equivalent; 4) NVQ2/GCE O-level equivalent; 5) NVQ1/CSE other grade equivalents; 6) foreign/other; and 7) no qualifications. For the thesis, education measure was derived to distinguish respondents with a degree qualification, some level of education and those who did not have any educational qualifications. The level of education variable was coded as: (0) degree qualification or equivalent; (1) lower than degree qualification; and (2) no qualifications.

Household income – income quintiles

ELSA had included a series of questions concerning respondent's income from a variety of resources, including employment, private state pensions, financial assets and state benefits. For this analysis, income was used as an appropriate measure to use in working-age cohorts, the majority of which earn their living via their main occupation. In ELSA, total income is defined as net of taxes and is the weekly sum of income from seven sources[j]. While the income measure is at the family unit level, total family income was adjusted to take into account family size using the modified Organisation for Economic Co-operation and Development (OECD) equivalence scale in order to analyse the income data at the individual level (Brewer et al., 2009). In this analysis, quintiles of the equivalised total income was used (Banks et al., 2005).

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[j] Income sources are: employment income, income from self-employment, private pension income, state pension income, other benefit income (excluding Housing Benefit and Council Tax Benefit), asset income and any other income.

3.3.4.3 General work-related factors

Type of employment

At a basic theoretical level, social reciprocity in work-related exchange may not be critical for health among self-employed and employees under other types of nonstandard work contracts (Siegrist, 2008b). This variable was categorised into (0) employed; and (1) self-employed.

3.3.4.4 Behavioural factors

Adverse health-related behaviours are considered as a response to stress exposure and are associated with poor oral health. There was very limited data on oral health-related behaviours available in ELSA; therefore, the selection was limited to smoking status (more details in *Chapter 7 – Discussion*).

Smoking status

Smoking is a key health-related behaviour that is linked to both the exposure and the outcome of this study. Participants were asked whether they currently smoke cigarettes at all nowadays. From this question, a smoking status variable was created with two categories: smoker and non-smoker. Although this variable contributes to a lot of missing cases, avoiding excluding all of them from the analytical sample was not feasible at the time of the analysis.

3.4 Overview of the analytical approaches

To achieve the main aims and the respective specific objectives of the thesis, this section provide descriptions of the analytical approach adopted in the thesis

3.4.1 Weighting

The study depositors of ELSA constructed and supplied cross-sectional and longitudinal weights. The cross-sectional weights were calculated for core sample members, taking into account the complex survey design, to correct for non-response and keep the ELSA sample representative of the population who are over 50 years in England. Therefore, the wave 3 cross-sectional weights were used in the cross-sectional analysis (*Chapter 4*).

Longitudinal weights were only defined for the subset of the core member participants who have taken part in all waves of ELSA. Accordingly, applying the longitudinal weights would result in a much smaller analytical sample, because it would have eliminated ELSA wave 3 core members who did not participate at wave 4 or wave 5. Hence, longitudinal weighting was not used for the longitudinal analysis (*chapters 5 and 6*).

Results were reported using Odds Ratios (ORs) and 95% Confidence Intervals (CIs). Survey commands were used to account for the complex sampling design of ELSA and to include appropriate weights to account for non-response in this analysis.

3.4.2 Significance

Results in all the analyses were considered as statistically significant if the p-value is below the 0.05 limit. The null hypothesis was rejected if $p \leq 0.05$.

3.4.3 Software

Descriptive analyses and logistic regression models were carried out using STATA software version 13SE.

3.4.4 Cross-sectional analysis (*Chapter 4*)

Aim 1: To investigate the cross-sectional association between psychosocial work environment and oral health in a national working sample of older adults in England.

Objective 1.1: To define and describe the characteristics of the cross-sectional analytical sample

The cross-sectional analytical sample originated from the overall ELSA wave 3 sample and was described in a flow chart (see *Chapter 4*). Then, missingness in the cross-sectional sample was examined using bivariate analysis to estimate the differences between the analytical sample and the eligible ELSA sample by psychosocial work environment predictors, oral health outcomes and all selected covariates. Finally, the frequency distributions of all variables (predictors, outcomes and covariates) were examined and descriptive statistics presented.

Objective 1.2: To identify the potential confounders or mediators in the association between psychosocial work environment and oral health

Potential confounders or mediators have to be associated with both the predictor measures and the outcomes. In this analysis, socio-economic indicators and health-related behaviour factor could be in the causal pathway in the association between psychosocial work environment and oral health. Associations between oral health and the selected covariates were examined by using the chi-square test. Similarly, chi-square analyses were also conducted to assess bivariate associations between psychosocial work environment and covariates.

Objective 1.3: To assess the unadjusted and adjusted association between work control and oral health

Multivariable associations between work control indicator and oral health outcomes were examined using a series of logistic regression models to estimate the odds of poor oral health by categories of the work control variable. To assess the independent contribution of work control on oral health, regression models were sequentially adjusted for selected covariates (demographic, socio-economic, work and smoking status). Initially, crude associations were examined by including only the main exposure variable into the logistic regression model. Then, demographic variables were included in the model to control for the individual differences in oral health. The third model included additional controlling for socio-economic variables to take account of potential confounders of the association between psychosocial work environment and oral health. The fourth model repeated the third one, except that the work type measure was added. The final model added smoking to take account of potential confounders and mediators of the association between psychosocial work environment and oral health. The process of adjusting for covariates was as follows:

Model 1: unadjusted model examining the crude association between psychosocial work environment and oral health;

Model 2: is Model 1 with additional adjustment for age, gender and marital status;

Model 3: is Model 2 additionally adjusting for socio-economic status indicators (education and income quintile);

Model 4: is Model 3 additionally adjusting for general work-related measure of work contract type; and

Model 5: is Model 4 additionally adjusting for smoking status.

Objective 1.4: To assess the unadjusted and adjusted association between effort-reward imbalance and oral health

Logistic regression models were repeated for the effort-reward imbalance as a predictor measure. The process followed was the same as the one employed in the previous objective.

Objective 1.5: To examine effect modification on the association between psychosocial work environment and oral health

Effect modification of the association between psychosocial work environment and oral health was examined by using the interaction between psychosocial work environment measures and oral health risk factors (namely, age, gender and socio-economic variables). Age was selected because psychosocial work environment might affect older participants who are at their later work stages to a different extent than those who are younger. Additionally, according to WHO (1986), complaints of strain at work increase with increasing age. Therefore, effect modification of age was examined in relation to oral health outcomes. Additionally, literature suggested that the association between psychosocial work environment and health risks follows a social gradient in high-income countries, and they strongly cluster among low-skilled occupations and people with atypical or dangerous employment (Benach et al., 2007; Hoven and Siegrist, 2013; Parent-Thirion et al., 2012). However, with the changes in work environments, the experience of work stress is no longer limited to low skilled occupational groups, but increasingly affects better-trained occupations (Cooper et al., 2012). Therefore, it is important to know to what extent these associations explain the social gradient of health (Hoven and Siegrist, 2013).

Research has tackled this challenge by applying the moderation strategy into the analysis. According to the moderation hypothesis, the effect of a predicting variable (work environment) on a criterion variable (oral health) varies according to the level of a third variable (socio-economic status). In this case, stronger effects of psychosocial work environment on health are expected among employed people in a less privileged as compared to a more privileged socio-economic position. Therefore, statistical interaction was performed to test effect modification. Stratified analyses were performed and an interaction term (of each of the psychosocial work measures and socio-economic variables on oral health) was assessed. The interaction term was entered

into the regression models after fitting the fully adjusted logistic regression models (Model 5).

3.4.5   Longitudinal analysis (*Chapter 5*)

Aim 2: To investigate the longitudinal association between psychosocial work environment and oral health in a national working sample of older adults in England.

Objective 2.1: To define and describe the characteristics of the longitudinal analytical sample

First, the attrition and missingness that were experienced by the baseline sample were examined. Then, a full description of the analytical sample for the longitudinal analysis was presented.

Objective 2.2: To assess the unadjusted and adjusted association between baseline work control and oral health at follow-up

To assess the longitudinal associations between work control at baseline and subsequent oral health, time-lagged logistic regression models were fitted as follows: the work control indicator as a predictor at wave 3 (2006-07) was related to the oral health variables as an outcome at wave 5 (2010-11). The time-lagged models were progressively adjusted for covariates at wave 3 (2006-07), following the same pattern of adjusting for covariates as in the cross-sectional analyses (models 1 to 5).

Objective 2.3: To assess the unadjusted and adjusted association between baseline effort-reward imbalance and oral health at follow-up

As the previous step, time-lagged logistic regression was used to examine the association between effort-reward imbalance at baseline predicting oral health at follow-up (models 1 to 5)

Objective 2.4: To examine effect modification on the association between baseline psychosocial work environment and oral health at follow-up

Consistent with the approach used in the previous analysis, effect modification of the association between baseline psychosocial work environment measures and oral health at follow-up was examined by adding the interaction terms between psychosocial work environment indicators and covariates in the fully adjusted model.

3.4.6 Longitudinal analysis of repeated exposure to the predictors (*Chapter 6*)

Aim 2: To investigate the longitudinal association between psychosocial work environment and oral health in a national working sample of older adults in England.

Objective 2.4: to examine the association between repeated exposure to psychosocial work environment on oral health at follow-up

Work control and work quality were used in all previous analyses as categorical variables with three categories at a single time point (wave 3). This analysis measures psychosocial work factors at two time points (wave 3 and wave 4) to allow changes in exposure to be taken into account. It also makes it possible to identify chronically exposed workers, who may have a higher risk of poor oral health than those who were exposed for a shorter period. The new variables measuring repeated exposure to psychosocial work environment were described in the variables section earlier (*3.3.3*). The first step of the repeated exposure analysis was a description of the analytical sample and analysis of missingness. Then, the association between repeated exposure to the psychosocial work environment and oral health was examined using the percentage distributions of the cumulative exposure to psychosocial work environment variables by all selected covariates. Pearson chi-square test was used to examine the differences between the new categories of repeated exposure to the psychosocial work environment with oral health outcomes and covariates.

Furthermore, to examine whether there was an association between each of the repeated psychosocial work environment indicators and oral health at follow-up, binary logistic regression models with sequential adjustment were performed as follows: unadjusted models examining the crude association between repeated exposure to psychosocial work environment and oral health status; followed by a model adjusted for demographic variables (Model 2); and then further adjusted for socio-economic (education and income) measures (Model 3); work-related factors (work type) and smoking status variables were adjusted for in the final two models (Model 4 and Model 5, respectively). Participants whose psychosocial work environment had remained at the highest category over the past four years were used as a reference group and were compared with those whose psychosocial work environment had worsened or remained in a low category. As in all previous analyses, each of the predictor variables was examined separately in relation to oral health outcomes.

3.5 Summary

This chapter has described the data that was used to achieve the specific objectives of the study. The psychosocial work environment predictor variables, oral health outcomes and covariates used in the analyses were defined. Finally, a description of the statistical models and the analytical plan was presented. In the next three chapters, the results of the analyses examining the association between psychosocial work environment and oral health are presented.

Chapter 4

The Cross-Sectional Association

Between Psychosocial Work

Environment And Oral Health

ELSA Wave 3 (2006-07)

4.1 Introduction

The objective of this chapter was to examine the cross-sectional association between psychosocial work environment and oral health at wave 3 (2006-07), at the individual level. The main exposure, psychosocial work environment, was assessed using two measures: work control and effort-reward imbalance (which is referred to as work quality in this thesis).

The three oral health outcome variables investigated were: self-rated oral health (good vs. poor), edentulousness (dentate vs. edentate) and Oral Impacts on Daily Performance (no impacts vs. at least one impact).

The key hypotheses to be examined in this chapter are:
1. Lower levels of work control are associated with poor oral health.
2. Higher levels of effort-reward imbalance are associated with poor oral health.
3. The association between psychosocial work environment measures and oral health remains significant after adjusting for socio-demographic, socio-economic, work-related variables and health-related behaviours.

This chapter presents a description of the analytical sample and data missingness followed by results from the regression analysis. It was planned as follows: the initial step was to compare the characteristics of the overall eligible sample in ELSA wave 3 (2006-07) with the analytical sample used in the cross-sectional analysis, which excluded a number of participants due to missing responses. The second section describes the distribution of all the variables used in the analysis. Following that, the results of the regression models that assessed the association between psychosocial work environment and oral health are described. The final section examines the evidence for effect modifications in the association between psychosocial work environment and oral health.

4.2 Eligible ELSA sample and cross-sectional analytical sample

As detailed in *Chapter 3*, the analytical sample used in this chapter was a subset sample of ELSA wave 3 (2006-07). From the full ELSA wave 3 sample of 9,771 participants (Cohort 1 and Cohort 3), 961 partners of the core members and 6,212 non-employed participants were excluded from the analysis. A further 171 participants were excluded

because they were older than 65 years (see *Chapter 3* for details on exclusion criteria). This left an eligible sample of 2,427 respondents who were in paid employment and aged between 50 and 65 years at the time of ELSA wave 3 (2006-07). Of these, 1,637 (67.5%) were Cohort 1 core members and 790 (32.5%) Cohort 3 core members.

From this eligible sample, a total of 573 respondents were excluded from further analysis because of missing values on any of the variables used in the analysis. That further exclusion was a decrease of 23.6% from the total eligible sample population. To deal with the missing data, an analysis of missingness was conducted (*Section 4.2.1*).

The final number included in the analysis was 1,854 participants; from which 1,491 (80.4%) were Cohort 1 core members and 363 (19.6%) Cohort 3 core members. This sample formed the analytical sample on which cross-sectional analysis was conducted. The formation of the analytical sample is illustrated in Figure 4-1 below and the following section examines the covariates correlated with missing data among the eligible sample of 2,427 participants.

Figure 4-1: The origin of the analytical sample for the cross-sectional analysis, wave 3 (2006-07)
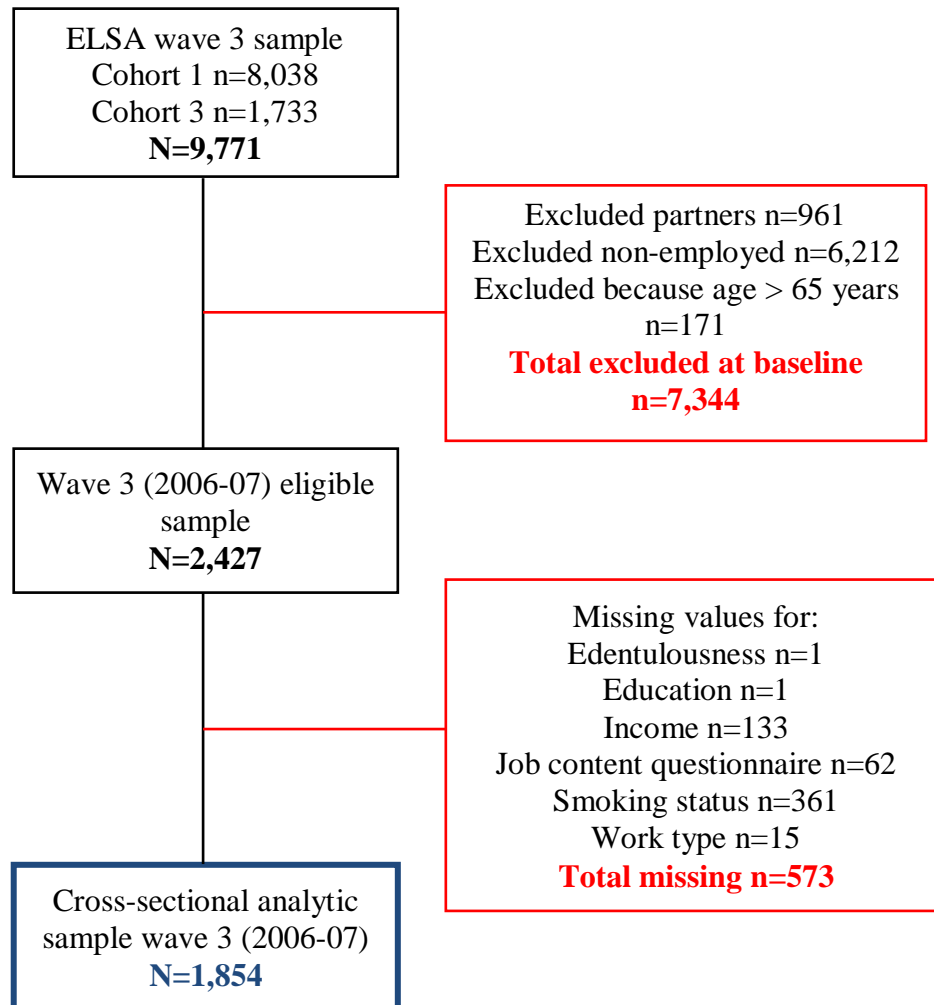
4.2.1   **Eligible ELSA wave 3 (2006-07) sample: characteristics of missingness**

This section analyses the covariates associated with the excluded observations. The eligible ELSA sample at wave 3 (2006-07) was reduced due to missing data on all covariates except for three variables that had complete data (age, gender and marital status).

Table 4-1 presents the number of observations with missing data and the total number of the eligible ELSA wave 3 sample within each category of the different variables used in the analysis. It shows that there were differences between the sample of missing participants and the characteristics of the eligible ELSA sample in age, gender, education level, edentulousness status, the level of work control and work quality.

Participants not included in the analytical sample were more likely to be younger (P<0.001), females (P=0.02), educated with a degree (P=0.02), dentate (P=0.01), have low control at work (P=0.03) and low quality of work (P=0.01).

Table 4-1: Characteristics of missingness in the eligible ELSA sample wave 3 (2006-07), distribution and p-value (N=2,427)

Covariates at wave 3	n missing/N	% missingness	p-value (χ^2)*
Socio-demographic factors			
Age			
50-54	434/864	50.2%	
55-59	87/999	8.7%	<0.001
60-65	52/564	9.2%	
Total	573/2427	23.6%	
Gender			
Male	260/1207	21.5%	
Female	313/1220	25.7%	0.017
Total	573/2427	23.6%	
Marital status			
Single	36/141	25.5%	
Married / civil partnership	460/1895	24.3%	0.130
Divorced / widowed	77/391	19.7%	
Total	573/2427	23.6%	
Socio-economic factors			
Educational level			
Degree or equivalent	173/640	27.0%	
Below degree	336/1461	23.0%	0.021
No qualification	63/325	19.4%	
Total	572/2426	23.6%	
Income quintile			
Lowest	35/148	23.7%	
2	38/185	20.5%	
3	70/407	17.2%	0.510
4	128/655	19.5%	
Highest	169/899	18.8%	
Total	440/2294	19.2%	
Work-related factors			
Employment status			
Employed	459/2047	22.4%	
Self-employed	94/360	26.1%	0.125
Total	553/2407	23.0%	
Health-related behaviours			
Smoking			
Yes	41/357	10.9%	
No	171/1691	10.1%	0.636
Total	212/2066	10.3%	

Covariates at wave 3	n missing/N	% missingness	p-value (χ^2)*
Oral health status (outcomes)			
Self-rated oral health			
Excellent/Good	484/2027	23.9%	0.484
Fair/Poor	89/400	22.3%	
Total	573/2427	23.6%	
OIDP			
No impact	535/2286	23.4%	0.336
At least one impact	38/141	27.0%	
Total	573/2427	23.6%	
Edentulousness			
Dentate	556/2309	24.1%	0.010
Edentate	16/117	13.7%	
Total	572/2426	23.6%	
Psychosocial work measures (predictors)			
Work control			
High	308/1472	20.9%	
Medium	142/583	24.4%	0.034
Low	91/340	26.8%	
Total	541/2395	22.6%	
Quality of work (ERI)			
High	131/759	17.3%	
Medium	160/803	19.9%	0.012
Low	178/761	23.4%	
Total	469/2323	20.2%	

* P-value for the difference between eligible and analytical sample, using chi-square test

4.3   Results of the cross-sectional analysis

In this chapter, all analyses have been weighted for non-response and account for the complex survey design. Using weights was described earlier in *Chapter 3*.

4.3.1   Baseline analytical wave 3 (2006-07) sample: distribution and characteristics

Table 4-2 below present the distribution of the variables used in the analysis and their bivariate associations with the three oral health outcomes. In the baseline sample, 51.1% were men and 48.9% were women. The largest proportion was in the middle age group (55-59), with 49.2% of the sample. More than three-quarters of the sample (above 77%) of the sample were married or in a civil relationship.

Regarding socio-economic position markers, over 60% of the sample achieved a level of education below degree qualification. In terms of income, 39.4% of the sample was

in the highest income quintile. Finally, 82% of the sample participants were non-smokers.

Table 4-2: The distribution of the baseline characteristics of the analytical sample, ELSA wave 3 (2006-07), N=1,854

Covariates at wave 3	n (%) of baseline participants
Age group	
50-54	430 (32.2)
55-59	912 (49.2)
60-65	512 (27.6)
Gender	
Male	947 (51.1)
Female	907 (48.9)
Marital status	
Single	105 (5.7)
Married or in a civil partnership	1435 (77.4)
Divorced or widowed	314 (16.9)
Educational level	
Degree or equivalent	467 (25.2)
Below degree	1125 (60.7)
No qualification	262 (14.1)
Income quintile	
Lowest	113 (6.1)
2	147 (7.9)
3	337 (18.2)
4	527 (28.4)
Highest	730 (39.4)
Employment status	
Employed	1588 (85.6)
Self-employed	266 (14.4)
Smoking	
Yes	334 (18.0)
No	1520 (82.0)

4.3.2   Oral health status

Table 4-3 shows the distribution of oral health status and covariates and the bivariate associations with oral health outcomes in the baseline sample. Overall, the prevalence of poor self-rated oral health was 16.8%; the prevalence of edentulism was 5.4%; and 5.6% of the sample participants had experienced at least one oral impact on their daily performance in the past six months.

Table 4-3: Distribution of oral health outcome variables in ELSA baseline wave 3 sample (2006-07), n (%), N=1,854

Oral health outcomes at wave 3 (2006-07)	n (%)
Self-rated oral health	
Good	1,543 (83.2)
Poor	311 (16.8)
Edentulousness	
Dentate	1,753 (94.6)
Edentate	101 (5.4)
Oral Impacts on Daily Performance (OIDP)	
No impacts	1,751 (94.4)
At least one impact	103 (5.6)

Regarding the prevalence of specific oral impacts (OIDP items), Table 4-4 demonstrates the breakdown of all five oral impacts measured by the OIDP variable. It shows that difficulty eating food was the most common oral impact (3.5%) and the least reported impact was enjoying the company of others, which was reported by nearly 0.4%.

Table 4-4: Prevalence of Oral Impacts on Daily Performance in ELSA baseline wave 3 sample (2006-07), n (%), N=1,854

Oral impacts	n (%)
Difficulty eating food	65 (3.5)
Difficulty speaking clearly	13 (0.7)
Problems smiling without embarrassment	41 (2.2)
Problems with emotional instability	10 (0.5)
Problems enjoying company of others	7 (0.4)
Any impact on daily performance (total)	103 (5.6)

4.3.2.1   Self-rated oral health

Table 4-5 shows the demographic characteristics of participants who reported poor self-rated oral health. The table shows that reporting poor oral health was associated with marital status, education and income. More than a third of single (23%) and divorced/widowed (21%) participants rated their oral health as poor, but this was less prevalent among married participants (15.4%). A third (20.2%) of participants in the youngest age group reported poor self-rated oral health, while 14.6% of the oldest rated their oral health as poor. Poor self-rated oral health was more prevalent in each successively lower education group: 13.5% of those with a degree level education, 16.5% of those that were below degree and 23.3% of those without qualification reported poor oral health status. Similarly, a higher prevalence of poor self-rated oral health was observed amongst those in the lowest income quintile (20.3%) compared to those in the highest income quintile (13.3%). Finally, poor self-rated oral health was more prevalent among smokers (27.5%) compared to non-smokers (14.4%) in the analytical sample.

4.3.2.2   Edentulousness

Being edentate was associated with age, education level, income and smoking status in the analytical sample. A higher prevalence of edentulousness was observed in each older age group successively. Amongst the oldest age group (60-65 years old), 8.2% were edentates, while 5.8% reported being edentate in the youngest age group (50-54 years old). A gradient of higher prevalence of edentulousness was found in relation to lower education level and income: 10.7% of participants with no qualification, 5.8% of those with below degree qualification and 1.7% of participants with no qualification reporting being edentate. In addition, 7.1% of participants in the poorest income quintile and 2.7% of those in the highest income quintile were edentate. Further, the prevalence of edentulousness was higher among smokers (11.7%) when compared to the non-smokers (4.1%).

4.3.2.3   Oral Impacts on Daily Performance (OIDP)

The Oral Impacts on Daily Performance measure was only associated with smoking status and marginally associated with gender. A higher prevalence of OIDP was

reported among females (6.6%) when compared to males (4.5%) in the analytical sample. Also, there was a higher prevalence of OIDP among smokers (9.3%) compared to non-smokers (4.7%).

Table 4-5: Distribution of oral health outcomes by socio-demographic, socio-economic and health-related factors in ELSA baseline wave 3 sample (2006-07), n(%) and bivariate p-value from chi-square distribution, N=1,854

Covariates at wave 3 (2006-07)	Oral health outcomes at wave 3 (2006-07)		
	Poor self-rated oral health n=311 (16.77%)	Edentate n=101 (5.45%)	OIDP n=103 (5.56%)
Age group			
50-54	87 (20.2)	25 (5.8)	26 (6.1)
55-59	149 (16.3)	34 (3.7)	51 (5.6)
60-65	75 (14.6)	42 (8.2)	26 (5.1)
p-value for trend	*0.065*	*0.002*	*0.516*
Gender			
Male	160 (16.9)	48 (5.1)	43 (4.5)
Female	151 (16.6)	53 (5.8)	60 (6.6)
p-value	*0.887*	*0.463*	*0.051*
Marital status			
Single	24 (22.9)	5 (4.8)	8 (7.6)
Married / civil partnership	221 (15.4)	78 (5.4)	81 (5.6)
Divorced / widowed	66 (21.0)	18 (5.7)	14 (4.5)
p-value for trend	*0.012*	*0.721*	*0.451*
Educational level			
Degree or equivalent	63 (13.5)	8 (1.7)	24 (5.1)
Below degree	187 (16.6)	65 (5.8)	65 (5.8)
No qualification	61 (23.3)	28 (10.7)	14 (5.3)
p-value for trend	*0.001*	*<0.001*	*0.820*
Income quintile			
Lowest	23 (20.3)	8 (7.1)	6 (5.3)
2	25 (17.0)	14 (9.5)	8 (5.4)
3	78 (23.1)	29 (8.6)	17 (5.0)
4	88 (16.7)	30 (5.7)	37 (7.0)
Highest	97 (13.3)	20 (2.7)	35 (4.8)
p-value for trend	*0.002*	*<0.001*	*0.821*
Employment type			
Employed	261 (16.4)	91 (5.7)	86 (5.4)
Self-employed	50 (18.8)	10 (3.8)	17 (6.4)
p-value	*0.340*	*0.190*	*0.520*
Smoking			
Yes	92 (27.5)	39 (11.7)	31 (9.3)
No	219 (14.4)	62 (4.1)	72 (4.7)
p-value	*<0.001*	*<0.001*	*0.001*

4.3.3 Distribution of psychosocial work environment measures

Psychosocial work environment, which was measured by two variables, is the main exposure in this study. The following six tables (Table 4-6 to Table 4-11) demonstrate the distribution of the different psychosocial work environment measures, i.e. work control and effort-reward imbalance (indicated by quality of work), and their bivariate associations with oral health and risk factors.

4.3.3.1 Work control

Over half of the respondents (62.8%) were in the highest category of work control (indicating no/lower experience of work stress), slightly less than one-quarter (23.8%) were in the middle category and 13.4% were in the lowest category of work control (indicating higher work stress) (Table 4-6).

Table 4-6: Distribution of work control categories at wave 3 (2006-07), N=1,854

Psychosocial work environment measure	n (%)
Work control	
High control	1164 (62.8)
Medium control	441 (23.8)
Low control	249 (13.4)

4.3.3.1.1 Distribution of elements for work control measure

Table 4-7 presents the detailed distribution of work control measure components, to explore the number of responses within the two items of the work control measure.

As established from the categories of the work control measure described previously, more than half of the sample (nearly 63%) were in the highest control group. There was a common pattern of responses to both items. This can be attributed to a skewed response towards the highest work control category in both items constructing the work control measurement. A thorough examination of the responses in the first work control item, "*I have very little freedom to decide how I do my work",* showed that the majority of participants in the sample reported having freedom. Similarly, the second item measuring work control, "*I have an opportunity to develop new skills*", showed that the

majority of participants reported having such an opportunity. Therefore, the distribution within the categories of the work control measures was uneven.

Table 4-7: Distribution of responses within each component of the work control measure at the baseline wave 3 (2006-07), N=1,854

Work control elements	Responses n(%)			
	Strongly agree	Agree	Disagree	Strongly disagree
*I have very little freedom to decide how I do my work**	81 (4.4)	291 (15.7)	975 (52.6)	507 (27.3)
I have an opportunity to develop new skills	224 (12.1)	1034 (55.8)	469 (25.3)	127 (6.8)

* Item reverse coded for scoring

4.3.3.1.2 Work control measure by baseline covariates, wave 3 (2006-07)

The bivariate associations between work control and socio-demographic, socio-economic and behavioural factors are presented in Table 4-8.

In the baseline sample, there was a significant association between work control with education level, income quintile and type of employment contract. The prevalence of low work control was greater for participants who had no educational qualification, were in the fourth highest income quintile and were employed. Participants who reported medium sense of work control had common educational and employment-type characteristics but were in the third income quintile. On the other hand, high work control was more prevalent among participants who were in the second lowest income quintile, with degree qualification and were self-employed. There was a general pattern in the association between work control and education: work control increased among those with a degree-level qualification and decreased among the participants with no qualification. However, the distribution of different work control categories was not of a graded nature with income quintiles and employment type (Table 4-8).

Table 4-8: Work control categories by characteristics of ELSA baseline wave 3 sample (2006-07), n (%), N=1,854

Covariates at wave 3 (2006-07)	Work control at wave 3 (2006-07)			
	High control n=1164 (60.8%)	**Medium control** n=441 (23.8%)	**Low control** n=249 (13.4%)	*p-value* *for trend*
Age group				
50-54	272 (63.3)	106 (24.6)	52 (12.1)	
55-59	584 (64.0)	206 (22.6)	122 (13.4)	0.548
60-65	308 (60.5)	129 (25.2)	75 (14.6)	
Gender				
Male	589 (62.2)	220 (23.2)	138 (14.6)	0.327
Female	575 (63.4)	221 (24.4)	111 (12.2)	
Marital status				
Single	64 (60.9)	27 (25.7)	14 (13.3)	
Married / civil partnership	906 (63.1)	344 (24.0)	185 (12.9)	0.667
Divorced / widowed	194 (61.8)	70 (22.3)	50 (15.9)	
Educational level				
Degree or equivalent	355 (76.0)	74 (15.8)	38 (8.1)	
Below degree	674 (59.9)	289 (25.7)	162 (14.4)	<0.001
No qualification	135 (51.5)	78 (29.8)	49 (18.7)	
Income quintile				
Lowest	65 (57.5)	31 (27.4)	17 (15.0)	
2	86 (58.5)	41 (27.9)	20 (13.6)	
3	188 (55.8)	100 (29.7)	49 (14.5)	<0.001
4	294 (55.8)	137 (26.0)	96 (18.2)	
Highest	531 (72.7)	132 (18.1)	67 (9.2)	
Employment type				
Employed	969 (61.0)	397 (25.0)	222 (14.0)	0.001
Self-employed	195 (73.3)	44 (16.5)	27 (10.1)	
Smoking				
Yes	197 (59.0)	90 (26.9)	47 (14.1)	0.250
No	967 (63.6)	531 (23.1)	202 (13.3)	

4.3.3.2 *Work quality*

As shown in Table 4-9 below, slightly above one-third of respondents (33.9%) were in the highest category of work quality (low effort-reward imbalance) and 34.7% were in the middle category, while the remaining 31.4% of respondents were in the lowest category of work quality (high effort-reward imbalance).

Table 4-9: Distribution of quality of work categories at wave 3 (2006-07), N=1,854

Psychosocial work environment measure	n (%)
Effort-reward imbalance (work quality)	
High quality	628 (33.9)
Medium quality	643 (34.7)
Low quality	583 (31.4)

4.3.3.2.1 Distribution of elements of quality of work measure

Table 4-10 below assesses the distribution of the components for the effort-reward imbalance measure used in this study. First, the two effort items: higher proportions of responses were in the highest scores categories (disagree and strongly disagree), indicating that the majority of respondents in the sample reported spending low amounts of effort in their work.

Regarding the second domain of this measure, the reward items: for three out the five items measuring reward, the responses indicated a positive experience (in terms of higher levels of rewards) among the sample participants, whilst for the other two items, the responses indicated lower levels of rewards. Therefore, the variability of the responses resulted in three equal categories of the work quality measurement.

Table 4-10: Distribution of responses within each component of the effort-reward imbalance measure at the baseline wave 3 (2006-07), N=1,854

Quality of work elements	Responses n(%)			
	Strongly agree	Agree	Disagree	Strongly disagree
Efforts				
My job is physically demanding	238 (12.8)	556 (30.0)	705 (38.0)	355 (19.2)
I am under constant time pressure due to a heavy workload	202 (11.0)	558 (30.1)	773 (41.7)	321 (17.3)
Rewards				
I receive the recognition I deserve for my work	253 (13.6)	1075 (58.0)	448 (24.2)	78 (4.2)
Considering all my efforts and achievements, my salary/earnings is/are adequate	242 (15.0)	1001 (54.0)	505 (27.2)	106 (5.7)
*My job promotion prospects/prospects for job advancement are poor**	372 (20.1)	803 (43.3)	521 (28.1)	158 (8.5)
*My job security is poor**	120 (6.5)	333 (18.0)	925 (49.9)	476 (25.6)
I receive adequate support in difficult situations	236 (12.7)	1166 (62.9)	374 (20.2)	78 (4.2)

* Items reverse coded for scoring

4.3.3.2.2 Quality of work by baseline covariates, wave 3 (2006-07)

Table 4-11 shows the results of the univariate associations on the different categories of work quality with demographic, socio-economic, work and behavioural factors. The distribution of characteristics in the quality of work showed significant associations with gender, education level, income and smoking status. The prevalence of reporting low and medium work quality was greater among participants who were males, had below degree educational qualification and were non-smokers. Participants who reported high work quality had common socio-economic characteristics with the others but the majority were females. A graded pattern was only observed in relation to income quintiles: high and medium levels of quality of work were less prevalent in each

consecutively lower income quintile (Table 4-11). However, this gradient was not present in relation to the lowest work quality category.

Table 4-11: Quality of work categories by characteristics of ELSA baseline wave 3 sample (2006-07), n (%), N=1,854

Covariates at wave 3 (2006-07)	Work quality at wave 3 (2006-07)			
	High quality n=628 (33.9%)	Medium quality n=643 (34.7%)	Low quality n=583 (31.4%)	*p-value* for trend
Age group				
50-54	133 (30.9)	153 (35.6)	144 (33.5)	
55-59	306 (33.5)	309 (33.9)	297 (32.6)	0.196
60-65	198 (36.9)	181 (35.4)	142 (27.7)	
Gender				
Male	278 (29.4)	345 (36.4)	324 (34.2)	<0.001
Female	350 (38.6)	298 (32.9)	259 (28.6)	
Marital status				
Single	33 (31.4)	33 (31.4)	39 (37.1)	
Married / civil partnership	497 (34.6)	496 (34.6)	442 (30.8)	0.552
Divorced / widowed	98 (31.2)	114 (36.3)	102 (32.5)	
Educational level				
Degree or equivalent	172 (36.3)	169 (36.2)	126 (27.0)	
Below degree	388 (34.5)	381 (33.9)	356 (31.6)	0.008
No qualification	68 (25.9)	93 (35.5)	101 (38.6)	
Income quintile				
Lowest	35 (31.0)	43 (38.0)	35 (31.0)	
2	50 (34.0)	49 (33.3)	48 (32.7)	
3	113 (33.5)	116 (34.4)	108 (32.0)	<0.001
4	138 (26.2)	191 (36.3)	198 (37.6)	
Highest	292 (40.0)	244 (33.4)	194 (26.6)	
Employment status				
Employed	528 (33.2)	554 (34.9)	506 (31.9)	0.364
Self-employed	100 (37.6)	89 (33.5)	77 (28.9)	
Smoking				
Yes	93 (27.8)	115 (34.4)	126 (37.7)	0.009
No	535 (35.2)	528 (34.7)	457 (30.1)	

4.4 Multivariable analysis for the cross-sectional association between psychosocial work environment predictors and oral health outcomes

As the first step, bivariate associations between psychosocial work environment measures and oral health outcomes were tested. Table 4-12 shows a consistently significant association between poor psychosocial work environment and poor oral health. However, this assessment does not take into account the potential influence of confounders or mediators in the observed association. Therefore, logistic regression models were used in the later analyses in this thesis. The results of the logistic regression for the association between psychosocial work environment and oral health adjusted for covariates are presented in Tables 4-13 to 4-18.

Table 4-12: The distribution and bivariate associations of oral health outcomes by psychosocial work environment predictors at baseline wave 3 (2006-07), n (%), N=1,854

Psychosocial work environment predictors at wave 3 (2006-07)	Oral health outcomes at wave 3 (2006-07)		
	Poor self-rated oral health n=311 (16.77%)	Edentate n=101 (5.45%)	OIDP[1] n=103 (5.56%)
Control at work			
High control	170 (14.6)	53 (4.5)	53 (4.5)
Medium control	92 (20.9)	34 (7.7)	30 (6.8)
Low control	49 (19.7)	14 (5.6)	20 (8.0)
p-value for trend	0.005	0.123	0.012
Quality of work			
High quality	84 (13.4)	34 (5.4)	27 (4.3)
Medium quality	108 (16.8)	24 (3.7)	30 (4.7)
Low quality	119 (20.4)	43 (7.4)	46 (7.9)
p-value for trend	0.001	0.147	0.007

[1] Oral Impacts on Daily Performance

4.4.1 Psychosocial work environment and self-rated oral health

This section presents the results of the logistic regression models for the association between psychosocial work environment measures and self-rated oral health. Regression models were sequentially adjusted for covariates. Unadjusted and adjusted logistic regression results are presented in Tables 4-13 and 4-14.

For this section of multivariate analysis, a test for trend was examined for each association to assess the significance of the patterns of estimates within work control and quality of work categories. When the fully adjusted models were run, the psychosocial work exposure variable was added as a count variable so the p-value for the variable would indicate the significance of any linear trend.

4.4.1.1 Work control and self-rated oral health

The unadjusted model (Table 4-13, Model 1) showed that both medium and low control at work were significantly associated with higher odds of poor self-rated oral health compared to respondents who had high control at work (OR 1.54; 95% CI: 1.16-2.04) and (OR 1.43; 95% CI: 1.01-2.04), respectively. However, the latter association was marginally significant.

After adjusting for socio-demographic variables (age, gender and marital status), these associations remained statistically significant, with the one for low control at work and self-rated oral health remaining marginally significant, and the actual estimates were almost unchanged (Model 2).

When further adjusting for socio-economic status indicators (Model 3), the association between medium control at work and poor self-rated oral health was attenuated but remained statistically significant. The odds ratio decreased from 1.55 (95% CI: 1.16-2.06) in Model 2 to 1.42 (95% CI: 1.07-1.90) in Model 3. In relation to low control at work, the marginal association became non-significant after adjusting for socio-economic factors and the odds ratio were reduced to 1.30 (95% CI: 0.91-1.86).

Adjusting for the work type measure in the model (Model 4) and smoking status in the fully adjusted model (Model 5) did not affect the associations in terms of the estimates or the significance. Medium sense of work control was significantly associated with higher odds of poor self-rated oral health (OR 1.44; 95% CI: 1.07-1.94) in the fully adjusted model.

Overall, adjustments in the regression models showed that demographic and behavioural factors did not influence the association between work control and poor self-rated oral health. However, adjusting for socio-economic variables explained the marginal association between low work control and self-rated oral health.

Table 4-13: Association between sense of control at work and poor self-rated oral health at wave 3 (2006-07): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,854

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: Poor self-rated oral health wave 3 (2006-07)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Control at work	High control (ref)	1	1	1	1	1
	Medium control	1.54 (1.16-2.04)**	1.55 (1.17-2.06)**	1.42 (1.07-1.90)*	1.45 (1.08-1.93)*	1.44 (1.07-1.94)*
	Low control	1.43 (1.01-2.04)*	1.43 (1.00-2.03)*	1.30 (0.91-1.86)	1.32 (0.92-1.90)	1.34 (0.93-1.93)
Age group	50-54		1	1	1	1
	55-59	-	0.79 (0.58-1.07)	0.79 (0.58-1.06)	0.78 (0.58-1.06)	0.89 (0.66-1.22)
	60-65		0.69 (0.49-0.97)*	0.68 (0.48-0.96)*	0.67 (0.47-0.94)*	0.77 (0.54-1.10)
Gender	Male		1	1	1	1
	Female	-	0.92 (0.72.1.19)	0.88 (0.68-1.13)	0.89 (0.69-1.15)	0.89 (0.69-1.16)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.65 (0.40-1.06)	0.66 (0.40-1.08)	0.67 (0.41-1.10)	0.72 (0.44-1.18)
	Divorced / widowed		0.95 (0.56-1.63)	0.94 (0.54-1.62)	0.94 (0.54-1.62)	0.94 (0.54-1.63)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	1.14 (0.82-1.58)	1.14 (0.82-1.59)	1.09 (0.79-1.52)
	No qualification			1.68 (1.10-2.55)*	1.69 (1.11-2.57)*	1.50 (0.98 -2.30)
Income quintile	Lowest			1	1	1
	2			0.86 (0.45-1.62)	0.87 (0.45-1.66)	0.87 (0.46-1.66)
	3	-	-	1.28 (0.75-2.17)	1.31 (0.76-2.24)	1.36 (0.79-2.33)
	4			0.89 (0.52-1.51)	0.92 (0.54-1.57)	0.95 (0.56-1.61)
	Highest			0.77 (0.46-1.30)	0.79 (0.46-1.34)	0.83 (0.49-1.41)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.26 (0.89-1.78)	1.28 (0.90-1.82)
Smoking	Yes					1
	No	-	-	-	-	0.51 (0.38-0.68)***

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^ P-value for trend = 0.028

4.4.1.2   Quality of work and self-rated oral health

In Table 4-14, the results of the unadjusted model (Model 1) showed a non-significant association between medium quality of work and poor self-rated oral health (OR 1.31; 95% CI: 0.96-1.78). This association was weakened and remained non-significant throughout the adjustment process (Model 2 to Model 5).

However, low quality of work was significantly associated with higher odds of reporting poor self-rated oral health in Model 1. Respondents who had low work quality were 1.66 times more likely to report poor self-rated oral health compared to participants who had high work quality (95% CI: 1.22-2.55). Adjusting for demographic variables in Model 2 did not change this association. When introducing the socio-economic indicators (in Model 3), the odds ratio substantially decreased to 1.52, but the association remained statistically significant (95% CI: 1.11-2.07). Adding the employment type variable in Model 4 did not affect the size or the significance of the estimate. The fully adjusted model (Model 5) reduced the odds ratio to 1.48 (95% CI: 1.08-2.03) for reporting poor self-rated oral health in participants who had low work quality versus those with high quality at work.

Overall, regardless of the fact that only the odds ratios of the low quality of work were statistically significant, there is a clear trend with a higher prevalence of poor self-rated oral health for every model with lower quality of work. There was a significant stepwise pattern observed in the association with quality of work (P=0.015). The pattern shows that there is an association that goes through the distribution of the outcome and it is not relevant to a particular category of work quality only. This is interesting because, unlike the associations found in the previous section, the stepwise nature of the association was only clear with the quality of work. However, similar to the previous section on work control, the socio-economic position was the only confounder that made a noticeable contribution to the odds of poor self-rated oral health (see Model 3).

Table 4-14: Association between psychosocial work environment and poor self-rated oral health at wave 3 (2006-07): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,854

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: Poor self-rated oral health wave 3 (2006-07)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Quality of work	High quality (ref)	1	1	1	1	1
	Medium quality	1.31 (0.96-1.78)	1.28 (0.94-1.75)	1.24 (0.90-1.69)	1.24 (0.91-1.70)	1.23 (0.89-1.69)
	Low quality	1.66 (1.22-2.25)**	1.61 (1.18-2.19)**	1.52 (1.11-2.08)**	1.53 (1.12-2.09)**	1.48 (1.08-2.03)*
Age group	50-54		1	1	1	1
	55-59	-	0.80 (0.59-1.07)	0.79 (0.59-1.07)	0.79 (0.58-1.06)	0.90 (0.66-1.23)
	60-65		0.72 (0.51-1.01)	0.70 (0.49-0.99)	0.70 (0.49-0.98)*	0.79 (0.55-1.14)
Gender	Male		1	1	1	1
	Female	-	0.96 (0.75.1.23)	0.91 (0.70-1.17)	0.92 (0.71-1.19)	0.92 (0.71-1.19)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.66 (0.41-1.07)	0.67 (0.40-1.01)	0.67 (0.40-1.10)	0.72 (0.44-1.19)
	Divorced / widowed		0.95 (0.55-1.62)	0.93 (0.53-1.61)	0.93 (0.54-1.60)	0.93 (0.54-1.61)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	1.18 (0.85-1.63)	1.18 (0.85-1.64)	1.13 (0.82-1.58)
	No qualification			1.71 (1.12-2.58)*	1.72 (1.13-2.62)*	1.54 (1.01-2.36)*
Income quintile	Lowest			1	1	1
	2			0.85 (0.45-1.62)	0.86 (0.45-1.65)	0.87 (0.46-1.67)
	3	-	-	1.29 (0.75-2.20)	1.32 (0.77-2.26)	1.37 (0.79-2.37)
	4			0.87 (0.51-1.48)	0.89 (0.53-1.53)	0.93 (0.54-1.60)
	Highest			0.76 (0.45-1.28)	0.77 (0.45-1.32)	0.82 (0.48-1.40)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.22 (0.86-1.72)	1.23 (0.87-1.74)
Smoking	Yes					1
	No	-	-	-	-	0.52 (0.38-0.70)***

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.015

In summary, there was evidence that both medium work control and low quality of work were associated cross-sectionally with poor self-rated oral health with odds ratio ranging from 1.44 (95% CI: 1.08-1.93) to 1.48 (95% CI: 1.08-2.03). These associations seemed to be independent of socio-demographic, socio-economic, work related and behavioural factors. However, socio-economic indicators contributed to explaining the association between low control at work and poor self-rated oral health.

4.4.2   Psychosocial work environment and edentulousness

This section presents the results of the logistic regression models for the association between psychosocial work environment measures and edentulousness. Results from the regression models are presented in Tables 4-15 and 4-16

4.4.2.1   Work control and edentate status

Table 4-15 shows that there was no evidence of an association between control at work and edentate status. The unadjusted estimates (in Model 1) showed a non-significant association between low control at work and edentulousness (OR 1.25; 95% CI: 0.68-2.29). However, a stronger association was found between medium control at work and being edentate. Medium control at work was significantly associated with higher odds of edentulousness (OR 1.75; 95% CI: 1.12-2.73), when compared to those who had high control at work.

Adjusting for age, gender and marital status (Model 2), has barely any influence on the estimates of the association between medium control at work and edentulousness. Including the socio-economic variables (Model 3) has fully explained the association and attenuated in the odds ratio of edentulousness to 1.38 (95% CI: 0.87-2.18) in relation to medium work control. After further adjusting for work type and smoking, the odds ratio was slightly reduced and remained non-significant in the fully adjusted model (OR 1.31; 95% CI: 0.82-2.09).

Taken together, work control did not seem to be associated with edentulousness, albeit there was a significant crude association between medium level of work control and edentate status. There was a very clear pattern whereby adjusting for socio-economic indicators fully explained the single significant association with control at work and considerably decreased the observed estimates.

Table 4-15: Association between psychosocial work environment and edentulousness at wave 3 (2006-07): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,854

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: Edentate status wave 3 (2006-07)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Control at work	High control (ref)	1	1	1	1	1
	Medium control	1.75 (1.12-2.73)*	1.71 (1.09-2.68)*	1.38 (0.87-2.18)	1.34 (0.85-2.13)	1.31 (0.82-2.09)
	Low control	1.25 (0.68-2.29)	1.23 (0.67-2.27)	0.97 (0.52-1.81)	0.95 (0.51-1.78)	0.96 (0.51-1.79)
Age group	50-54		1	1	1	1
	55-59	-	0.63 (0.37-1.08)	0.63 (0.36-1.07)	0.63 (0.37-1.08)	0.79 (0.45-1.38)
	60-65		1.46 (0.87-2.46)	1.41 (0.83-2.39)	1.43 (0.84-2.43)	1.85 (1.05-3.24)*
Gender	Male		1	1	1	1
	Female	-	1.21 (0.80.1.83)	1.07 (0.70.1.63)	1.04 (0.68.1.59)	1.07 (0.69.1.64)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	1.16 (0.45-2.95)	1.17 (0.45-3.03)	1.15 (0.44-2.99)	1.33 (0.50-3.49)
	Divorced / widowed		1.20 (0.43-3.36)	1.15 (0.41-3.28)	1.15 (0.40-3.29)	1.18 (0.41-3.39)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	2.66 (1.26-5.64)*	2.65 (1.23-5.71)*	2.44 (1.13-5.26)*
	No qualification			4.52 (2.01-10.16)***	4.47 (1.98-10.36)***	3.64 (1.56-8.51)***
Income quintile	Lowest			1	1	1
	2			1.12 (0.44-2.81)	1.09 (0.43-2.76)	1.09 (0.43-2.72)
	3	-	-	1.17 (0.51-2.67)	1.12 (0.49-2.58)	1.16 (0.51-2.65)
	4			0.77 (0.34-1.76)	0.74 (0.32-1.70)	0.76 (0.33-1.74)
	Highest			0.47 (0.20-1.12)	0.46 (0.19-1.09)	0.49 (0.21-1.14)
Employment status	Employed				1	1
	Self-employed	-	-	-	0.67 (0.34-1.32)	0.67 (0.34-1.34)
Smoking	Yes					1
	No	-	-	-	-	0.36 (0.22-0.58)***

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.759

4.4.2.2   Quality of work and edentate status

Results from Table 4-16 show that there was no significant association between edentate status and quality of work in any of the models (Model 1 to Model 5). Although the odds ratio of being edentate in relation to low quality of work ranged from 1.39 (95% CI: 0.87-2.21) to 1.16 (95% CI: 0.71-1.91), the association was not statistically significant.

In this model, again, the stepwise pattern in the association with quality of work appeared. Although none of the estimates were statistically significant, there was a trend with higher odds of edentulousness in the low quality of work group compared with the medium quality of work group. However, the pattern here seemed to be a random variation; the p-value for trend was also not statistically significant (P=0.471).

Table 4-16: Association between psychosocial work environment and edentulousness at wave 3 (2006-07): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,854

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: Edentate status wave 3 (2006-07)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Quality of work	High quality (ref)	1	1	1	1	1
	Medium quality	0.67 (0.39-1.15)	0.69 (0.40-1.19)	0.63 (0.36-1.10)	0.63 (0.36-1.00)	0.61 (0.35-1.07)
	Low quality	1.39 (0.87-2.21)	1.49 (0.92-2.42)	1.28 (0.78-2.09)	1.27 (0.78-2.08)	1.16 (0.71-1.91)
Age group	50-54		1	1	1	1
	55-59	-	0.63 (0.36-1.06)	0.62 (0.36-1.06)	0.62 (0.36-1.06)	0.78 (0.45-1.37)
	60-65		1.52 (0.86-2.57)	1.43 (0.83-2.44)	1.45 (0.84-2.48)	1.86 (1.05-3.27)*
Gender	Male		1	1	1	1
	Female	-	1.24 (0.82.1.88)	1.10 (0.72.1.69)	1.06 (0.69.1.64)	1.07 (0.69.1.66)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	1.21 (0.47-3.08)	1.22 (0.49-3.00)	1.21 (0.47-2.80)	1.37 (0.54-3.44)
	Divorced / widowed		1.24 (0.45-3.44)	1.20 (0.44-3.28)	1.20 (0.43-3.11)	1.20 (0.43-3.36)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	2.69 (1.28-5.68)**	2.66 (1.26-5.63)*	2.44 (1.15-5.21)*
	No qualification			4.55 (2.03-10.17)***	4.48 (1.99-10.06)***	3.63 (1.59-8.29)***
Income quintile	Lowest			1	1	1
	2			1.08 (0.44-2.71)	1.06 (0.43-2.66)	1.08 (0.43-2.69)
	3	-	-	1.16 (0.51-2.63)	1.12 (0.49-2.53)	1.17 (0.52-2.64)
	4			0.74 (0.33-1.70)	0.71 (0.31-1.63)	0.75 (0.33-1.71)
	Highest			0.46 (0.19-1.06)	0.44 (0.19-1.03)	0.48 (0.20-1.10)
Employment status	Employed				1	1
	Self-employed	-	-	-	0.65 (0.33-1.29)	0.65 (0.33-1.31)
Smoking	Yes					1
	No	-	-	-	-	0.37 (0.23-0.58)***

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.471

To summarise, there was some evidence that control at work was cross-sectionally associated with edentulousness. However, this association was explained by socio-economic factors. There was no association between quality of work and edentulousness.

4.4.3 Psychosocial work environment and Oral Impacts on Daily Performance (OIDP)

Table 4-17 and Table 4-18 show the results of the logistic regression models for the association between psychosocial work environment measures and OIDP.

4.4.3.1 Work control and OIDP

Table 4-17 shows that control at work was associated with increased likelihood of reporting at least one oral impact on daily performance. In the unadjusted Model 1, medium control at work had a marginally non-significant association with oral impacts, whereas low control at work was strongly associated with higher odds of at least one OIDP (OR 1.83; 95% CI: 1.07-3.12). The size of the association with low control at work group was slightly increased to 1.90 (95% CI: 1.11-3.25) when demographic variables were included in the model (Model 2). Adding socio-economic factors (Model 3) slightly decreased the odds ratio to 1.85 (95% CI: 1.07-3.19) but the association remained strong and statistically significant. Further adjustment for work type and smoking (models 4 and 5), showed that low work control remained significantly associated with higher odds of OIDP (OR 1.91; 95% CI: 1.10-3.31) in the fully adjusted model.

Generally, in Table 4-17, the crude associations remained unchanged throughout the adjustment process. None of the covariates adjusted for contributed to the association between work control and oral health-related quality of life (OHRQoL). Thus, the odds ratios in the fully adjusted model (Model 5) were very similar to odds ratios in the unadjusted Model 1. Additionally, the association between medium control at work and OIDP was marginally non-significant throughout the adjustment process. A strong and robust association was found between low control at work and OIDP. Unlike previous models (sections *4.4.1.1 and 4.4.2.1*), this association was not affected by socio-economic variables. In addition, a significant stepwise association was observed with worse OHRQoL for each group of lower work control (P=0.011). The gradient in

OHRQoL by work control was statistically significant. Similar to the earlier self-rated oral health models (section *4.4.1*), this shows that the association goes through the distribution of the outcome variable and it is not specific to one category of work control.

Table 4-17: Association between psychosocial work environment and OIDP at wave 3 (2006-07): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,854

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: OIDP wave 3 (2006-07)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Control at work	High control (ref)	1	1	1	1	1
	Medium control	1.53 (0.96-2.43)	1.52 (0.96-2.42)	1.51 (0.95-2.42)	1.55 (0.97-2.49)	1.55 (0.97-2.49)
	Low control	1.83 (1.07-3.12)*	1.90 (1.11-3.25)*	1.85 (1.07-3.19)*	1.89 (1.09-3.27)*	1.91 (1.10-3.31)*
Age group	50-54		1	1	1	1
	55-59	-	0.94 (0.58-1.54)	0.93 (0.57-1.53)	0.92 (0.56-1.51)	1.09 (0.65-1.81)
	60-65		0.87 (0.49-1.53)	0.85 (0.48-1.51)	0.83 (0.47-1.47)	0.98 (0.53-1.77)
Gender	Male		1	1	1	1
	Female	-	1.54 (1.03-2.33)*	1.57 (1.04-2.38)*	1.62 (1.07-2.48)*	1.63 (1.07-2.47)*
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.75 (0.35-1.61)	0.74 (0.34-1.61)	0.76 (0.35-1.64)	0.83 (0.38-1.82)
	Divorced / widowed		0.53 (0.21-1.31)	0.53 (0.21-1.31)	0.53 (0.21-1.32)	0.53 (0.21-1.32)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	0.99 (0.59-1.66)	0.99 (0.60-1.67)	0.95 (0.58-1.59)
	No qualification			0.83 (0.40-1.72)	0.84 (0.41-1.74)	0.72 (0.35-1.51)
Income quintile	Lowest			1	1	1
	2			1.05 (0.35-3.17)	1.08 (0.36-3.24)	1.07 (0.35-3.22)
	3	-	-	0.94 (0.36-2.47)	0.98 (0.37-2.57)	1.00 (0.38-2.65)
	4			1.37 (0.56-3.37)	1.43 (0.58-3.52)	1.46 (0.59-3.61)
	Highest			0.97 (0.39-2.42)	1.00 (0.40-2.52)	1.05 (0.42-2.64)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.42 (0.81-2.46)	1.44 (0.83-2.53)
Smoking	Yes					1
	No	-	-	-	-	0.46 (0.29-0.74)**

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.011

4.4.3.2   Quality of work and OIDP

Table 4-18 shows that the crude association between medium quality of work and OIDP was weak and non-statistically significant (OR 1.09; 95% CI: 0.64 -1.85) (Model 1). This remained unchanged throughout the adjustment process. In terms of low quality of work, there was a robust association with higher odds of OIDP. In Model 1, participants with low quality of work were more likely to report at least one OIDP compared to those with a high quality of work (OR 1.91; 95% CI: 1.17-3.11). Adjusting for age, gender and marital status in Model 2 slightly increased the odds ratio to 2.01 (95% CI: 1.23-3.29). In Model 3 and Model 4, when socio-economic factors and employment type were included, the association became stronger with OR 1.98 (95% CI: 1.19-3.26). In the fully adjusted model (Model 5), controlling for smoking status attenuated the odds ratio and the association remained statistically significant (OR 1.91; 95% CI: 1.15-3.15).

Similar to the previous section (*4.4.3.1*), the crude and fully adjusted estimates were the same, which indicates that none of the variables adjusted for had any role in the association between psychosocial work environment and OIDP.

Albeit the association between medium quality of work and oral impacts was clearly non-significant, associations between quality of work levels with oral impacts seemed to be graded: with higher odds of OIDP within each lower level of work control. The p-value for trend was statistically significant (P=0.009), which indicates an association that goes through the distribution of OIDP. The overall picture of this model shows that there is a very weak non-significant association between medium quality of work and reporting oral impacts. However, there is a strong and robust association between low quality of work and OIDP, indicating a very clear difference in terms of OHRQoL between the low quality of work and the rest of the top two categories in the quality of work measure. Similar to the previous section, adjusting for socio-economic variable and other covariates had absolutely no effect on the crude estimates.

Table 4-18: Association between psychosocial work environment and OIDP at wave 3 (2006-07): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,854

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: OIDP wave 3 (2006-07)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Quality of work	High quality (ref)	1	1	1	1	1
	Medium quality	1.09 (0.64-1.85)	1.15 (0.67-1.96)	1.12 (0.65-1.92)	1.13 (0.66-1.95)	1.10 (0.64-1.90)
	Low quality	1.91 (1.17-3.11)*	2.01 (1.23-3.29)*	1.95 (1.18-3.21)**	1.98 (1.19-3.26)**	1.91 (1.15-3.15)*
Age group	50-54		1	1	1	1
	55-59	-	0.95 (0.58-1.55)	0.94 (0.58-1.55)	0.94 (0.57-1.53)	1.10 (0.66-1.84)
	60-65		0.92 (0.52-1.63)	0.91 (0.51-1.61)	0.89 (0.50-1.58)	1.05 (0.58-1.89)
Gender	Male		1	1	1	1
	Female	-	1.61 (1.06-2.43)*	1.62 (1.07-2.45)*	1.67 (1.08-2.58)*	1.66 (1.09-2.53)*
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.77 (0.36-1.67)	0.76 (0.35-1.66)	0.77 (0.36-1.66)	0.85 (0.40-1.87)
	Divorced / widowed		0.54 (0.22-1.35)	0.53 (0.21-1.33)	0.53 (0.21-1.33)	0.53 (0.21-1.34)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	1.05 (0.63-1.75)	1.06 (0.65-1.73)	1.00 (0.61-1.69)
	No qualification			0.87 (0.42-1.79)	0.88 (0.44-1.78)	0.76 (0.37-1.58)
Income quintile	Lowest			1	1	1
	2			1.02 (0.34-3.05)	1.04 (0.34-3.16)	1.05 (0.35-3.19)
	3	-	-	0.93 (0.35-2.44)	0.96 (0.36-2.57)	1.00 (0.38-2.66)
	4			1.30 (0.53-3.21)	1.36 (0.53-3.44)	1.43 (0.56-3.56)
	Highest			0.93 (0.37-2.32)	0.96 (0.38-2.42)	1.03 (0.41-2.60)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.38 (0.79-2.40)	1.38 (0.79-2.40)
Smoking	Yes					1
	No	-	-	-	-	0.48 (0.29-0.76)**

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.009

To recap, there was evidence of a strong significant association between both low work control and low quality of work with OHRQoL. The estimate sizes ranged from OR 1.83 (95% CI: 1.07-3.12) to OR 1.91 (95% CI: 1.15-3.15). These associations were of a graded nature and were not affected by any of the covariates adjusted for. Additionally, medium work control was only marginally significantly associated with OHRQoL, whereas the association with medium quality of work was weak and non-significant.

4.5 Effect modification in the association between psychosocial work environment and oral health

This last section of the cross-sectional analysis examines whether oral health risk factors modified the association between psychosocial work environment and poor oral health outcomes. The final fully adjusted regression model (Model 5) was used to examine the effect modification for the psychosocial work measures by the risk factors (namely, age, gender and socio-economic factors). The association between psychosocial work environment measures variables and oral health outcomes was hypothesised to differ for each category of age, gender, income and education (as explained in *Chapter 3*).

There was some evidence of effect modification by age group and educational level on only two of the oral health outcomes. However, no evidence was found of effect modification for edentate status. Table 4-19 and Table 4-20 present the non-stratified estimates and the stratum-specific odds ratio for each interaction group.

4.5.1 Effect modification for poor self-rated oral health

4.5.1.1 Effect modification by age group

In the stratum-specific analysis, the association between medium and low control at work and poor self-rated oral health was greater in the middle age group (55-59 years old). Medium work control and low work control among participants aged 55-59 years old were associated with higher odds of poor self-rated oral health compared to participants with high work control at the same age group (OR 1.93; 95% CI: 1.27-2.92 and OR 1.83; 95% CI: 1.11-3.04), respectively.

Similarly, the association between medium and low quality of work was greater among participants who were in the middle age group (55-59 years old). The odds ratio of

reporting poor self-rated oral health among participants in the 55-59 years age group was significantly higher in relation to medium quality of work (OR 1.64; 95% CI: 1.03-2.60) and low quality of work (OR 1.73; 95% CI: 1.09-3.04). In contrast, there was no difference in reporting poor self-rated oral health among those in the youngest and the oldest age groups (50-54 years old and 60-65 years old) compared to those with high work control and work quality. Although the age-specific estimates were larger in size when compared to the main effect, these findings should be interpreted with caution, as the largest proportions of participants were 55-59 years old within work control and quality of work categories (detailed previously in Table 4-8 and Table 4-11). Therefore, the interaction effect was significant only for this age group (Table 4-19).

4.5.1.2 *Effect modification by educational level*

The association between work control and poor self-rated oral health appeared to have differential effects by educational level, as individuals with below degree qualifications and medium work control were 1.51 (95% CI: 1.05-2.17) times more likely to report poor self-rated oral health compared to those who had a high sense of control at work.

Additionally, participants with no qualification who had low control at work were 2.22 (95% CI: 1.06-4.67) times more likely to report poor self-rated oral health compared to those who had high sense of control at work.

There was a significant interaction between work quality and education level. Participants with below degree qualification who had low quality of work were more likely to rate their oral health as poor when compared to others in the same educational level and with high quality of work (OR 1.66; 95% CI: 1.11-2.48).

Generally, stratum-specific estimates for education level were larger than the main non-stratified ones. However, no statistically significant difference was found among the participants with degree or no qualifications and low or medium quality of work (Table 4-19).

Table 4-19: Associations of psychosocial work environment measures with poor self-rated oral health at wave 3 (2006-07) stratified by age group and educational level, reporting OR (95% CI)

Predictors wave 3 (2006-07)	Main effect[1]	Poor self-rated oral health at wave 3 (2006-07) OR (95% CI)		
		Interaction groups		
		Age		
		Younger age group (50-54)	Middle age group (55-59)	Oldest age group (60-65)
Control at work				
High control	1	1	1	1
Medium control	1.44 (1.08-1.93)*	1.14 (0.65-1.10)	1.93 (1.27-2.92)*	1.07 (0.59-1.94)
Low control	1.34 (0.93-1.93)	0.75 (0.34-1.66)	1.83 (1.11-3.04)*	1.23 (0.62-2.47)
Quality of work				
High quality	1	1	1	1
Medium quality	1.23 (0.89-1.69)	1.51 (0.79-2.87)	1.64 (1.03-2.60)*	0.62 (0.33-1.14)
Low quality	1.48 (1.08-2.03)*	1.88 (0.99-3.55)	1.73 (1.09-2.74)*	0.94 (0.52-1.72)
		Educational class		
		Degree or equivalent	Below degree	No qualification
Control at work				
High control	1	1	1	1
Medium control	1.44 (1.08-1.93)*	1.60 (0.83-3.11)	1.51 (1.05-2.17)*	1.19 (0.59-2.37)
Low control	1.34 (0.93-1.93)	0.74 (0.25-2.22)	1.22 (0.76-1.96)	2.22 (1.06-4.67)*
Quality of work				
High quality	1	1	1	1
Medium quality	1.23 (0.89-1.69)	1.12 (0.59-2.13)	1.24 (0.82-1.86)	1.38 (0.62-3.08)
Low quality	1.48 (1.08-2.03)*	1.09 (0.55-2.16)	1.66 (1.11-2.48)*	1.44 (0.66-3.15)

[1] fully adjusted model as described in Chapter 3 (from tables 4-13 and 4-14)
p-value for interaction term: * p < 0.05, p ≥ 0.05

4.5.2 Effect modification for Oral Impacts on Daily Performance (OIDP)

4.5.2.1 Effect modification by age group

A significant interaction was found in low control at work and low quality of work with age group. The age-specific analysis showed higher odds of OIDP among the oldest participants (60-65 years old) who had low control at work (OR 2.88; 95% CI: 1.11-7.45) compared to those of the same age who had high sense of control at work.

Similarly, participants who were in the oldest age group and had low quality of work reported 2.10 (95% CI: 1.13-7.42) time more oral impacts compared to their counterparts who had high quality of work (Table 4-20). Both estimates were greater than the main effect of low control and low quality of work on OIDP. Therefore, the

findings suggest that low control and low quality of work had a particularly significant effect on oral impacts among older participants (60-65 years old).

4.5.2.2 Effect modification by educational level

In Table 4-20 there was no significant difference in the association between control at work and OIDP among different educational levels.

However, low quality of work was greatly associated with higher odds of OIDP among participants with below degree qualification in comparison to participants at the same educational level who had a high quality of work (OR 2.41; 95% CI: 1.26-4.63).

Table 4-20: Associations of psychosocial work environment measures with OIDP at wave 3 (2006-07) stratified by age group and educational level, reporting OR (95% CI)

Predictors wave 3 (2006-07)	Main effect	OIDP at wave 3 (2006-07) OR (95% CI)		
		Interaction groups		
		Age		
		Younger age group (50-54)	Middle age group (55-59)	Oldest age group (60-65)
Control at work				
High control	1	1	1	1
Medium control	1.55 (0.97-2.49)	1.69 (0.70-4.06)	1.69 (0.86-3.29)	1.17 (0.42-3.24)
Low control	1.91 (1.10-3.31)*	0.69 (0.15-3.18)	2.06 (0.95-4.47)	2.88 (1.11-7.45)*
Quality of work				
High quality	1	1	1	1
Medium quality	1.10 (0.64-1.90)	2.57 (0.80-8.26)	0.94 (0.44-1.97)	0.57 (0.16-1.10)
Low quality	1.91 (1.15-3.15)*	2.19 (0.66-7.26)	1.52 (0.77-2.10)	2.10 (1.13-7.42)*
		Educational class		
		Degree or equivalent	Below degree	No qualification
Control at work				
High control	1	1	1	1
Medium control	1.55 (0.97-2.49)	2.16 (0.84-5.51)	1.69 (0.95-3.03)	0.53 (0.10-2.71)
Low control	1.91 (1.10-3.31)*	0.57 (0.07-4.44)	1.91 (0.96-3.80)	3.09 (0.93-10.24)
Quality of work				
High quality	1	1	1	1
Medium quality	1.10 (0.64-1.90)	0.74 (0.28-1.94)	1.44 (0.72-2.89)	0.75 (0.10-5.52)
Low quality	1.91 (1.15-3.15)*	0.72 (0.25-2.05)	2.41 (1.26-4.63)*	3.53 (0.74-16.84)

[1] fully adjusted model as described in Chapter 3 (from tables 4-17 and 4-18)
p-value for interaction term: * p < 0.05, p ≥ 0.05

4.5.3 Summary of effect modification analysis

Out of eight different interaction effects examined, only two interactions were found statistically significant in the analysis of effect modification. In the age group-specific analysis, the association of work control and work quality with poor self-rated oral health was greater in the middle-aged group in this analysis (55-59 years), whereas the association of both low control at work and low quality of work with OIDP was greater in the oldest age group (60-65 years).

Regarding educational level, there was a significant association between control at work and self-rated oral health by education levels. Medium sense of work control was associated with higher odds of self-rated oral health among those with a below degree level of qualification, while low control at work was associated with greater poor self-rated oral health among participants with no qualification.

Furthermore, a consistent finding was observed for the association of low quality of work with both poor self-rated oral health and OIDP among participants with below degree qualification attainment. However, these findings need to be interpreted with caution as the number of observations in each cell of the different categories in the stratum-specific analysis was small.

4.5.4 Summary of the cross-sectional association between psychosocial work environment and oral health

This chapter assessed the cross-sectional associations between psychosocial work environment and oral health status in a sample from ELSA. Additionally, the analysis investigated whether theses associations were explained by socio-demographic, socio-economic, work-related and behavioural factors.

The results of this cross-sectional analysis provided some evidence in support of the main hypothesis. Table 4-21 summarises the results of the adjusted regression models for the association between psychosocial work measures and all three oral health outcomes (poor self-rated oral health, edentulousness and OIDP).

In summary, the results suggested that stressful psychosocial work environment was associated with poor oral health status, even after controlling for selected covariates.

The analysis showed that low control at work was only associated with oral impacts on daily performance. Weaker and non-significant associations were found between low

control at work with poor self-rated oral health and edentulousness. The odds ratios for the association between control at work and oral health outcomes ranged from OR 1.44 (95% CI: 1.08-1.93) for self-rated oral health to OR 1.91 (95% CI: 1.10-3.31) for OIDP.

On the other hand, low quality of work was associated with poor self-rated oral health and oral impacts on daily performance. Weaker associations were found between low quality of work with both edentate status and self-rated oral health; however, only the latter was statistically significant. The range of odds ratios for the association between quality of work and oral health outcomes was from OR 1.48 (95% CI: 1.08-2.03) for poor self-rated oral health to OR 1.91 (95% CI: 1.15-3.15) for the association with OIDP.

Except for oral impacts, all associations between psychosocial work environment and oral health decreased when socio-economic factors were adjusted for, and some associations were explained by socio-economic variables (education level and income). However, adjusting for smoking status slightly attenuated the associations between quality of work and self-rated oral health, but it did not explain the link between psychosocial work environment measures and oral health outcomes. Therefore, the preliminary findings of this cross-sectional analysis did not relate to the hypothesised mediating role of smoking on the association between psychosocial work environment and oral health.

Table 4-21: Summary of the association between psychosocial work environment and oral health, OR (95% CI) from the fully adjusted model (Model 5), N=1,854

Psychosocial work environment predictors	Oral health outcomes Odds ratio (95% CI)[1]		
	Poor self-rated oral health	Edentate status	OIDP[2]
Control at work			
Lowest category	1.34 (0.93-1.93)	0.96 (0.51-1.79)	**1.91 (1.10-3.31)***
Quality of work			
Lowest category	**1.48 (1.08-2.03)***	1.16 (0.71-1.91)	**1.91 (1.15-3.15)***

* p < 0.05
[1] odds ratios (95% CI) were from the fully adjusted model (Model 5)
[2] Oral Impacts on Daily Performance

The next chapter will assess the temporal associations between psychosocial work environment and oral health, using longitudinal data from ELSA wave 3 and wave 5.

Chapter 5

The Longitudinal Association Between Psychosocial Work Environment And Oral Health

ELSA Wave 3 (2006-07) and Wave 5 (2010-11)

5.1 Introduction

The results of the previous chapter showed that control at work was significantly associated with the Oral Impacts on Daily Performance (OIDP). Similarly, a significant association was found between quality of work with both self-rated oral health and OIDP. The observed associations were significant even after adjusting for a number of covariates. On the other hand, psychosocial work environment predictors (both work control and quality of work) were not associated with edentate status.

The cross-sectional analysis in the previous chapter did not allow for the assessment of the temporal order between psychosocial work environment measures and oral health outcomes. Therefore, the current chapter examines the longitudinal association between psychosocial work environment at baseline (wave 3; 2006-07) with subsequent oral health outcomes four years later (wave 5; 2010-11), taking into account the associated covariates at wave 3.

The key hypotheses examined in this chapter are:

1. Lower level of work control at baseline was associated with poorer oral health and related quality of life four years later.
2. Higher level of effort-reward imbalance at baseline was associated with poorer oral health and quality of life four years later.
3. The associations between both psychosocial work environment measures at baseline and oral health at follow-up remained significant after adjusting for baseline demographic, socio-economic, work-related variables and health-related behaviours.

For the longitudinal analysis, logistic regression models were used to assess the association between the main exposures and outcomes, adjusted sequentially for covariates. The analytical strategy and adjustment process was consistent with the method employed in the previous analysis and described in detail in *Chapter 3*.

The main sections of the chapter were planned as follows: the initial step was to present the characteristics of missingness in the eligible sample in ELSA wave 3 and wave 5 compared with the analytical sample used in the longitudinal analysis. The second section presents the results of the regression models that assessed the association between psychosocial work environment at wave 3 and oral health at wave 5. Then, the

third section examines the interaction effects between the psychosocial work environment and selected covariates. The final section compares the findings of the longitudinal analysis with the findings of the cross-sectional analysis from *Chapter 4*.

5.2 Longitudinal analytical sample

For the longitudinal analysis, the previous cross-sectional wave 3 analytical sample (from *Chapter 4*) was used as a baseline for the longitudinal analytical sample. The longitudinal analytical sample originated from the baseline wave 3 (N=1,854) from which 312 participants were excluded because of missing values on one of the outcomes of the study (Oral Impacts on Daily Performance) at wave 5. That exclusion resulted in a drop of 16.8% from the baseline sample population. This resulted in N=1,542 participants forming the longitudinal analytical sample. The origin of the longitudinal analytical samples is displayed in Figure 5-1 below and the following section examines the covariates correlated with missing data among the eligible sample of 1,854 participants.

Figure 5-1: The origin of the analytical sample for the longitudinal analysis, wave 3 (2006-07) and wave 5 (2010-11)
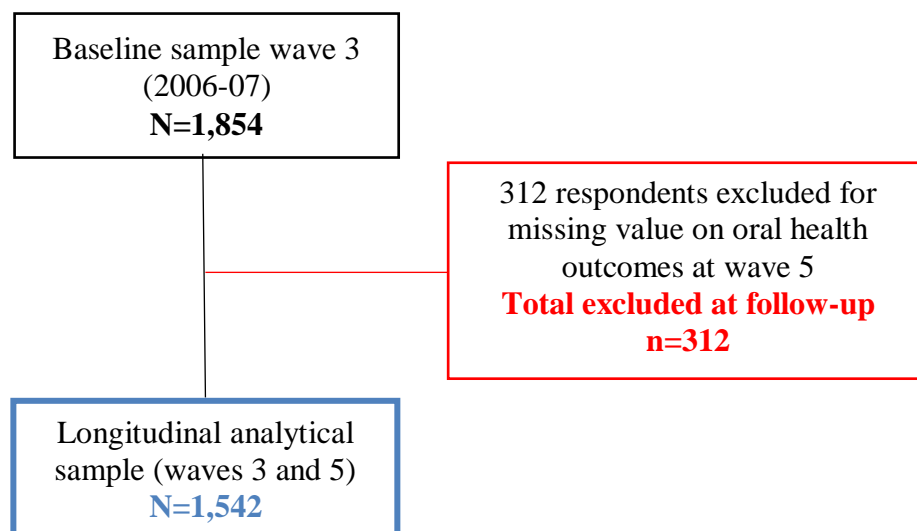
5.2.1 Eligible ELSA wave 3 (2006-07) sample: characteristics of missingness

Table 5-1 examines the number of observations with missing data in the longitudinal analytical sample and the characteristics of the covariates in the eligible ELSA wave 3 sample. It shows that there were differences between the sample of missing participants and the characteristics of the eligible ELSA sample in age, education level and smoking status. Participants not included in the analytical sample were more likely to be younger (P<0.001), with no degree qualification (P=0.001) and smokers (P<0.001).

Table 5-1: Characteristics of missingness in the analytical ELSA sample, wave 3 (2006-07) and wave 5 (2010-11), distribution and p-value (N=1,854)

Covariates at wave 3	n missing/N	% missingness	p-value (χ^2)*
Socio-demographic factors			
Age			
50-54	99/430	32.0%	
55-59	128/912	14.0%	<0.001
60-65	85/512	16.6%	
Gender			
Male	174/947	18.4%	0.069
Female	138.907	15.2%	
Marital status			
Single	9/105	8.6%	
Married / civil partnership	246/1435	17.1%	0.061
Divorced / widowed	57/314	18.2%	
Socio-economic factors			
Educational level			
Degree or equivalent	58/467	12.4%	
Below degree	194/1125	17.2%	0.001
No qualification	60/262	22.9%	
Income quintile			
Lowest	25/113	22.1%	
2	23/147	15.7%	
3	59/337	17.5%	0.322
4	95/527	18.0%	
Highest	110/730	15.1%	
Work-related factors			
Employment status			
Employed	268/1588	16.9%	
Self-employed	44/266	16.5%	0.892

Covariates at wave 3	n missing/N	% missingness	p-value (χ^2)*
Health-related behaviours			
Smoking			
Yes	79/334	23.7%	
No	233/1520	15.3%	<0.001
Oral health status (outcomes)			
Self-rated oral health			
Excellent/Good	262/1543	17.0%	0.698
Fair/Poor	50/311	16.1%	
OIDP			
No impact	297/1751	17.0%	0.527
At least one impact	15/103	14.6%	
Edentulousness			
Dentate			
Edentate	288/1753	16.4%	0.055
	24/101	23.8%	
Psychosocial work measures (predictors)			
Work control			
High	199/1164	17.1%	
Medium	69/441	15.7%	0.731
Low	44/249	17.7%	
Quality of work (ERI)			
High	102/628	16.2%	
Medium	104/643	16.2%	0.573
Low	106/583	18.2%	
Total missing	312/1854	16.8%	-

* P-value for the difference between eligible and analytical sample, using chi-square test

5.3 Results of the longitudinal analysis

The analytical sample for this study was formed from the data of 1,542 ELSA participants who were in paid employment at the time of wave 3 (2006-07) and provided data on oral health outcomes at wave 5 (2010-11). This section presents the results of the logistic regression models for the association between the psychosocial work measures and subsequent oral health outcomes. The interaction between psychosocial work environment with demographic and socio-economic variables is then presented. The cross-sectional models used in Chapter 4 were re-estimated to establish the replicated associations between psychosocial work exposure with oral health outcomes using the longitudinal analytical sample (*Appendix C*).

5.3.1 The distribution of the three oral health outcomes in the longitudinal analytical sample: wave 3 (2006-07) and wave 5 (2010-11)

The cross-tabulations of the oral health outcomes between wave 3 and wave 5 were used to assess changes in the outcomes between those two waves (Table 5-2).

Around 8% of those in good/excellent self-rated oral health in wave 3 reported fair/poor oral health in wave 5. Additionally, half (50.2%) of those in fair/poor oral health improved between wave 3 and wave 5 and nearly half (49.8%) of the sample remained consistently in "poor self-rated oral health" in both waves. The overall prevalence of poor self-rated oral heath was higher in wave 3 (16.9%) compared to wave 5 (15.2%). Edentulousness status remained mostly unchanged between waves 3 and 5, with only 1.1% of the dentate in wave 3 becoming edentate at wave 5. Overall, edentate status was slightly more prevalent in wave 3 (5.4%) in comparison to wave 5 (5%). Regarding Oral Impacts on Daily Performances, 6.9% of those without oral impacts at wave 3 reported an impact at wave 5. On the other hand, 59.1% of those with an oral impact at wave 3 did not report an impact at wave 5 and 40.9% reported at least one oral impact in both waves. Overall, the prevalence of oral impacts was slightly higher in wave 5 (8.8%) compared to wave 3 (5.7%).

Table 5-2: Proportions of oral health outcomes between wave 3 (2006-07) and wave 5 (2010-11), n (%), N=1,542

Self-rated oral health at wave 3	Self-rated oral health at wave 5	
	Excellent/good	**Fair/poor**
Excellent/good	1,176 (91.8)	105 (8.2)
Fair/poor	131 (50.2)	130 (49.8)
Edentate status at wave 3	**Edentate status at wave 5**	
	Dentate	**Edentate**
Dentate	1,465 (98.9)	16 (1.1)
Edentate	n/a	61 (100)
Oral Impacts on Daily Performances at wave 3	**Oral Impacts on Daily Performances at wave 5**	
	No impacts	**One or more impact**
No impacts	1,354 (93.1)	100 (6.9)
One or more impact	52 (59.1)	36 (40.9)

5.3.2 Psychosocial work environment predictors at wave 3 (2006-07) and oral health outcomes at wave 5 (2010-11)

The bivariate associations between the psychosocial work environment predictors at wave 3 and oral health outcomes at wave 5 were examined.

Table 5-3 showed a significant association between adverse psychosocial work environment and poor oral health status in terms of self-rated oral health and oral impacts. Edentate status was marginally non-significantly associated with control at work (Table 5-3).

Table 5-3: The distribution of oral health outcomes at wave 5 (2010-11) by psychosocial work environment predictors at wave 3 (2006-07), n (%), N=1,542

Psychosocial work environment predictors at wave 3 (2006-07)	Oral health outcomes at wave 5 (2010-11)		
	Poor self-rated oral health n=235 (15.2%)	Edentate n=77 (5%)	OIDP[1] n=136 (8.8%)
Control at work			
High control (ref)	133 (13.8)	37 (3.8)	77 (8.0)
Medium control	62 (16.7)	29 (7.8)	35 (9.4)
Low control	40 (19.5)	11 (5.4)	24 (11.7)
p-value for trend	0.024	0.052	0.079
Quality of work (ERI)			
High quality (ref)	67 (12.7)	26 (4.9)	39 (7.4)
Medium quality	76 (14.1)	18 (3.3)	42 (7.8)
Low quality	92 (19.3)	33 (6.9)	55 (11.5)
p-value for trend	0.004	0.171	0.024

[1] Oral Impacts on Daily Performance

The following sections present the results of the logistic regression models for the association between psychosocial work environment predictors at wave 3 and the three oral health outcomes at wave 5. The regression models were set to sequentially adjust for selected covariates (Model 1 to Model 5). The series of regression models followed a consistent pattern, as per the previous chapter. Model 1 was the unadjusted association between psychosocial work environment and oral health; Model 2 adjusted for age, gender and marital status; Model 3 adjusted further for socio-economic factors

(education and income); Model 4 added work type; and then smoking status was added in Model 5. Logistic regression results are presented in the next sections.

In line with the previous cross-sectional analysis, a test for trend was conducted in the fully adjusted models. The psychosocial work exposure measures were added to the regression model as a count variable to obtain the p-value for the significance of any linear trend within work control and quality of work categories.

5.3.3 Psychosocial work environment and self-rated oral health

5.3.3.1 Work control at wave 3 (2006-07) and self-rated oral health at wave 5 (2010-11)

The first unadjusted association (Model 1) in Table 5-4 showed that, compared with those with high sense of control at work, participants with low sense of control at work were 1.52 (95% CI: 1.02-2.24) times more likely to report poor self-rated oral health. The association with low sense of work control was marginally significant, while the respective estimate for those with medium sense of control at work was not statistically significant (OR 1.25; 95% CI: 0.90-1.74).

In Model 2, after adjusting for demographic variables (age, gender and marital status), the association between low work control with poor self-rated oral health was slightly reduced to 1.48 (95% CI: 1.01-2.19) when compared to participants with high control at work. Adjusting for socio-economic status indicators in Model 3, the odds ratio of reporting poor self-rated oral health was further decreased and the association was fully explained by socio-economic factors (OR 1.33; 95% CI: 0.90 -1.99).

Adding the work type measure in the model (Model 4) and smoking status in the fully adjusted model (Model 5) did not change the association between low work control and poor self-rated oral health (OR 1.37; 95% CI: 0.91-2.05).

Generally, Table 5-3 shows that only low sense of control at work was marginally associated with higher odds of poor self-rated oral health. However, this association was attenuated and fully explained by socio-economic position variables. This was interesting because socio-economic position seems to be the only factor that contributes to the association between work control and self-rated oral health (see *Chapter 4*). Furthermore, it is also evident that there was a graded association with higher odds of

poor self-rated oral health for each lower group in terms of control at work. This stepwise pattern did not appear in the cross-sectional analysis (*Chapter 4*).

Table 5-4: Association between psychosocial work environment at wave 3 (2006-07) and poor self-rated oral health at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,542

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: Poor self-rated oral health at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Control at work	High control (ref)	1	1	1	1	1
	Medium control	1.25 (0.90-1.74)	1.25 (0.90-1.74)	1.18 (0.84-1.65)	1.19 (0.85-1.67)	1.19 (0.84-1.67)
	Low control	1.52 (1.02-2.24)*	1.48 (1.01-2.19)*	1.33 (0.90-1.99)	1.35 (0.90-2.02)	1.37 (0.91-2.05)
Age group	50-54		1	1	1	1
	55-59	-	0.67 (0.47-0.95)*	0.66 (0.58-0.93)*	0.66 (0.46-0.93)*	0.74 (0.52-1.06)
	60-65		0.75 (0.51-1.11)	0.72 (0.48-1.06)	0.71 (0.48-1.06)	0.81 (0.54-1.22)
Gender	Male		1	1	1	1
	Female	-	0.82 (0.62-1.09)	0.81 (0.60-1.07)	0.81 (0.61-1.09)	0.81 (0.61-1.09)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.68 (0.40-1.17)	0.66 (0.38-1.14)	0.67 (0.39-1.15)	0.72 (0.42-1.25)
	Divorced / widowed		1.13 (0.62-2.04)	1.09 (0.60-1.99)	1.09 (0.60-1.99)	1.09 (0.59-1.99)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	1.07 (0.75-1.54)	1.08 (0.75-1.55)	1.05 (0.79-1.51)
	No qualification			1.64 (1.02-2.65)*	1.65 (1.02-2.67)*	1.49 (0.91 -2.24)
Income quintile	Lowest			1	1	1
	2			0.92 (0.43-1.98)	0.93 (0.43-2.00)	0.91 (0.42-1.96)
	3	-	-	1.03 (0.53-1.99)	1.05 (0.54-2.03)	1.06 (0.54-2.05)
	4			1.38 (0.74-2.68)	1.41 (0.76-2.65)	1.40 (0.74-2.64)
	Highest			0.90 (0.48-1.69)	0.92 (0.49-1.73)	0.95 (0.50-1.79)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.16 (0.78-1.72)	1.19 (0.80-1.77)
Smoking	Yes					1
	No	-	-	-	-	0.53 (0.37-0.74)***

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.103

5.3.3.2 *Quality of work at wave 3 (2006-07) and self-rated oral health at wave 5 (2010-11)*

In Table 5-5, the results of the unadjusted model (Model 1) show a non-significant association between medium work quality at wave 3 and poor self-rated oral health at wave 5 (OR 1.12; 95% CI: 0.79-1.60). In terms of low work quality, there was a considerably stronger significant association in the unadjusted model. Participants with low quality of work at baseline were 1.64 (95% CI: 1.16-2.30) times more likely to report poor-self-rated oral health, four years later, compared to others with high work quality.

In Model 2, the association between low quality of work and self-rated oral health was slightly decreased to 1.58 (95% CI: 1.12-2.24) but remained robust and statistically significant. Adding the socio-economic indicators in Model 3 attenuated the odds ratio of reporting poor self-rated oral health among participants with low quality of work, but the association remained marginally significant (OR 1.45; 95% CI: 1.02-2.06).

When adding the work-related variable in Model 4, the size of the estimate remained generally the same and statistically significant. Adjustment for smoking status (Model 5) slightly reduced the odds ratio to 1.43 (95% CI: 1.01-2.04) for reporting poor self-rated oral health in participants who had low work quality versus those with high quality in their work.

Overall, this table shows that only low quality of work was significantly associated with poor self-rated oral health throughout the models. Similar to the association with work control, socio-economic position appeared to be the only confounder that attenuated the association with poor self-rated oral health.

Although medium quality of work was not associated with poor self-rated oral health in any model, the association with quality of work seems to follow a stepwise pattern with a higher odds ratio of poor self-rated oral health as work quality gets lower. This graded association was statistically significant (P=0.041).

Table 5-5: Association between psychosocial work environment at wave 3 (2006-07) and poor self-rated oral health at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,542

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: Poor self-rated oral health at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Quality of work	High quality (ref)	1	1	1	1	1
	Medium quality	1.12 (0.79-1.60)	1.08 (0.76-1.55)	1.02 (0.71-1.47)	1.03 (0.72-1.48)	1.02 (0.71-1.46)
	Low quality	1.64 (1.16-2.30)**	1.58 (1.12-2.24)**	1.45 (1.02-2.06)*	1.46 (1.03-2.08)*	1.43 (1.01-2.04)*
Age group	50-54		1	1	1	1
	55-59	-	0.67 (0.47-0.95)*	0.66 (0.45-0.93)*	0.66 (0.46-0.93)*	0.74 (0.52-1.07)
	60-65		0.79 (0.54-1.17)	0.75 (0.50-1.11)	0.74 (0.50-1.10)	0.84 (0.56-1.26)
Gender	Male		1	1	1	1
	Female	-	0.84 (0.63-1.12)	0.82 (0.61-1.09)	0.83 (0.62-1.10)	0.82 (0.61-1.10)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.70 (0.41-1.19)	0.67 (0.39-1.17)	0.68 (0.39-1.17)	0.74 (0.42-1.28)
	Divorced / widowed		1.14 (0.63-2.08)	1.10 (0.60-2.02)	1.10 (0.60-2.02)	1.10 (0.60-2.03)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	1.10 (0.77-1.58)	1.10 (0.77-1.58)	1.08 (0.79-1.55)
	No qualification			1.66 (1.03-2.54)*	1.66 (1.03-2.68)*	1.51 (0.93-2.44)
Income quintile	Lowest			1	1	1
	2			0.90 (0.42-1.94)	0.91 (0.42-1.96)	0.89 (0.41-1.92)
	3	-	-	1.02 (0.53-1.98)	1.04 (0.54-2.02)	1.05 (0.54-2.04)
	4			1.35 (0.72-2.52)	1.37 (0.73-2.58)	1.37 (0.73-2.59)
	Highest			0.88 (0.47-1.66)	0.89 (0.47-1.69)	0.93 (0.49-1.76)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.13 (0.76-1.68)	1.16 (0.78-1.72)
Smoking	Yes					1
	No	-	-	-	-	0.53 (0.38-0.75)***

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.041

In summary, the association between low sense of work control and poor self-rated oral health was confounded by socio-economic position. On the other hand, there was evidence that low quality of work was associated with subsequent poor self-rated oral health. This association appeared to be independent of socio-demographic, socio-economic, work-related and behavioural factors.

5.3.4 Psychosocial work environment and edentulousness

This section presents the results of the logistic regression models for the association between psychosocial work environment measures at wave 3 and edentulousness at wave 5.

5.3.4.1 *Work control at wave 3 (2006-07) and edentate status at wave 5 (2010-11)*

The unadjusted model (Model 1) in Table 5-6 shows that medium control at work was significantly associated with higher odds of being edentate (OR 2.12; 95% CI: 1.28-3.50), whereas the association between low sense of work control and edentate status was not statistically significant (OR 1.42; 95% CI: 0.71-2.84). It is important to note here that the association between edentulousness and medium control at work was stronger than the association with low control at work. This is an unusual finding, although it was in line with the previous findings from the cross-sectional analysis (*Chapter 4*). This finding was partially due to the sample distribution of the edentulousness by work control categories (in Table 5-2), which revealed that there were a very small number of edentates in the low control at work group in comparison to the other two groups. In the longitudinal analysis, the sample size is smaller than the sample analysed in the cross-sectional analysis. Thus, the issue of small numbers for some of the categories was especially clear in this analysis.

Adjusting for age, gender and marital status (Model 2) did not significantly change the odds ratio for the association between medium control at work and edentulousness. Including the socio-economic variables (Model 3) largely reduced the size of the association between medium control at work and edentate status (OR 1.75; 95% CI: 1.04-2.94), but the association remained statistically significant.

After adjusting for work type and smoking, the odds ratio of being edentate among those with medium work control was slightly reduced to OR 1.70 (95% CI: 1.00-2.86), and became marginally non-significant (Table 5-6).

Table 5-6: Association between psychosocial work environment at wave 3 (2006-07) and edentulousness at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,542

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: Edentate status at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Control at work	High control (ref)	1	1	1	1	1
	Medium control	2.12 (1.28-3.50)**	2.13 (1.28-3.53)**	1.75 (1.04-2.94)*	1.73 (1.03-2.91)*	1.70 (1.00-2.86)
	Low control	1.42 (0.71-2.84)	1.39 (0.69-2.79)	1.01 (0.54-2.24)	1.09 (0.53-2.22)	1.11 (0.54-2.26)
Age group	50-54		1	1	1	1
	55-59	-	1.28 (0.63-2.61)	1.20 (0.58-2.46)	1.20 (0.59-2.46)	1.46 (0.69-3.04)
	60-65		3.06 (1.51-6.19)**	2.70 (1.32-5.51)**	2.72 (1.33-5.55)**	3.13 (1.59-6.91)**
Gender	Male	-	1	1	1	1
	Female		1.54 (0.96-2.49)	1.37 (0.84-2.23)	1.35 (0.83-2.21)	1.36 (0.83-2.22)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.53 (0.23-1.21)	0.48 (0.20-1.15)	0.48 (0.20-1.14)	0.51 (0.21-1.21)
	Divorced / widowed		0.66 (0.25-1.69)	0.59 (0.22-1.57)	0.59 (0.23-1.57)	0.57 (0.21-1.51)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	3.71 (1.43-9.61)**	3.70 (1.43-9.58)**	3.58 (1.38-9.29)**
	No qualification			6.36 (2.26-17.90)***	6.31 (2.24-17.78)***	5.54 (1.96-15.71)**
Income quintile	Lowest			1	1	1
	2			1.85 (0.56-6.06)	1.83 (0.56-5.99)	1.74 (0.53-5.75)
	3	-	-	1.48 (0.48-4.59)	1.45 (0.47-4.51)	1.41 (0.45-4.43)
	4			1.16 (0.38-3.57)	1.14 (0.37-3.50)	1.09 (0.35-3.40)
	Highest			0.91 (0.29-2.86)	0.89 (0.28-2.81)	0.89 (0.28-2.83)
Employment status	Employed	-	-	-	1	1
	Self-employed				0.84 (0.40-1.76)	0.87 (0.41-1.82)
Smoking	Yes	-	-	-	-	1
	No					0.45 (0.26-0.77)**

* $p < 0.05$, ** $p < 0.01$, *** $p \leq 0.001$, $p \geq 0.05$

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^ P-value for trend = 0.352

5.3.4.2 *Quality of work at wave 3 (2006-07) and edentate status at wave 5 (2010-11)*

Results from Table 5-7 shows that quality of work at wave 3 was not associated with edentate status at wave 5. The unadjusted model (Model 1) shows that participants who had medium quality of work were 0.66 times less likely to be edentate (95% CI: 0.36-1.23). Additionally, respondents who had low quality of work were 1.43 times more likely to be edentate (95% CI: 0.84-2.43) when compared to respondents who had high quality of work.

Adjusting for covariates in models 2, 3, 4 and 5 slightly decreased the odds ratio to 0.65 (95% CI: 0.34-1.22) for medium control at work and 1.37 (95% CI: 0.78-2.39) for low quality of work. Although adjusting for socio-economic position in Model 3 made some contribution to the associations, the odds ratio remained statistically non-significant.

Table 5-7: Association between psychosocial work environment at wave 3 (2006-07) and edentulousness at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,542

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: Edentate status at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Quality of work	High quality (ref)	1	1	1	1	1
	Medium quality	0.66 (0.36-1.23)	0.70 (0.38-1.31)	0.66 (0.35-1.24)	0.66 (0.35-1.23)	0.65 (0.34-1.22)
	Low quality	1.43 (0.84-2.43)	1.62 (0.95-2.78)	1.46 (0.84-2.54)	1.47 (0.83-2.53)	1.37 (0.78-2.39)
Age group	50-54		1	1	1	1
	55-59	-	1.25 (0.61-2.54)	1.14 (0.56-2.33)	1.14 (0.56-2.33)	1.38 (0.66-2.88)
	60-65		3.16 (1.56-6.39)**	2.68 (1.31-5.47)**	2.69 (1.32-5.52)**	3.25 (1.56-6.79)**
Gender	Male	-	1	1	1	1
	Female		1.58 (0.98-2.55)	1.41 (0.86-2.30)	1.39 (0.85-2.27)	1.38 (0.84-2.25)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.58 (0.25-1.33)	0.54 (0.23-1.28)	0.54 (0.22-1.27)	0.57 (0.24-1.36)
	Divorced / widowed		0.70 (0.27-1.82)	0.64 (0.24-1.69)	0.64 (0.24-1.70)	0.61 (0.23-1.62)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	3.88 (1.50-10.02)**	3.85 (1.49-9.94)**	3.70 (1.43-9.59)**
	No qualification			6.50 (2.32-18.22)***	6.43 (2.29-18.04)***	5.64 (1.99-15.92)**
Income quintile	Lowest			1	1	1
	2			1.74 (0.53-5.71)	1.70 (0.52-5.60)	1.66 (0.50-5.52)
	3	-	-	1.39 (0.45-4.34)	1.35 (0.43-4.22)	1.34 (0.42-4.21)
	4			1.05 (0.34-3.22)	1.01 (0.32-3.12)	1.00 (0.32-3.12)
	Highest			0.80 (0.25-2.53)	0.78 (0.25-2.46)	0.79 (0.24-2.52)
Employment status	Employed	-	-	-	1	1
	Self-employed				0.78 (0.38-1.63)	0.80 (0.38-1.68)
Smoking	Yes	-	-	-	-	1
	No					0.46 (0.26 (0.79)**

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.237

To summarise, there was some evidence that medium control at work at wave 3 was associated with edentulousness at follow-up wave 5. However, this association became marginal after adjusting for socio-economic status and it was explained by smoking. Quality of work at wave 3 was not significantly associated with follow-up edentulousness. It is important to keep in mind that the results for edentulousness need to be interpreted carefully due to the small prevalence of edentulousness in the analytical sample.

5.3.5 Psychosocial work environment and Oral Impacts on Daily Performance (OIDP)

Table 5-8 and Table 5-9 below demonstrates the results of the logistic regression models for the association between psychosocial work environment measures at wave 3 and OIDP at follow-up (wave 5).

5.3.5.1 *Work control at wave 3 (2006-07) and OIDP at wave 5 (2010-11)*

Table 5-8 shows that medium sense of control at work at wave 3 was non-significantly associated with reporting at least one oral impact on daily performance at wave 5 (OR 1.19; 95% CI: 0.78-1.82). Additionally, low sense of control at work at wave 3 was not statistically associated with OIDP at wave 5 (OR 1.53; 95% CI: 0.94-2.48).

Both associations remained non-significant throughout the adjustment process (Model 2 to Model 5). In the fully adjusted model, the estimates for OIDP did not change for medium control at work and low control at work with OR 1.18 (95% CI: 0.77-1.82) and OR 1.55 (95% CI: 0.94-2.55), respectively (Table 5-8).

Overall, there was a notable stepwise pattern in the odds ratio of OIDP through work control categories. However, the p-value for trend was not statistically significant (P=0.087). Similar to the previous cross-sectional analysis (*Chapter 4*), the adjustment process had no effect on the estimates for oral health-related quality of life (OHRQoL) measure in relation to work control and therefore the unadjusted (Model 1) and the fully adjusted (Model 5) were very similar.

Table 5-8: Association between psychosocial work environment at wave 3 (2006-07) and OIDP at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,542

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: OIDP at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Control at work	High control (ref)	1	1	1	1	1
	Medium control	1.19 (0.78-1.82)	1.19 (0.78-1.81)	1.16 (1.75-1.77)	1.19 (0.77-1.82)	1.18 (0.77-1.82)
	Low control	1.53 (0.94-2.48)	1.55 (0.95-2.53)	1.50 (0.91-2.46)	1.54 (0.93-2.53)	1.55 (0.94-2.55)
Age group	50-54		1	1	1	1
	55-59	-	0.72 (0.47-1.11)	0.69 (0.45-1.07)	0.69 (0.45-1.06)	0.73 (0.47-1.14)
	60-65		0.73 (0.44-1.19)	0.67 (0.41-1.11)	0.66 (0.40-1.09)	0.70 (0.42-1.17)
Gender	Male		1	1	1	1
	Female	-	1.32 (0.92-1.89)	1.30 (0.90-1.87)	1.33 (0.92-1.92)	1.33 (0.92-1.92)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.97 (0.47-2.00)	0.85 (0.41-1.77)	0.85 (0.41-1.77)	0.88 (0.42-1.85)
	Divorced / widowed		1.08 (0.48-2.41)	1.00 (0.44-2.26)	1.00 (0.44-2.26)	1.00 (0.44-2.26)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	1.38 (0.86-2.21)	1.39 (0.87-2.22)	1.37 (0.85-2.19)
	No qualification			1.71 (0.91-3.22)	1.73 (0.92-3.26)	1.64 (0.86-3.09)
Income quintile	Lowest			1	1	1
	2			3.53 (0.96-12.90)	3.61 (0.98-13.24)	3.56 (0.97-13.08)
	3	-	-	2.91 (0.85-10.01)	3.03 (0.88-10.42)	3.03 (0.88-10.47)
	4			3.39 (1.01-11.38)*	3.55 (1.06-11.93)*	3.53 (1.05-11.88)*
	Highest			3.65 (1.09-12.17)*	3.82 (1.14-12.77)*	3.86 (1.15-12.95)*
Employment status	Employed				1	1
	Self-employed	-	-	-	1.36 (0.83-2.22)	1.37 (0.83-2.24)
Smoking	Yes					1
	No	-	-	-	-	0.72 (0.46-1.13)

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.087

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5.3.5.2   Quality of work at wave 3 (2006-07) and OIDP at wave 5 (2010-11)

Table 5-9 shows that low quality of work was associated with the subsequent experience of OIDP. Participants with low quality of work at baseline were more likely to report at least one OIDP compared to those with those with high quality of work (OR 1.63; 95% CI: 1.06-2.50). On the other hand, medium quality of work was not significantly associated with OIDP (OR 1.05; 95% CI: 0.67-1.66).

When adjusting covariates in Model 2 to the fully adjusted model (Model 5), the association between low quality of work and OIDP did not substantially change in size and remained statistically significant, with participants who had low quality of work at wave 3 OR 1.65 (95% CI: 1.06-2.57) times more likely to report at least one OIDP at wave 5.

In general, the association between quality of work and OIDP showed a very similar picture as for the sense of work control and OIDP. There was a fairly consistent association between quality of work and OIDP throughout the adjustment process. The odds ratio of OIDP in relation to low quality of work did not change between Model 1 and Model 5. The crude association remained unchanged throughout the adjustment process and, as a result, the fully adjusted estimates were very similar to the crude ones. Only a small change occurred in the estimates for medium quality of work, although the association was not statistically significant. This means that none of the covariates adjusted for played any part in the association between quality of work and OHRQoL.

Similar to the earlier cross-sectional analyses (*Chapter 4*), there was a stepwise pattern in the association between quality of work and OHRQoL, with higher odds ratio of OIDP in the lowest quality of work category throughout the analysis. Although the associations in the medium quality of work category were clearly non-significant, the gradient in OHRQoL by quality of work was statistically significant (P=0.024).

Table 5-9: Association between psychosocial work environment at wave 3 (2006-07) and OIDP at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,542

Predictors (psychosocial work environment) wave 3 (2006-07)		Dependent variable: OIDP at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Quality of work	High quality (ref)	1	1	1	1	1
	Medium quality	1.05 (0.67-1.66)	1.06 (0.67-1.68)	1.08 (0.68-1.71)	1.10 (0.69-1.74)	1.10 (0.68-1.73)
	Low quality	1.63 (1.06-2.50)*	1.65 (1.07-2.55)*	1.63 (1.05-2.54)*	1.66 (1.07-2.59)*	1.65 (1.06-2.57)*
Age group	50-54		1	1	1	1
	55-59	-	0.72 (0.47-1.11)	0.69 (0.45-1.07)	0.69 (0.45-1.07)	0.73 (0.47-1.14)
	60-65		0.77 (0.47-1.26)	0.71 (0.43-1.17)	0.70 (0.42-1.15)	0.74 (0.44-1.23)
Gender	Male		1	1	1	1
	Female	-	1.35 (0.94-1.94)	1.33 (0.92-1.92)	1.37 (0.95-1.98)	1.36 (0.94-1.97)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.99 (0.48-2.06)	0.86 (0.41-1.18)	0.86 (0.41-1.79)	0.89 (0.43-1.87)
	Divorced / widowed		1.10 (0.49-2.48)	1.01 (0.45-2.28)	1.00 (0.44-2.27)	1.01 (0.44-2.27)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	1.43 (0.89-2.28)	1.44 (0.90-2.30)	1.42 (0.89-2.27)
	No qualification			1.74 (0.93-3.26)	1.76 (0.94-3.30)	1.67 (0.89-3.15)
Income quintile	Lowest			1	1	1
	2			3.43 (0.94-12.59)	3.54 (0.96-12.99)	3.51 (0.95-12.93)
	3	-	-	2.90 (0.84-9.98)	3.02 (0.87-10.44)	3.04 (0.88-10.54)
	4			3.29 (0.98-11.07)	3.46 (1.02-11.67)*	3.47 (1.03-11.74)*
	Highest			3.59 (1.07-12.02)*	3.77 (1.12-12.67)*	3.84 (1.14-12.95)*
Employment status	Employed				1	1
	Self-employed	-	-	-	1.34 (0.82-2.20)	1.35 (0.82-2.21)
Smoking	Yes					1
	No	-	-	-	-	0.73 (0.47-1.16)

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for trend = 0.024

To summarise, the findings showed evidence that low work quality at wave 3 was associated with increased odds of OIDP at wave 5. This association was consistent even after adjusting for demographic variables, socio-economic factors, work-related measures and behavioural factors. However, work control at wave 3 was not significantly associated with oral impacts at wave 5. Generally, none of the associations between quality of work and OIDP were affected by any of the covariates during the adjustment process.

5.4 Effect modification in the association between psychosocial work environment and oral health

Findings from the cross-sectional analysis showed statistically significant interaction with age and education level (*Chapter 4*). This section examines whether covariates modify the association between psychosocial work environment at wave 3 and subsequent poor oral health at wave 5. In line with the previous analysis, this was investigated by examining effect modification for the psychosocial work measures by age group, education level and income quintile. In the longitudinal analysis, only three interaction terms with age and educational level significantly predicted higher odds of poor self-rated oral health and OIDP at wave 5. There was no evidence of effect modification for edentate status.

5.4.1 Effect modifications for poor self-rated oral health

5.4.1.1 *Effect modification by age group*

For effect modification by age, the association between low sense of work control and poor self-rated oral health was greater among participants in the oldest age group (60-65 years old) when compared to the pooled estimate. Participants who were in the oldest age group and had low work control at wave 3 were 2.05 (95% CI: 1.04-4.04) times more likely to report poor self-rated oral health at wave 5 compared to participants at the same age group with high sense of control at work. However, the pooled estimates for the association between work control and poor self-rated oral health was not statistically significant (Table 5-10).

In contrast, being in the oldest age group appeared to be protective against poor self-rated oral health in relation to quality of work. The age-specific analysis showed that participants at the oldest age group who had reported medium quality of work at wave 3 were less likely to report poor oral health at wave 5, compared to older participants with high quality of work (OR 0.46; 95% CI: 0.23-0.91). On the other hand, marginally non-significant associations were found for greater odds of reporting poor self-rated oral health among those in the middle age group (55-59 years old) with medium and low quality of work. The odds ratio of reporting poor self-rated oral health among participants in the 55-59 years age group was higher in relation to medium quality of work (OR 1.70; 95% CI: 0.99 -2.91) and low quality of work (OR 1.64; 95% CI: 0.95-2.81) when compared to those with high quality of work (Table 5-9). Similar interactions were found in the cross-sectional analysis (*Chapter 4*), although the associations were statistically significant.

Table 5-10: Associations of psychosocial work environment measures at wave 3 (2006-07) with poor self-rated oral health at wave 5 (2010-11) stratified by age group, reporting OR (95% CI)

	Poor self-rated oral health at wave 5 (2010-11) OR (95% CI)			
		Interaction groups		
Predictors wave 3 (2006-07)		Age		
	Main effect[1]	Younger age group (50-54)	Middle age group (55-59)	Oldest age group (60-65)
Control at work				
High control	1	1	1	1
Medium control	1.19 (0.84-1.67)	1.25 (0.59-2.13)	1.43 (0.87-2.33)	0.88 (0.45-1.77)
Low control	1.37 (0.91-2.05)	0.42 (0.14-1.28)	1.57 (0.88-2.82)	2.05 (1.04-4.04)*
Quality of work				
High quality	1	1	1	1
Medium quality	1.02 (0.71-1.46)	1.04 (0.49-2.21)	1.70 (0.99-2.91)	0.46 (0.23-0.91)*
Low quality	1.43 (1.01-2.04)*	1.87 (0.91-3.86)	1.64 (0.95-2.81)	1.03 (0.54-1.93)

[1] fully adjusted model as described in Chapter 3 (from tables 5-3 and 5-4)
p-value for interaction term: * p < 0.05, p ≥ 0.05

5.4.2   Effect modification for Oral Impacts on Daily Performance (OIDP)

5.4.2.1   *Effect modification by education level*

Among individuals with below degree and no educational qualifications, those with low quality of work at wave 3 were 2.80 (95% CI: 1.18-6.64) and 4.90 (95% CI: 1.82-13.19)

times more likely to report oral impacts at wave 5, respectively, when compared to those who had a high quality of work.

Similar results were found in the cross-sectional analysis in terms of the interaction term with the below degree qualification category. On the other hand, there was no difference in OIDP at wave 5 among participants with degree qualification and low quality of work at wave 3.

Table 5-11: Associations of quality of work categories at wave 3 (2006-07) with OIDP at wave 5 (2010-11) stratified by education level, reporting OR (95% CI)

Predictors wave 3 (2006-07)	OIDP at wave 5 (2010-11) OR (95% CI)			
		Interaction groups		
	Main effect[1]	**Educational level**		
		Degree or equivalent	**Below degree**	**No qualification**
Quality of work				
High quality	1	1	1	1
Medium quality	1.10 (0.68-1.73)	2.10 (0.80-5.40)	1.81 (0.74-4.37)	1.24 (0.34-4.53)
Low quality	1.65 (1.06-2.57)*	1.48 (0.52-4.27)	2.80 (1.18-6.64)*	4.90 (1.82-13.19)*

[1] fully adjusted model as described in Chapter 3 (from table 5-8)
p-value for interaction term: * p < 0.05, p ≥ 0.05

5.4.3 Summary of effect modification analysis

Three interactions terms were significantly associated with higher odds of poor oral health and quality of life in the analysis of effect modification. In the age-specific analysis, different results were found for the association between each psychosocial work exposure and self-rated oral health by age. The association between low control at work at wave 3 and poor self-rated oral health at wave 5 was greater among individuals who were in the oldest age group (60-65 years) at wave 3. In contrast, the association between medium quality of work at wave 3 and poor self-rated oral health at wave 5 was reduced among individuals who were in the oldest age group (60-65 years old) at wave 3. Therefore, being in the oldest age group appeared to increase the effect of low sense of work control on poor self-rated oral health. On the other hand, medium sense of control at work appeared to buffer the effect of being in the oldest age group on poor self-rated oral health.

When stratifying by the education level, low quality of work at wave 3 was associated with higher odds of oral impacts at wave 5 among participants educated at below degree level and those with no educational qualifications. The estimates for these education-specific associations were greater than the non-stratified association between low quality of work and OIDP.

5.4.4 Summary of the association between psychosocial work environment at wave 3 (2006-07) and oral health status at wave 5 (2010-11)

To summarise, this chapter examined the longitudinal associations between psychosocial work environment at wave 3 (2006-07) and oral health status at wave 5 (2010-11) in an ELSA sample of employed participants. The results showed a different pattern of associations between psychosocial work environment measures and oral health. For instance, with regard to control at work and wave 3 and oral health outcomes at wave 5, medium sense of control at work at wave 3 was only associated with edentate status at wave 5 with higher odds compared to high sense of control at work at wave 3. After adjusting for socio-economic status in Model 3, the association became marginally significant. Then, adjusting for smoking status (Model 5), medium control at work was no longer associated with edentate status. Weaker and non-significant associations were found between both medium and low control at work with poor self-rated oral health and OIDP at wave 5.

With regard to work quality, low quality of work at wave 3 was significantly associated with poor self-rated oral health and oral impacts at wave 5. A slightly smaller and non-significant association found between low quality of work and edentate status at wave 5.

The size of the association between psychosocial work environment measures and oral health differed when adjusting for different covariates. The socio-economic factors of education and income explained most of the association between psychosocial work environment measures at wave 3 and the oral health measures at follow-up wave 5. The size of associations between psychosocial work environment measures at wave 3 and oral health at follow-up (wave 5) decreased largely after introducing the socio-economic variables into the regression model. Socio-economic factors attenuated the associations between psychosocial work environment measures with self-rated oral health and edentulousness and explained the association between low work control and poor self-rated oral health. This suggests that the socio-economic factors included in the analysis

could be important confounders of the association between psychosocial work environment measures and oral health status. However, the association between psychosocial work environment with oral health-related quality of life measure (OIDP) did not change when adjusting for socio-economic indicator variables.

Additionally, only one finding of the longitudinal analysis partially supports the hypothesised behavioural pathway between psychosocial work environment and oral health. That is, smoking status at wave 3 explained the association between medium work control at wave 3 and edentate status at wave 5. Accordingly, socio-economic status and smoking appeared to be important factors in the associations between psychosocial work environment and oral health.

Among the covariates measured at wave 3, smoking was positively associated with self-rated oral health at wave 5. Additionally, age, educational level and smoking at wave 3 were positively associated with edentate status. Finally, income at wave 3 was positively associated with OIDP at wave 5.

Table 5-12 below summarises the results of the fully adjusted regression models for the association between psychosocial work measures at baseline and all three oral health outcomes at follow-up.

Table 5-12: Summary of the association between psychosocial work environment at wave 3 (2006-07) and oral health outcomes at wave 5 (2010-11), OR (95% CI) from the fully adjusted model (from Model 5), N=1,542

Psychosocial work environment predictors at wave 3 (2006-07)	Oral health outcomes at wave 5 (2010-11) Odds ratio (95% CI)[1]		
	Poor self-rated oral health	Edentate status	OIDP[2]
Control at work			
Lowest tertile	1.37 (0.91-2.05)	1.11 (0.54-2.26)	1.55 (0.94-2.55)
Quality of work			
Lowest tertile	**1.43 (1.01-2.04)***	1.37 (0.78-2.39)	**1.65 (1.06-2.57)***

* p <0.05
[1] odds ratios (95% CI) were from the fully adjusted model
[2] Oral Impacts on Daily Performance

5.5 Comparison between cross-sectional and longitudinal analysis

To review the main findings for the association between psychosocial work measures and oral health, a comparison between the cross-sectional and longitudinal findings is presented in tables 5-13, 5-15 and 5-15. The odds ratios presented in the tables correspond to the final models that have been adjusted for all covariates (demographic, socio-economic, and health-related behaviour).

5.5.1 Psychosocial work environment and poor self-rated oral health

There were no differences in cross-sectional and longitudinal results in relation to self-rated oral health. The cross-sectional analysis found that participants who had low sense of work control had greater odds of reporting poor oral health compared to those with high work control (OR 1.34; 95% CI: 0.93-1.93), but the difference was not statistically significant. Similarly, a non-significant association between low sense of work control at wave 3 and poor self-rated oral health at wave 5 was found in the longitudinal analysis with similar estimates (OR 1.37; 95% CI: 0.91-2.05).

Low quality of work was significantly associated with higher odds of poor self-rated oral health in the cross-sectional analysis (OR 1.48; 95% CI: 1.08 -2.03). In the longitudinal analysis, a similar association was found between low quality of work at wave 3 and poor self-rated oral health at wave 5 (OR 1.43; 95% CI: 1.01-2.04).

Table 5-13: Comparison of cross-sectional and longitudinal odds ratios for poor self-rated oral health by baseline psychosocial work environment, OR (95% CI)

Psychosocial work environment measures at wave 3	Cross-sectional association (wave 3)	Longitudinal association (wave 3 / 5)
	Poor self-rated oral health at wave 3 Odds ratio (95% CI)[1]	Poor self-rated oral health at wave 5 Odds ratio (95% CI)[2]
Control at work		
Lowest tertile	1.34 (0.93-1.93)	1.37 (0.91-2.05)
Quality of work		
Lowest tertile	**1.48 (1.08-2.03)***	**1.43 (1.01-2.04)***

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05
[1] odds ratios (95% CI) from the fully adjusted cross-sectional model
[2] odds ratios (95% CI) from the fully adjusted longitudinal model

5.5.2 Psychosocial work environment and edentate status

For edentate status as the outcome (Table 5-14), the cross-sectional and longitudinal results were similar. Being in the lowest tertile of work control and work quality were not associated with edentulousness in both analyses.

Table 5-14: Comparison of cross-sectional and longitudinal odds ratios for edentate status by baseline psychosocial work environment, OR (95% CI)

Psychosocial work environment measures at wave 3	Cross-sectional association (wave 3)	Longitudinal association (wave 3 / 5)
	Edentulousness at wave 3 Odds ratio (95% CI)[1]	Edentulousness at wave 5 Odds ratio (95% CI)[2]
Control at work		
Lowest tertile	0.96 (0.51-1.79)	1.11 (0.54-2.26)
Quality of work		
Lowest tertile	1.16 (0.71-1.91)	1.37 (0.78-2.39)

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05
[1] odds ratios (95% CI) from the fully adjusted cross-sectional model
[2] odds ratios (95% CI) from the fully adjusted longitudinal model

5.5.3 Psychosocial work environment Oral Impacts on Daily Performances (OIDP)

Regarding the Oral Impacts on Daily Performances outcome (Table 5-15), having low sense of control at work was associated with oral impacts in the cross-sectional analysis but the association was weaker and not statistically significant in the longitudinal analysis.

On the other hand, low quality of work was consistently associated with greater odds of oral impacts in both the cross-sectional and the longitudinal analyses. The odds ratio for oral impacts was smaller in the longitudinal analysis (OR 1.65; 95% CI: 1.06-2.57) compared to that for the cross-sectional analysis (OR 1.91; 95% CI: 1.15-3.15).

Table 5-15: Comparison of cross-sectional and longitudinal odds ratios for Oral Impacts on Daily Performance by baseline psychosocial work environment, OR (95% CI)

Psychosocial work environment measures at wave 3	Cross-sectional association (wave 3)	Longitudinal association (wave 3 / 5)
	Oral Impacts on Daily Performance at wave 3 Odds ratio (95% CI)[1]	**Oral Impacts on Daily Performance at wave 5** Odds ratio (95% CI)[2]
Control at work		
Lowest tertile	**1.91 (1.10-3.31)***	1.55 (0.94-2.55)
Quality of work		
Lowest tertile	**1.91 (1.15-3.15)***	**1.65 (1.06-2.57)***

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05
[1] odds ratios (95% CI) from the fully adjusted cross-sectional model
[2] odds ratios (95% CI) from the fully adjusted longitudinal model

Although the analytical samples were not the same across these comparisons, the previous Tables showed that the results were very similar in relation to self-rated oral health and edentulousness.

The next chapter assesses the association between repeated exposure to adverse psychosocial work environment at wave 3 and wave 4 in relation to subsequent oral health at wave 5.

Chapter 6

The Longitudinal Association Between Repeated Exposure to Adverse Psychosocial Work Environment And Oral Health

ELSA Wave 3 (2006-07), Wave 4 (2008-09) and Wave 5 (2010-11)

6.1 Introduction

This chapter examines the longitudinal association between repeated measures of psychosocial work environment (at two time points; wave 3 in 2006-07 and wave 4 in 2008-09) with subsequent oral health outcomes at wave 5 (2010-11). This analysis was conducted to identify participants who are chronically exposed to work stress and assess whether they potentially have higher risk of poor oral health status.

The analysis in the previous chapter assessed the association between a single measurement of the predictors (psychosocial work environment variables) and subsequent oral health outcomes. Therefore, this chapter takes into account the association between repeated measurements of psychosocial work environment at two consequent waves with oral health status at the following wave.

The key hypotheses to be examined in this chapter are:
1. There was an association between work control at waves 3 and 4 with poorer oral health and oral health-related quality of life at wave 5.
2. There was an association between quality of work at waves 3 and 4 with poorer oral health and oral health-related quality of life at wave 5.
3. The associations between repeated exposure to low control and low quality of work at waves 3 and 4 with oral health at wave 5 remain significant after adjusting for demographic, socio-economic, work-related variables and health-related behaviours at wave 3.

For this part of the analysis, logistic regression models were used and adjustment for covariates process was completed in accordance with the method used in the previous analyses (see *Chapter 4*). The chapter was also planned in line with previous chapters: the first part describes the characteristics of the analytical sample and the characteristics of missingness in the eligible sample in comparison with the analytical sample. The second part presents the results of the regression models that assessed the association between the predictors and the outcomes. The third part examines the interaction effects between the predictors and selected covariates. The final part summarises the results of the analysis.

6.2 Analytical sample from ELSA wave 3 (2006-07), wave 4 (2008-09) and wave 5 (2010-11)

The analytical sample was originated from the wave 3 eligible ELSA sample of 1,854 participants (see *Chapter 4*). From the eligible sample, 725 participants were excluded for different reasons: n=170 because of attrition (lost to follow-up between wave 3 and wave 4) or they did not complete the wave 4 questionnaire, n=555 had incomplete or missing values on predictors at wave 4, n=14 were no longer in employment at wave 4 while a further 71 participants were excluded for missing values on outcomes at wave 5. Overall, 796 participants were excluded, a drop of 42.9% from the eligible wave 3 sample. The total analytical sample used in this chapter contained N=1,058 participants. It included participants who had complete data for the main predictors at waves 3 and 4 and the main outcomes at wave 5. The flowchart for analytical sample is presented in Figure 6-1 below.

Figure 6-1: The origins of the longitudinal analytical sample, measuring predictors at wave 3 (2006-07) and wave 4 (2008-09) and outcomes at wave 5 (2010-11)
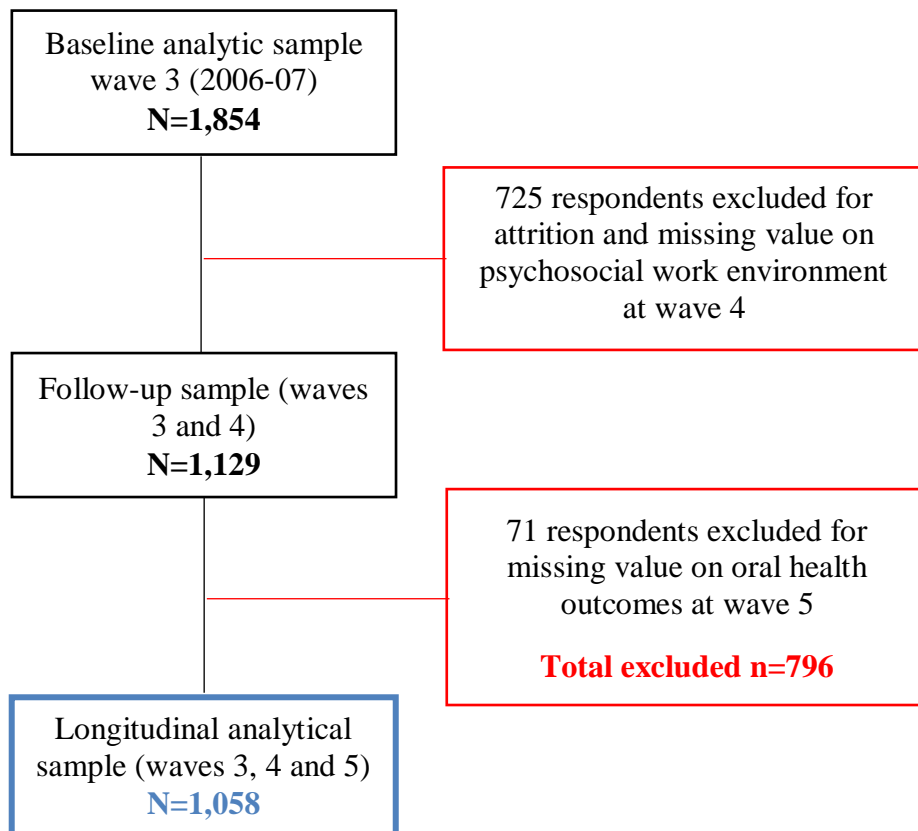
6.2.1 Eligible ELSA wave 3 (2006-07) sample: characteristics of missingness

Table 6-1 examines the characteristics of the covariates in the eligible ELSA wave 3 sample. The table shows that there were differences between the characteristics of the eligible ELSA sample and participants with missing data in terms of age, education level, income and type of work contract. A higher proportion of missing data was among participants who were in the oldest age group (P<0.001), with no educational qualifications (P=0.010), at the lowest income quintile (P<0.001) and self-employed (P=0.005).

Table 6-1: Characteristics of missingness in the eligible ELSA sample wave 3 (2006-07), wave 4 (2008-09) and wave 5 (2010-11), distribution and p-value (N=1,854)

Covariates at wave 3	n missing/N	% missingness	p-value (χ^2)*
Socio-demographic factors			
Age			
50-54	178/430	41.4%	
55-59	359/912	39.4%	<0.001
60-65	259/512	50.6%	
Gender			
Male	388/947	41.0%	
Female	408/907	45.0%	0.081
Marital status			
Single	40/105	38.1%	
Married / civil partnership	610/1435	42.5%	0.255
Divorced / widowed	146/314	46.5%	
Socio-economic factors			
Educational level			
Degree or equivalent	178/467	38.1%	
Below degree	488/1125	43.4%	0.010
No qualification	130/262	49.6%	
Income quintile			
Lowest	71/113	62.8%	
2	69/147	46.9%	
3	145/337	43.0%	<0.001
4	234/527	44.4%	
Highest	277/730	38.0%	
Work-related factors			
Employment status			
Employed	661/1588	41.6%	
Self-employed	135/266	50.8%	0.005

Covariates at wave 3	n missing/N	% missingness	p-value (χ^2)*
Health-related behaviours			
Smoking			
Yes	155/334	46.4%	0.157
No	641/1520	42.2%	
Oral health status (outcomes)			
Self-rated oral health			
Excellent/Good	648/1543	42.0%	0.069
Fair/Poor	148/311	47.6%	
OIDP			
No impact	752/1751	43.0%	0.964
At least one impact	44/103	42.7%	
Edentulousness			
Dentate	747/1753	42.6%	0.244
Edentate	49/101	48.5%	
Psychosocial work measures (predictors)			
Work control			
High	485/1164	41.7%	
Medium	198/441	44.9%	0.356
Low	113/249	45.4%	
Quality of work (ERI)			
High	272/628	43.3%	
Medium	277/643	43.1%	0.942
Low	247/583	42.4%	
Total missing	796/1854	42.9%	-

* P-value for the difference between eligible and analytical sample, using chi-square test

6.3 Results of the longitudinal analysis

This section first examines the characteristics of the analytical sample of the analysis. Then, it presents the association between predictors at waves 3 and 4 with the outcomes at wave 5. The cross-sectional and longitudinal models used in the previous chapters were re-estimated to establish the replicated associations between psychosocial work exposure and oral health outcomes using the smaller analytical sample (*Appendix D*).

6.3.1 Analytical wave 3 (2006-07), wave 4 (2008-09) and wave 5 (2010-11) sample: distribution and characteristics

The characteristics of the analytical sample are presented in Table 6-2. In this sample, 52.8% of the participants were males and the largest proportion of participants was in the middle age group (55-59 years), which made up over half (52.3%) of the sample. Additionally, 78% were married or in a civil relationship and 87.6% were employed.

Regarding socio-economic status variables, over 60% of the sample had achieved a level of below degree qualification and 42.8% were in the highest income quintile. Finally, 83.1% of participants were non-smokers.

Table 6-2: Distribution of characteristics of analytical sample wave 3 (2006-07), wave 4 (2008-09) and wave 5 (2010-11) - N=1,058

Covariates at wave 3	n (%) of analytical sample participants
Age group	
50-54	252 (23.8)
55-59	553 (52.3)
60-65	253 (23.9)
Gender	
Male	559 (52.8)
Female	499 (47.2)
Marital status	
Single	65 (6.1)
Married / civil partnership	825 (78.0)
Divorced / widowed	168 (15.9)
Educational level	
Degree or equivalent	289 (27.3)
Below degree	637 (60.2)
No qualification	132 (12.5)
Income quintile	
Lowest	42 (4.0)
2	78 (7.4)
3	192 (18.1)
4	293 (27.7)
Highest	453 (42.8)
Employment status	
Employed	927 (87.6)
Self-employed	131 (12.4)
Smoking	
Yes	179 (16.9)
No	879 (83.1)

6.3.1.1 Distribution of psychosocial work environment measures

Different from the previous analyses, the psychosocial work environment measures used in this chapter were derived from both waves 3 (2006-07) and wave 4 (2008-09). Participants who were in the lowest categories of work control and work quality were defined as 'exposed' to work stress. The accumulation of exposure to work stress over the two measurement periods (wave 3 and 4) was measured by adding together the number of times the participant was exposed to lower levels of work control and work quality. Chronic exposure to work stress was defined as being in the medium/low levels of work control or work quality twice. Each measure (control at work and quality of work) was divided into three categories:

1) Participants who were in the highest category at wave 3 and wave 4 (i.e. participants with high work control – and the same for work quality – at two waves),

2) Participants who had medium/low work control and medium/low work quality at one wave (i.e. participants who reported being in the lowest categories of the psychosocial work exposure measures at either wave 3 or wave 4) and

3) Participants who were in the lowest categories (medium/low) at two waves (i.e. individuals with medium/low work control or low work quality at both wave 3 and wave 4).

First, the distribution of both measures of psychosocial work environment at wave 3 and wave 4 was described in Table 6-3 below. The table shows that, for work control, the majority of the participants who reported high control at work at wave 3 also reported high work control at wave 4 (72.3%), whereas 27.7% of those in high work control at wave 3 have deteriorated by wave 4. Additionally, 44% of participants who had medium work control at wave 3 had better work control at wave 4 and 32.1% remained the same (at the medium control category). A considerable proportion of participants with low work control at wave 3 reported high work control at wave 4 (28.7%) and 44.8% remained at the lowest level of work control.

Regarding work quality, around two thirds of respondents who had high quality of work at wave 3 remained in the highest category at wave 4 (65.4%), while around one third (34.6%) of those with high work quality at wave 3 deteriorated in wave 4. Similarly, 50.3% of participants at the medium level of work quality at wave 3 remained the same at wave 4 while 24% of those who were in the medium level had moved to the highest

level at wave 4 and a similar proportion (25.7%) moved from middle to low work quality between waves 3 and 4. For the lowest category, 58.6% were in the lowest quality of work category at both waves and 12.2% had moved from the lowest category at wave 3 to the highest at wave 4, while another 29.2% moved up to the middle work quality group at wave 4.

Table 6-3: Proportions of psychosocial work predictors between wave 3 (2006-07) and wave 4 (2008-09), n (%), N=1,085

Work control at wave 3	Work control at wave 4		
	High control	**Medium control**	**Low control**
High control	491 (72.3%)	134 (19.7%)	54 (8%)
Medium control	107 (44.0%)	78 (32.1%)	58 (23.9%)
Low control	39 (28.7%)	36 (26.5%)	61 (44.8%)
Quality of work at wave 3	**Quality of work at wave 4**		
	High quality	**Medium quality**	**Low quality**
High quality	233 (65.4%)	94 (26.4%)	29 (8.2%)
Medium quality	88 (24%)	184 (50.3%)	94 (25.7%)
Low quality	41 (12.2%)	98 (29.2%)	197 (58.6%)

Next, the predictor variable of accumulative exposure to work stress is described. Table 6-4 shows the characteristics of the predictor variables of psychosocial work environment at wave 3 and wave 4. In the sample, less than half of the participants were not exposed to lower levels of control at work at either wave (46.4%), whereas 31.6% had one exposure to lower levels of work control and over a third (22%) had repeated exposure to low work control at both waves.

With regard to quality of work, 22% of participants had no exposure to lower quality of work levels at either wave, while 23.8% reported low quality of work at one wave and over half of the participants (54.2%) had repeated exposure to medium/low quality of work over both waves.

Table 6-4: Psychosocial work predictors variables from wave 3 (2006-07) and wave 4 (2008-09), n (%), N=1,058

Psychosocial work environment measures	n (%)
Low work control, over 2 waves	
No exposure (high control)	491 (46.4)
Single exposure (low control in one wave)	334 (31.6)
Repeated exposure (low control in two waves)	233 (22.0)
Low quality of work, over 2 waves	
No exposure (high quality)	233 (22.0)
Single exposure (low quality in one wave)	252 (23.8)
Repeated exposure (low quality in two waves)	573 (54.2)

6.3.1.1.1 Low work control measure by covariates

The distribution and bivariate associations between work control and demographic, socio-economic and behavioural variables are presented in Table 6-5 below.

The table examine whether there are any differences that run across the three groups of the repeated exposure to low work control variable. There was a significant association between work control at waves 3 and 4 with gender (P=0.003), education level (P<0.001), income quintile (P<0.001) and type of employment contract (P<0.001) at wave 3. The prevalence of repeated exposure to low work control was greater among male, employed participants, those who had no educational qualification and those in the middle-income quintile. The characteristics of participants who were exposed to lower levels of work control at one wave were similar across the three work control categories, but it was more prevalent among females. Participants who had no exposure to low work control were more likely to be males, with a degree qualification, in the middle-income quintile and self-employed. Generally, exposure to lower control at work increased as educational level decreased. No specific pattern was observed for gender, income and work type (Table 6-5).

Table 6-5: Low work control at wave 3 (2006-07) and wave 4 (2008-09) by characteristics of the participants at wave 3 (2006-07), n (%), N=1,058

Covariates at wave 3 (2006-07)	Low work control at wave 3 (2006-07) and wave 4 (2008-09)			
	No exposure n=491 (46.4%)	Single exposure n=334 (31.6%)	Repeated exposure n=233 (22.0%)	*p-value* *for trend*
Age group				
50-54	109 (43.3)	85 (33.7)	58 (23.0)	
55-59	275 (49.7)	163 (29.5)	115 (20.8)	0.267
60-65	107 (42.3)	86 (34.0)	60 (23.7)	
Gender				
Male	280 (50.1)	151 (27.0)	128 (22.9)	0.003
Female	211 (42.3)	183 (36.7)	105 (21.0)	
Marital status				
Single	28 (43.1)	24 (36.9)	13 (20.0)	
Married / civil partnership	400 (48.5)	253 (30.7)	172 (20.9)	0.066
Divorced / widowed	63 (37.5)	57 (33.9)	48 (28.6)	
Educational level				
Degree or equivalent	176 (60.9)	76 (26.3)	37 (12.8)	
Below degree	271 (42.5)	211 (33.1)	155 (24.3)	<0.001
No qualification	44 (33.3)	47 (35.6)	41 (31.1)	
Income quintile				
Lowest	16 (38.1)	18 (42.9)	8 (19.1)	
2	30 (38.5)	30 (38.5)	18 (23.1)	
3	80 (41.7)	55 (28.7)	57 (29.7)	<0.001
4	114 (38.9)	96 (32.8)	83 (28.3)	
Highest	251 (55.4)	135 (29.8)	67 (14.8)	
Employment status				
Employed	410 (44.2)	298 (32.2)	219 (23.6)	<0.001
Self-employed	81 (61.8)	36 (27.5)	14 (10.7)	
Smoking				
Yes	69 (38.6)	61 (34.1)	49 (27.4)	0.047
No	422 (48.0)	273 (31.1)	184 (20.9)	

6.3.1.1.2 Low quality of work measure by covariates

The distribution of covariates in lower quality of work categories was similar to the distribution observed in the work control categories. The prevalence of repeated exposure to low quality of work was significantly associated with gender, education level and income quintile. However, the associations between quality of work categories were not graded by any of the covariates. Participants who reported low quality of work

at two waves were more likely to be males (P=0.005) with no educational qualification (P=0.037) and in the second lowest income quintiles (P=0.009).

The prevalence of being in the lowest quality of work categories in one wave was greatest among female participants, those with a degree educational qualification and those who were in the lowest income quintile. However, no exposure to lower work quality levels was associated with being female, with below degree qualification and being in the highest income quintile (Table 6-6).

Table 6-6: Low quality of work at wave 3 (2006-07) and wave 4 (2008-09) by characteristics of the participants at wave 3 (2006-07), n (%), N=1,058

Covariates at wave 3 (2006-07)	Low quality of work at wave 3 (2006-07) and wave 4 (2008-09)			
	No exposure n=233 (22.0%)	Single exposure n=252 (23.8%)	Repeated exposure n=573 (54.2%)	*p-value* for trend
Age group				
50-54	40 (15.9)	65 (25.8)	147 (58.3)	
55-59	128 (23.2)	133 (24.1)	292 (52.8)	0.080
60-65	65 (25.7)	54 (21.3)	134 (53.0)	
Gender				
Male	111 (19.9)	119 (21.3)	329 (58.9)	0.005
Female	122 (24.5)	133 (26.7)	244 (48.9)	
Marital status				
Single	15 (23.1)	14 (21.5)	36 (55.4)	
Married / civil partnership	187 (22.7)	203 (24.6)	435 (52.7)	0.432
Divorced / widowed	31 (18.5)	35 (20.8)	102 (60.7)	
Educational level				
Degree or equivalent	64 (22.2)	82 (28.4)	143 (49.5)	
Below degree	148 (23.2)	144 (22.6)	345 (54.2)	0.037
No qualification	21 (15.9)	26 (19.7)	85 (64.4)	
Income quintile				
Lowest	10 (23.8)	14 (33.3)	18 (42.9)	
2	16 (20.5)	14 (17.9)	48 (61.5)	
3	35 (18.2)	45 (23.4)	112 (58.3)	0.009
4	50 (17.1)	66 (22.5)	177 (60.4)	
Highest	122 (26.9)	113 (24.9)	218 (48.1)	
Employment status				
Employed	196 (21.1)	223 (24.1)	508 (54.8)	0.185
Self-employed	37 (28.2)	29 (22.1)	65 (49.2)	
Smoking				
Yes	29 (16.2)	43 (24.0)	107 (59.8)	0.102
No	204 (23.2)	209 (23.8)	466 (53.0)	

6.3.2 The association between psychosocial work environment predictors at wave 3 (2006-07) and wave 4 (2008-09) with oral health outcomes at wave 5 (2010-11)

First, the bivariate associations between the new psychosocial work environment measures and oral health outcomes were examined. Table 6-7 below shows that there was a significant association between low control at work at waves 3 and 4 with poor self-rated oral health and edentulousness at wave 5. Additionally, there was a significant association between low quality of work at waves 3 and 4 with poor self-rated oral health at wave 5. Interestingly, the oral health-related quality of life indicator (OIDP) was not associated with the predictors of repeated exposure to low work control or quality.

In addition, the statistically significant associations with poor self-rated oral health and edentulousness were graded by different levels of exposure to work control and work quality. For instance, the prevalence of poor self-rated oral health increased as exposure to low control at work increased. However, the gradient was more profound between those with no exposure to work control and those with single or repeated exposure to low work control. This pattern was different when looking at exposure to low work quality and poor self-rated oral health, as the gradient was more profound between those with single exposure and those with repeated exposure to low quality of work. Therefore, the association between exposure to adverse psychosocial work environment and oral health appeared to differ within the exposure groups. To further investigate the observed associations and to account for the potential influence of the confounders on these associations, logistic regression models were used, as described in the next sections.

Table 6-7: The distribution of oral health outcomes at wave 5 (2010-11) by psychosocial work environment predictors at wave 3 (2006-07) and wave 4 (2008-09), n (%), N=1,058

Psychosocial work environment predictors at wave 3 (2006-07) and wave 4 (2008-09)	Oral health outcomes at wave 5 (2010-11)		
	Poor self-rated oral health n=156 (14.7%)	Edentate n=48 (4.5%)	OIDP[1] n=79 (7.5%)
Low control at work			
No exposure (ref)	56 (11.4)	14 (2.9)	29 (5.9)
Single exposure	58 (17.4)	18 (5.4)	33 (10.0)
Repeated exposure	42 (18.0)	16 (6.9)	17 (7.3)
p-value for trend	0.008	0.010	0.283
Low quality of work			
No exposure (ref)	24 (10.3)	8 (3.4)	8 (3.4)
Single exposure	31 (12.3)	11 (4.4)	25 (10.0)
Repeated exposure	101 (17.6)	29 (5.1)	46 (8.0)
p-value for trend	0.004	0.310	0.069

[2] Oral Impacts on Daily Performance

The next section presents the results of the logistic regression models for the association between psychosocial work environment predictors at waves 3 and 4 with the three oral health outcomes at wave 5. The regression models in Table 6-8 to Table 6-13 below were adjusted sequentially for covariates as previously explained: Model 1 shows the crude association between predictors and outcomes; Model 2 controlled for age, gender and marital status; Model 3 additionally adjusted for education and income; Model 4 added work type, and finally Model 5 adjusted for all aforementioned variables and smoking.

6.3.3 The longitudinal association between repeated exposure to adverse psychosocial work environment and self-rated oral health

6.3.3.1 Low work control at wave 3 (2006-07) and 4 (2008-09) with self-rated oral health at wave 5 (2010-11)

Table 6-8 shows that there was a significant association between single and repeated exposures to low work control and poor self-rated oral health with OR 1.63 (95% CI: 1.10-2.43) and OR 1.71 (95% CI: 1.11-2.64), respectively (Model 1). After adjusting for the demographic variables in Model 2, single and repeated exposures to low work control remained significantly associated with higher odds of subsequent poor oral

health rating. However, the inclusion of socio-economic factors (in Model 3) explained the association between repeated exposure to low work control and self-rated oral health as the estimates decreased and became non-significant (OR 1.42; 95% CI: 0.90-2.23). Single exposure to low work control remained marginally associated with higher odds of reporting poor self-rated oral health (OR 1.52; 95% CI: 1.01-2.29).

Further adding work type in Model 4 and smoking status in the fully adjusted model (Model 5) did not change the marginal association. Participants who had a single report of medium/low work control, at either wave 3 or wave 4, were more likely to report poor self-rated oral health at wave 5 compared to respondents with no reports of low work control (OR 1.52; 95% CI: 1.01-2.29).

Overall, the models showed that reporting medium/low control at work at wave 3 or 4 was significantly associated with poor self-rated oral health at wave 5. The crude model showed associations between single and repeated exposures to low work control and poor self-rated oral health, which were slightly attenuated over the initial adjustment process. Although the associations were not very strong to start with, when adjusting for socio-economic position in Model 3, the association with single report of low work control became marginally significant and the association with repeated exposure to low work control was fully explained. Nevertheless, socio-economic variables had a more substantial contribution to the association between repeated exposure to low work control than a single exposure, as the crude associations were initially very similar in terms of the confidence intervals in Model 1.

Table 6-8: Association between psychosocial work environment at wave 3 (2006-07) and wave 4 (2008-09) with poor self-rated oral health at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07) and wave 4 (2008-09)		Dependent variable: Poor self-rated oral health at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Low control at work	No exposure (ref)	1	1	1	1	1
	Single exposure	1.63 (1.10-2.43)*	1.61 (1.08-2.42)*	1.52 (1.01-2.29)*	1.53 (1.01-2.30)*	1.53 (1.01-2.30)*
	Repeated exposure	1.71 (1.11-2.64)*	1.64 (1.06-2.54)*	1.42 (0.90-2.23)	1.43 (0.91-2.26)	1.41 (0.89-2.23)
Age group	50-54		1	1	1	1
	55-59	-	0.82 (0.54-1.24)	0.78 (0.52-1.19)	0.78 (0.51-1.19)	0.85 (0.56-1.31)
	60-65		0.83 (0.51-1.35)	0.76 (0.46-1.25)	0.76 (0.46-1.25)	0.83 (0.50-1.37)
Gender	Male		1	1	1	1
	Female	-	0.81 (0.57-1.15)	0.80 (0.56-1.14)	0.80 (0.56-1.15)	0.80 (0.56-1.14)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.71 (0.37-1.39)	0.70 (0.36-1.45)	0.71 (0.36-1.40)	0.75 (0.38-1.50)
	Divorced / widowed		1.20 (0.57-2.51)	1.15 (0.88-2.82)	1.16 (0.55-2.45)	1.17 (0.55-2.48)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	0.93 (0.60-1.45)	0.93 (0.60-1.45)	0.91 (0.60-1.43)
	No qualification			1.57 (0.90-2.82)	1.57 (0.88-2.82)	1.48 (0.82-2.67)
Income quintile	Lowest			1	1	1
	2			0.96 (0.34-2.71)	0.97 (0.35-2.73)	0.90 (0.32-2.54)
	3	-	-	1.10 (0.45-2.74)	1.12 (0.45-2.78)	1.09 (0.44-2.73)
	4			1.46 (0.61-3.49)	1.47 (0.61-3.56)	1.43 (0.57-3.46)
	Highest			0.71 (0.29-1.72)	0.72 (0.30-1.75)	0.72 (0.28-1.75)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.08 (0.64-1.84)	1.09 (0.64-1.85)
Smoking	Yes					1
	No	-	-	-	-	0.61 (0.40-0.93)*

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for linear trend = 0.096

6.3.3.2 Low quality of work at wave 3 (2006-07) and wave 4 (2008-09) with self-rated oral health at wave 5 (2010-11)

Table 6-9 shows that there was no association between single exposure to low quality of work at waves 3 and 4 and poor self-rated oral health. However, the unadjusted model (Model 1) showed that repeated exposure to low quality of work was significantly associated with higher odds of subsequent poor self-rated oral health (OR 1.86; 95% CI: 1.16-2.99). This association was slightly attenuated when adjusting for demographic variables in Model 2 (OR 1.77; 95% CI: 1.10-2.86). In Model 3, adjusting for socio-economic variables explained the association between repeated exposures to low quality of work with poor self-rated oral health (OR 1.57; 95% CI: 0.97-2.56). Then, the association did not change and remained marginally non-significant in the fully adjusted model (OR 1.55; 95% CI: 0.95-2.52) (Model 5).

Despite the lack of association between exposures to low quality of work at one wave or two waves, the estimates for poor self-rated oral health were constantly higher among participants with repeated exposure to low quality of work when compared to those with one exposure, with the p-value for the trend being marginally significant (P=0.046).

Table 6-9: Association between psychosocial work environment at wave 3 (2006-07) and wave 4 (2008-09) with poor self-rated oral health at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07) and wave 4 (2008-09)		Dependent variable: Poor self-rated oral health at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Low quality of work	No exposure (ref)	1	1	1	1	1
	Single exposure	1.22 (0.69-2.15)	1.21 (0.68-2.13)	1.13 (0.63-2.00)	1.13 (0.64-2.01)	1.10 (0.62-1.96)
	Repeated exposure	1.86 (1.16-2.99)*	1.77 (1.10-2.86)*	1.57 (0.97-2.56)	1.58 (0.97-2.57)	1.55 (0.95-2.52)
Age group	50-54		1	1	1	1
	55-59	-	0.83 (0.55-1.26)	0.80 (0.52-1.22)	0.80 (0.52-1.22)	0.87 (0.56-1.34)
	60-65		0.87 (0.54-1.42)	0.80 (0.49-1.32)	0.80 (0.49-1.32)	0.87 (0.53-1.45)
Gender	Male		1	1	1	1
	Female	-	0.90 (0.62-1.25)	0.86 (0.60-1.23)	0.86 (0.60-1.23)	0.86 (0.60-1.23)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.70 (0.36-1.37)	0.70 (0.35-1.38)	0.70 (0.36-1.40)	0.75 (0.38-1.50)
	Divorced / widowed		1.18 (0.56-2.47)	1.14 (0.54-2.41)	1.14 (0.54-2.42)	1.15 (0.54-2.46)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	0.97 (0.63-1.51)	0.98 (0.63-1.52)	0.96 (0.61-1.49)
	No qualification			1.61 (0.90-2.90)	1.67 (0.90-2.88)	1.57 (0.85-2.72)
Income quintile	Lowest			1	1	1
	2			0.91 (0.32-2.56)	0.91 (0.32-2.57)	0.85 (0.30-2.41)
	3	-	-	1.03 (0.41-2.56)	1.04 (0.41-2.60)	1.02 (0.41-2.55)
	4			1.37 (0.57-3.30)	1.38 (0.57-3.36)	1.35 (0.55-3.30)
	Highest			0.67 (0.27-1.63)	0.68 (0.28-1.65)	0.68 (0.28-1.66)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.05 (0.62-1.78)	1.05 (0.62-1.78)
Smoking	Yes					1
	No	-	-	-	-	0.61 (0.40-0.93)*

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for linear trend = 0.046

In summary, repeated exposure to low work control and low work quality was associated with poor self-rated oral health in the unadjusted and age-sex-marital status adjusted models. Theses associations were in general explained by socio-economic factors and became marginally non-significant. However, there was evidence that a single exposure of low work control was marginally associated with poor self-rated oral health. This marginal association appeared to be independent of demographic, socio-economic and behavioural variables.

6.3.4 Repeated exposure to adverse psychosocial work environment and edentulousness

6.3.4.1 Low work control at wave 3 (2006-07) and wave 4 (2008-09) with edentate status at wave 5 (2010-11)

The unadjusted model (Model 1) in Table 6-10 shows that exposure to low control at work at one wave was marginally not associated with higher odds of being edentate at wave 5 (OR 1.94; 95% CI: 0.95-3.96). However, repeated exposure to low control at work was strongly associated with higher odds of being edentate at wave 5 (OR 2.51; 95% CI: 1.20-5.24). In Model 2, the association between one exposure to low work control and edentulousness was attenuated but remained significant (OR 2.42; 95% CI: 1.15-5.08). After adding the socio-economic factors in Model 3, the size of the association was substantially decreased to 1.74 (95% CI: 0.81-3.73) and became clearly non-significant. In Models 4 and 5, when adjusting for work type and smoking status the odds ratio of being edentate in relation to a single exposure of low work control were slightly reduced to 1.62 (95% CI: 0.75-3.50) and remained non-significant.

Finally, even though the results were not significant, there was a stepwise pattern (gradient) of the estimates of edentulousness in relation to different levels of exposure to low work control. However, the p-value for the linear trend was not statistically significant (P=0.218).

Table 6-10: Association between psychosocial work environment at wave 3 (2006-07) and wave 4 (2008-09) with edentulousness at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07) and wave 4 (2008-09)		Dependent variable: Edentate status at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Low control at work	No exposure (ref)	1	1	1	1	1
	Single exposure	1.94 (0.95-3.96)	1.75 (0.85-3.60)	1.47 (0.71-3.07)	1.43 (0.86-2.99)	1.45 (0.69-3.03)
	Repeated exposure	2.51 (1.20-5.24)*	2.42 (1.15-5.08)*	1.74 (0.81-3.73)	1.67 (0.77-3.61)	1.62 (0.75-3.50)
Age group	50-54		1	1	1	1
	55-59	-	1.39 (0.60-3.21)	1.25 (0.53-2.92)	1.25 (0.53-2.92)	1.45 (0.61-3.46)
	60-65		2.82 (1.19-6.65)*	2.35 (0.98-5.63)	2.37 (0.90-5.67)	2.75 (1.13-6.72)*
Gender	Male		1	1	1	1
	Female	-	1.82 (0.90-3.33)	1.66 (0.94-3.08)	1.62 (0.87-3.02)	1.60 (0.86-2.98)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.62 (0.21-1.85)	0.57 (0.19-1.76)	0.56 (0.18-1.74)	0.61 (0.20-1.88)
	Divorced / widowed		0.78 (0.23-2.65)	0.66 (0.20-2.33)	0.66 (0.19-2.31)	0.65 (0.19-2.29)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	3.36 (0.98 -11.48)	3.34 (0.98-11.43)	3.24 (0.95-11.08)
	No qualification			5.96 (1.74-22.48)**	5.95 (1.58-22.44)**	5.48 (1.45-20.68)**
Income quintile	Lowest			1	1	1
	2			1.94 (0.38-9.74)	1.92 (0.38-9.66)	1.74 (0.34-8.78)
	3	-	-	1.24 (0.26-5.87)	1.19 (0.25-5.70)	1.14 (0.24-5.44)
	4			0.99 (0.21-4.63)	0.95 (0.21-4.48)	0.89 (0.19-4.19)
	Highest			0.55 (0.11-2.71)	0.53 (0.10-2.61)	0.50 (0.10-2.48)
Employment status	Employed				1	1
	Self-employed	-	-	-	0.68 (0.23-1.99)	0.65 (0.22-1.94)
Smoking	Yes					1
	No	-	-	-	-	0.50 (0.26-0.99)

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for linear trend = 0.218

6.3.4.2 Low quality of work at wave 3 (2006-07) and edentate status at wave 5 (2010-11)

The unadjusted model (Model 1) in Table 6-11 shows that there was no association between single or repeated exposure to low quality of work at waves 3 and 4 and edentate status at wave 5. The odds ratio of being edentate in relation to single exposure to low work quality were OR 1.28 (95% CI: 0.51-3.25) in the crude model (Model 1) and remained almost the same throughout the adjustment process (OR 1.29; 95% CI: 0.49-3.37 in Model 5).

Similarly, the association between repeated exposure to low quality of work and edentulousness remained non-significant in all the models (OR 1.50; 95% CI: 0.67-3.33 in the unadjusted model, Model 1, and OR 1.37; 95% CI: 0.59-3.16 in the fully adjusted model, Model 5).

Table 6-11: Association between psychosocial work environment at wave 3 (2006-07) and wave 4 (2008-09) with edentulousness at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07) and wave 4 (2008-09)		Dependent variable: Edentate status at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Low quality of work	No exposure (ref)	1	1	1	1	1
	Single exposure	1.28 (0.51-3.25)	1.39 (0.55-3.54)	1.37 (0.53-3.57)	1.33 (0.63-2.89)	1.29 (0.49-3.37)
	Repeated exposure	1.50 (0.67-3.33)	1.65 (0.74-3.71)	1.46 (0.64 -3.36)	1.42 (0.62-3.28)	1.37 (0.59-3.16)
Age group	50-54		1	1	1	1
	55-59	-	1.38 (0.60-3.21)	1.25 (0.54-2.94)	1.25 (0.54-2.93)	1.46 (0.61-3.49)
	60-65		2.93 (1.24-6.92)*	2.44 (1.02-5.88)*	2.46 (1.02-5.91)*	2.87 (1.17-7.04)*
Gender	Male	-	1	1	1	1
	Female		1.89 (1.03-3.46)*	1.73 (0.93 -3.22)	1.67 (0.89-3.12)	1.64 (0.87-3.08)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	0.62 (0.21-1.85)	0.58 (0.19-1.78)	0.57 (0.19-1.75)	0.62 (0.20-1.92)
	Divorced / widowed		0.81 (0.24-2.72)	0.67 (0.19-2.35)	0.66 (0.19-2.32)	0.66 (0.19-2.33)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	3.64 (1.07-12.40)*	3.60 (1.05-12.28)*	3.47 (1.01-11.84)*
	No qualification			6.51 (1.74-22.33)**	6.46 (1.73-24.17)**	5.90 (1.57-22.14)*
Income quintile	Lowest			1	1	1
	2			1.96 (0.39-8.83)	1.92 (0.38-9.68)	1.76 (0.35-8.90)
	3	-	-	1.20 (0.25-5.70)	1.16 (0.24-5.51)	1.10 (0.23-5.26)
	4			0.99 (0.21-3.65)	0.95 (0.20-4.47)	0.88 (0.19-4.18)
	Highest			0.53 (0.11-2.62)	0.50 (0.10-2.51)	0.48 (0.10-2.40)
Employment status	Employed	-	-	-	1	1
	Self-employed				0.63 (0.22-1.86)	0.61 (0.21-1.81)
Smoking	Yes	-	-	-	-	1
	No					0.50 (0.26-0.99)

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for linear trend = 0.478

To summarise, the association between repeated exposure to low control at work and edentulousness was explained by socio-economic variables. Additionally, reporting low quality of work in one wave and two waves was not significantly associated with being edentate at wave 5.

6.3.5 Repeated exposure to adverse psychosocial work environment and Oral Impacts on Daily Performance (OIDP)

6.3.5.1 Low work control at wave 3 (2006-07) and wave 4 (2008-09) with OIDP at wave 5 (2010-11)

Table 6-12 shows that there was no association between repeated low work control exposure and OIDP at wave 5 (OR 1.25; 95% CI: 0.67-2.33). However, a single exposure to low control at work in either wave 3 or wave 4 was marginally associated with higher odds of oral impacts at wave 5 (OR 1.75; 95% CI: 1.04-2.94). This association remained almost the same when adjusting for demographic factors in Model 2. Adjusting for socio-economic variables in Model 3 decreased the odds ratio of OIDP in relation to single exposure to low work control to 1.69 (95% CI: 0.99-2.87), and the association became marginally non-significant. However, including work type in the regression model (Model 4) slightly increased the odds ratio for OIDP to 1.74 (95% CI: 1.02-2.97) in relation to single exposure to low work control, and the association became marginally significant. This could be due to negative confounding, as employed participants were more likely to report low control at work in one wave.

In the fully adjusted model, the association remained almost unchanged and marginally significant. That is, participants who were exposed to low control of work at one wave were 1.75 (95% CI: 1.04-2.94) times more likely to report oral impacts at wave 5, compared with participants who had no exposure to low work control (Model 5).

Overall, there was no difference between the unadjusted and the fully adjusted models in the size of the association between single exposure to low control at work and OIDP, showing the very limited role of adjusting for covariates in the association between work control and OIDP. This finding was consistent in all previous analyses (*Chapters 4* and *5*).

Table 6-12: Association between psychosocial work environment at wave 3 (2006-07) and wave 4 (2008-09) with OIDP at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07) and wave 4 (2008-09)		Dependent variable: OIDP at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Low control at work	No exposure (ref)	1	1	1	1	1
	Single exposure	1.75 (1.04-2.94)*	1.72 (1.02-2.91)*	1.69 (0.99-2.87)	1.74 (1.02-2.97)*	1.74 (1.02 -2.96)*
	Repeated exposure	1.25 (0.67-2.33)	1.21 (0.64-2.36)	1.16 (0.61-2.20)	1.23 (0.65-2.35)	1.22 (0.64-2.33)
Age group	50-54		1	1	1	1
	55-59	-	0.86 (0.50-1.50)	0.84 (0.48-1.46)	0.82 (0.47-1.43)	0.86 (0.49-1.51)
	60-65		0.70 (0.36-1.38)	0.66 (0.33-1.30)	0.64 (0.32-1.27)	0.67 (0.33-1.34)
Gender	Male		1	1	1	1
	Female	-	0.98 (0.61-1.57)	0.98 (0.61-1.57)	1.02 (0.64-1.65)	1.02 (0.63-1.65)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	1.22 (0.42-3.52)	1.13 (0.39-3.29)	1.15 (0.39-3.34)	1.19 (0.41-3.48)
	Divorced / widowed		1.91 (0.61-5.93)	1.83 (0.58-5.74)	1.84 (0.59-5.79)	1.85 (0.60-5.83)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	1.16 (0.64-2.10)	1.17 (0.65-2.12)	1.16 (0.64-2.10)
	No qualification			1.48 (0.65-3.34)	1.48 (0.65-3.35)	1.44 (0.63-3.25)
Income quintile	Lowest			1	1	1
	2			4.31 (0.51-36.61)	4.52 (0.53-38.47)	4.31 (0.51-36.77)
	3	-	-	3.27 (0.41-24.86)	3.49 (0.44-27.79)	3.45 (0.43-27.41)
	4			4.37 (0.57-32.44)	4.77 (0.62-36.72)	4.69 (0.61-36.06)
	Highest			4.06 (0.53-29.84)	4.44 (0.58-33.95)	4.42 (0.58-33.72)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.66 (0.87-3.17)	1.65 (0.86-3.16)
Smoking	Yes					1
	No	-	-	-	-	0.77 (0.43-1.37)

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for linear trend = 0.354

6.3.5.2 Low quality of work at wave 3 (2006-07) and wave 4 (2008-09) with OIDP at wave 5 (2010-11)

Table 6-13 shows that a single exposure to low quality of work at one wave was significantly associated with subsequent oral impacts at wave 5 (OR 3.10; 95% CI: 1.37-7.01). Similarly, repeated exposure to low quality of work at two waves was significantly associated with higher odds of oral impacts (OR 2.45; 95% CI: 1.14-5.28). Although both associations were statistically significant, they did not follow a gradient pattern.

Both associations remained statistically significant when adjusting for age, gender and marital status (Model 2). There were higher odds of OIDP among participants who had single exposure to low work quality at one wave (OR 3.03; 95% CI: 1.33-6.87) and repeated exposure at two waves (OR 2.37; 95% CI: 1.10-5.14).

In Model 3 and Model 4, adjusting for socio-economic variables and work type did not change estimates of OIDP in relation to single exposure to low work quality (OR 3.21; 95% CI: 1.40-7.33) and repeated exposure to low work quality (OR 2.40; 95% CI: 1.10-5.24).

In the fully adjusted model (Model 5), associations between both single and repeated exposures to low work quality and oral impacts marginally decreased to OR 3.17 (95% CI: 1.39-7.25) and OR 2.38 (95% CI: 1.09-5.20), respectively. However, both associations remained statistically significant.

Table 6-13: Association between psychosocial work environment at wave 3 (2006-07) and wave 4 (2008-09) with OIDP at wave 5 (2010-11): sequentially adjusted logistic regression models, reporting OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07) and wave 4 (2008-09)		Dependent variable: OIDP at follow-up wave 5 (2010-11)				
		Model 1	Model 2	Model 3	Model 4	Model 5^
		Odds ratio (95% CI)				
Low quality of work	No exposure (ref)	1	1	1	1	1
	Single exposure	3.10 (1.37-7.01)**	3.03 (1.33-6.87)**	3.12 (1.37-7.10)**	3.21 (1.40-7.33)**	3.17 (1.39-7.25)**
	Repeated exposure	2.45 (1.14-5.28)*	2.37 (1.10-5.14)*	2.31 (1.06-5.04)*	2.40 (1.10-5.24)*	2.38 (1.09-5.20)*
Age group	50-54		1	1	1	1
	55-59	-	0.90 (0.52-1.56)	0.87 (0.50-1.51)	0.86 (0.50-1.49)	0.89 (0.51-1.58)
	60-65		0.77 (0.39-1.52)	0.71 (0.36-1.42)	0.70 (0.35-1.38)	0.73 (0.36-1.46)
Gender	Male		1	1	1	1
	Female	-	1.05 (0.65-1.68)	1.04 (0.64-1.65)	1.10 (0.67-1.78)	1.09 (0.67-1.77)
Marital status	Single		1	1	1	1
	Married / civil partnership	-	1.16 (0.40-3.35)	1.05 (0.36-3.06)	1.07 (0.39-3.13)	1.10 (0.38-3.23)
	Divorced / widowed		1.82 (0.59-5.66)	1.70 (0.54-5.33)	1.72 (0.59-5.43)	1.73 (0.55-5.43)
Educational level	Degree or equivalent			1	1	1
	Below degree	-	-	1.29 (0.71-2.33)	1.30 (0.72-2.34)	1.29 (0.71-2.32)
	No qualification			1.59 (0.70-3.58)	1.59 (0.70-3.58)	1.54 (0.68-3.49)
Income quintile	Lowest			1	1	1
	2			4.43 (0.52-37.86)	4.71 (0.55-40.40)	4.49 (0.52-38.66)
	3	-	-	3.14 (0.39-24.93)	3.38 (0.42-27.43)	3.32 (0.41-26.52)
	4			4.28 (0.56-32.93)	4.71 (0.61-36.46)	4.61 (0.59-35.68)
	Highest			4.17 (0.54-31.88)	4.56 (0.52-35.14)	4.54 (0.59-34.89)
Employment status	Employed				1	1
	Self-employed	-	-	-	1.68 (0.88-3.21)	1.67 (0.87-3.19)
Smoking	Yes					1
	No	-	-	-	-	0.79 (0.44-1.42)

* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05

Model 1: crude unadjusted model
Model 2: Model 1 + age, gender and marital status
Model 3: Model 2 + socio-economic status indicators (education and income)

Model 4: Model 3 + work-related measures (work type)
Model 5 (fully adjusted): Model 4 + health-related behaviour (smoking status)
^P-value for linear trend = 0.102

To conclude, the findings indicate that single exposure to low control at work at one wave was significantly associated with oral health-related quality of life (OHRQoL). Similarly, single and repeated exposures to low quality of work at waves 3 and 4 were significantly associated with higher odds of worse OHRQoL at wave 5. The size of the associations between single and repeated exposures to low quality of work with OHRQoL hardly changed throughout the adjustment process and remained statistically significant.

6.4 Effect modification in the association between psychosocial work environment and oral health

In the current analysis, there were no statistically significant interaction terms for psychosocial work measures by age, gender, education or income. Therefore, there was no evidence of effect modification for the association between psychosocial work environment measured at waves 3 and 4 in relation to oral health at wave 5.

6.5 Summary of the association between psychosocial work environment at wave 3 (2006-07) and wave 4 (2008-09) with oral health at wave 5 (2010-11)

To recap, different patterns of associations were found by type of psychosocial work environment and oral health measures. The findings of this chapter showed that single exposure to low work control at one wave was significantly associated with poor self-rated oral health and oral health-related quality of life (reporting oral impacts) at wave 5. Repeated exposure to low work control at two waves appeared initially to be associated with poor self-rated oral health and edentulousness; however, the associations were explained by socio-economic variables. Thus, greater exposure to low work control was not associated with greater risk of any of the oral health outcomes and there was no evidence to support an increased risk of oral health in relation to increased exposure to low work control at two waves.

With regard to exposure to low work quality, exposure at one wave was only associated with oral impacts at wave 5. A smaller but significant association was also found between repeated exposure to low work quality at waves 3 and 4 with oral impacts at wave 5. After risk factors were taken into account, participants with chronic exposure to

low quality of work had more than double the odds of the oral impacts when compared to those with high quality of work.

During the adjustment process, introducing the socio-economic variables into the regression models reduced the size of the estimates (OR) and explained some of the associations, for example, the association between repeated exposure to low control with self-rated oral health and edentate status. Therefore, in agreement with previous analyses (*Chapter 4* and *Chapter 5*), socio-economic status seems to be crucial in the associations between exposure to adverse psychosocial work environment and oral health.

Generally, the results of this chapter did not find evidence to support the hypothesis of increased risk of poor oral health among participants who had increased exposure to low work control or quality. Although the analysis showed that repeated exposure to low quality of work was associated with higher odds of oral impacts, this association was not graded in nature. In the fully adjusted model, participants with a single exposure to low quality of work had more than three times the odds for reporting oral impacts when compared to those with high quality of work, while participants with two exposures to low quality of work had more than double the odds of oral impacts when compared to others with high quality of work, after risk factors were taken into account. Therefore, there was no gradient in the association between repeated exposure to low levels of quality of work and oral health-related quality of life. Table 6-14 summarises the results of the regression models for the association between repeated exposure to stressful psychosocial work environment and all three oral health outcomes.

Table 6-14: Summary of the association between psychosocial work environment at wave 3 (2006-07) and wave 4 (2008-09) with oral health outcomes at wave 5 (2010-11), OR (95% CI) from the fully adjusted model (Model 5), N=1,058

Psychosocial work environment predictors at wave 3 (2006-07) and wave 4 (2008-09)	Oral health outcomes at wave 5 (2010-11) Odds ratio (95% CI)[1]		
	Poor SROH[2]	Edentate status	OIDP[3]
Low control at work			
No exposure (ref)	1	1	1
Single exposure	**1.53 (1.01-2.30)***	1.45 (0.69-3.03)	**1.74 (1.02 -2.96)***
Repeated exposure	1.41 (0.89-2.23)	1.62 (0.75-3.50)	1.22 (0.64-2.33)
Low quality of work			
No exposure (ref)	1	1	1
Single exposure	1.10 (0.62-1.96)	1.29 (0.49-3.37)	**3.17 (1.39-7.25)**
Repeated exposure	1.55 (0.95-2.52)	1.37 (0.59-3.16)	**2.38 (1.09-5.20)***

* p < 0.05
[1] Odds Ratios (95% CI) were from the fully adjusted model
[2] Self-rated oral health
[3] Oral Impacts on Daily Performance

Finally, the results described above were generally in agreement with previous findings from the cross-sectional and longitudinal analyses (*Chapters 4* and *5*). This analysis confirmed the associations between low control at work with self-rated oral health and oral impacts and the association between low quality of work with oral impacts.

6.6 Comparison between cross-sectional and longitudinal analyses (chapters 4 to 6)

To review all the findings for the association between psychosocial work predictors and oral health outcomes, a comparison between the cross-sectional and longitudinal findings is presented in Table 6-15 below. The table shows all the results from unadjusted and fully adjusted logistic regression models for different elements of psychosocial work environment in relation to the three oral health outcomes.

Table 6-15: Summary of the unadjusted and adjusted associations between psychosocial work environment predictors and oral health outcomes in the cross-sectional and longitudinal analyses, OR (95% CI)

Predictors wave 3		Poor self-rated oral health		Edentulousness		OIDP[k]	
		Cross-sectional (wave 3)					
		Unadjusted	Fully adjusted	Unadjusted	Fully adjusted	Unadjusted	Fully adjusted
Control at work	High control (ref)	1	1	1	1	1	1
	Medium control	**1.54 (1.16-2.04)****	**1.44 (1.08-1.93)***	**1.75 (1.12-2.73)***	1.31 (0.82-2.09)	1.53 (0.96-2.43)	1.55 (0.97-2.49)
	Low control	**1.43 (1.01-2.04)***	1.34 (0.93-1.93)	1.25 (0.68-2.29)	0.96 (0.51-1.79)	**1.83 (1.07-3.12)***	**1.91 (1.10-3.31)***
Quality of work	High quality (ref)	1	1	1	1	1	1
	Medium quality	1.31 (0.96-1.78)	1.23 (0.89-1.69)	0.67 (0.39-1.15)	0.61 (0.35-1.07)	1.09 (0.64-1.85)	1.10 (0.64-1.90)
	Low quality	**1.66 (1.22-2.25)****	**1.48 (1.08-2.03)***	1.39 (0.87-2.21)	1.16 (0.71-1.91)	**1.91 (1.17-3.11)***	**1.91 (1.15-3.15)***
		Longitudinal (wave 5)					
		Unadjusted	Fully adjusted	Unadjusted	Fully adjusted	Unadjusted	Fully adjusted
Control at work	High control (ref)	1	1	1	1	1	1
	Medium control	1.25 (0.90-1.74)	1.19 (0.84-1.67)	**2.12 (1.28-3.50)****	1.70 (1.00-2.86)	1.19 (0.78-1.82)	1.18 (0.77-1.82)
	Low control	**1.51 (1.02-2.24)***	1.37 (0.91-2.05)	1.42 (0.71-2.84)	1.11 (0.54-2.26)	1.53 (0.94-2.48)	1.55 (0.94-2.55)
Quality of work	High quality (ref)	1	1	1	1	1	1
	Medium quality	1.12 (0.79-1.60)	1.02 (0.71-1.46)	0.66 (0.36-1.23)	0.65 (0.34-1.22)	1.05 (0.67-1.66)	1.10 (0.68-1.73)
	Low quality	**1.64 (1.16-2.30)****	**1.43 (1.01-2.04)***	1.43 (0.84-2.43)	1.37 (0.78-2.39)	**1.63 (1.06-2.50)***	**1.65 (1.06-2.57)***
Repeated exposure to predictors wave 3 and 4		Longitudinal (wave 5)					
		Unadjusted	Fully adjusted	Unadjusted	Fully adjusted	Unadjusted	Fully adjusted
Low control	No exposure (ref)	1	1	1	1	1	1
	Single exposure	**1.63 (1.10-2.43)***	**1.53 (1.01-2.30)***	1.94 (0.95-3.96)	1.45 (0.69-3.03)	**1.75 (1.04-2.94)***	**1.74 (1.02 -2.96)***
	Repeated exposure	**1.71 (1.11-2.64)***	1.41 (0.89-2.23)	**2.51 (1.20-5.24)***	1.62 (0.75-3.50)	1.25 (0.67-2.33)	1.22 (0.64-2.33)
Low quality	No exposure (ref)	1	1	1	1	1	1
	Single exposure	1.22 (0.69-2.15)	1.10 (0.62-1.96)	1.28 (0.51-3.25)	1.29 (0.49-3.37)	**3.10 (1.37-7.01)****	**3.17 (1.39-7.25)****
	Repeated exposure	**1.86 (1.16-2.99)***	1.55 (0.95-2.52)	1.50 (0.67-3.33)	1.37 (0.59-3.16)	**2.45 (1.14-5.28)***	**2.38 (1.09-5.20)***

[k] Oral Impacts on Daily Performance
* p < 0.05, ** p < 0.01, *** p ≤ 0.001, p ≥ 0.05
Fully adjusted models controlled for: age, gender, marital status, education, income, work type and smoking status (at wave 3)

6.6.1 Psychosocial work environment and poor self-rated oral health

Although the analytical samples were not the same across these comparisons, Table 6-15 showed that the results across the different cross-sectional and longitudinal analyses were generally similar in relation to the association between psychosocial work environment and self-rated oral health. The similarity in the estimates across different analyses and the differences in the confidence intervals could be partly due to different sample sizes.

In the fully adjusted models, exposure to the lowest level of work control was not significantly associated with poor self-rated oral health in the cross-sectional analysis and longitudinal analyses. However, medium work control was significantly associated with poor self-rated oral health in the cross-sectional analysis (OR 1.44; 95% CI: 1.08 - 1.93). Additionally, this association also appeared in the repeated exposure analysis. That is, single exposure to medium/low work control at either wave 3 or 4 was marginally associated with higher odds of reporting poor oral health at wave 5 (OR 1.53; 95% CI: 1.01 -2.30).

Low work quality was significantly associated with higher odds of poor self-rated oral health in the cross-sectional analysis (OR 1.48; 95% CI: 1.08 -2.03). However, the estimates remained almost the same but became marginally significant in the longitudinal analysis (OR 1.43; 95% CI: 1.01-2.04) and the association faded in the repeated exposure analysis (OR 1.55; 95% CI: 0.95 -2.52). Although the association was not particularly strong in the cross-sectional analysis, the smaller sample size could have effected this association.

6.6.2 Psychosocial work environment and edentate status

Consistently in all cross-sectional and longitudinal analyses, neither work control nor work quality was significantly associated with edentate status.

6.6.3 Psychosocial work environment Oral Impacts on Daily Performances (OIDP)

The cross-sectional analysis showed that participants who were in the lowest level of work control had increased odds of OIDP compared to those who had high work control

(OR 1.91; 95% CI: 1.10-3.31). However, the association was weaker and not statistically significant in the longitudinal analysis (OR 1.55; 95% CI: 0.94-2.55). On the other hand, being in the low level of work quality was associated with OIDP in both the cross-sectional and longitudinal analyses (OR 1.91; 95% CI: 1.15-3.15 and OR 1.65; 95% CI: 1.06-2.57, respectively). Although the longitudinal estimate indicates a slightly weaker association compared to the ORs form the cross-sectional analysis, both associations were statistically significant. Furthermore, in contrast to the other comparative results, single and repeated exposures to medium/low levels of work quality were strongly associated with higher odds of OIDP (OR 3.17; 95% CI: 1.39-7.25 and OR 2.38; 95% CI: 1.09-5.20, respectively). Both associations were stronger when compared to the preliminary cross-sectional and longitudinal analyses. This suggests that low levels of work quality may predict oral impacts.

A full discussion and interpretation of all the results and any potential biases can be found in the next chapter.

Chapter 7

Discussion

7.1 Introduction

The thesis investigated the associations between two dimensions of psychosocial work environment in relation to subjective oral health outcomes among a sample of older English adults. This final chapter summarises the principle findings from the previous three results chapters (*chapters 4 to 6*). The findings are also compared with existing literature previously described in *Chapter 2*. The strengths and limitations of the thesis are reviewed, followed by the relevance of the findings and their implications. Finally, the possibilities for future research are outlined.

7.2 Summary of principle findings

The work in this thesis generates new evidence to highlight the importance of the psychosocial work environment factors at an individual level. First, the association between psychosocial work environment and general health was established through literature review. Second, a hypothesis was formulated that links psychosocial work factors with oral health. Third, cross-sectional and longitudinal analyses were conducted to test the hypothesised links. Then these analyses were repeated using data from ELSA waves 3, 4 and 5 to examine whether repeated exposure to adverse psychosocial work risk factors was followed by an increased risk of poor oral health. Furthermore, examining whether gender, age, socio-economic status or health behaviours explains the associations. Two sequential general aims were examined: 1) whether aspects of psychosocial work environment were associated with oral health and 2) whether prolonged exposure to psychosocial work environment was associated with oral health.

The principle findings of each hypothesis are presented next, compared with existing literature when possible and discussed collectively. Hypotheses 1.1 to 1.4 concerned the cross-sectional analysis presented in *Chapter 4*. Hypotheses 2.1 to 2.2 were about the longitudinal analysis presented in *Chapter 5*. Hypothesis 2.3 was about the longitudinal repeated exposure analysis demonstrated in the preceding chapter, *Chapter 6*.

7.2.1 Hypothesis 1.1: Lower levels of work control were associated with poorer oral health

The findings from the cross-sectional analysis in *Chapter 4* partially support this hypothesis. Logistic regression models demonstrated a significant relationship between

medium work control and self-rated oral health. Medium work control was also associated with increased odds of edentulousness. However, this association became weaker and not significant in the fully adjusted model.

Low level of work control was shown to be associated with higher odds of Oral Impacts on Daily Performance (OIDP). It was interesting that the odds ratio for the association between different levels of work control was graded. However, this pattern was only observed in relation to oral impacts and not with poor self-rated oral health and edentate status.

The results of the present study were generally in agreement with former studies. The literature review in *Chapter 2* identified four studies on psychosocial work environment and oral health. Of these, only two studies have used the job-demand control measure to assess psychosocial work environment. Both of these studies showed significant associations between some aspects of psychosocial work environment with worse periodontal health status and higher chances of self-perception of worse oral health (Scalco et al., 2013; Marcenes and Sheiham, 1992). However, neither of the former studies included employees over 55 years of age and both used a cross-sectional design.

7.2.2   Hypothesis 1.2: Lower levels of work quality were associated with poorer oral health

Findings on work quality generated new evidence for the role of effort-reward imbalance model on oral health outcomes. Consistent with the hypothesis, participants who experienced low quality of work reported poor oral health status relative to those who were in the high work quality group. Low quality of work was significantly associated with higher odds of poor self-rated oral health and worse oral health related quality of life (OHRQoL), whereas the association with edentate status was not statistically significant.

Additionally, the logistic regression models showed that the association between quality of work and oral health outcomes followed a stepwise pattern. The pattern showed a trend of increased odds ratio of poor self-rated oral health and oral impacts as work quality declined.

There was no other study that explored the role of work quality on oral health outcomes. Therefore, the findings here were not comparable in the context of oral health literature.

7.2.3 Hypothesis 1.3: The association between psychosocial work environment and oral health remained statistically significant after adjusting for demographic, socio-economic and work-related risk factors

Demographic (age, gender and marital status), socio-economic indicators (education and income) and work-related measure (type of work: employed vs. self-employed) were hypothesised to confound the association between psychosocial work environment and oral health. Previous studies indicated that adverse psychosocial work environment (according to the job demand-control and the effort-reward imbalance work stress models) follows a social gradient, with a higher prevalence in lower social positions (Bosma et al., 1998; Bruner et al., 2004), regardless of whether indicated by education, income or occupational class. Thus, the effect of psychosocial work environment on oral health may be attributable to confounding with low socio-economic status.

In the cross-sectional analysis, some associations between psychosocial work environment and oral health measures were attenuated or explained when socio-economic indicators were adjusted for in the logistic regression models. The association between low control at work and self-rated oral health was explained by socio-economic position. Similarly, the association between medium work control and edentate status was no longer significant after adjusting for socio-economic indicators. This suggests that these associations between psychosocial work environment and oral health measures were partially confounded by education and income. However, associations between quality of work with self-rated oral health and OIDP remained statistically significant after taking into account socio-economic indicators. Other demographic factors that the logistic regression models were adjusted for – such as age and gender – did not seem to confound any of the associations investigated in this thesis.

By examining the odds of oral impacts through the adjustment progression, it seems reasonable to propose that the influence of low control at work on OHRQoL was independent from socio-economic characteristics and smoking. Similarly, the association between medium level of work control and poor self-rated oral health was independent from the adjusted covariates.

The thesis also examined the interaction of psychosocial work environment with age, gender, education and income. Interactions were tested to understand whether oral

health risk factors, including low socio-economic status, might moderate the effects of negative psychosocial work environment on oral health. This analysis found few interactions between psychosocial work environment with age and education. In the cross-sectional analysis, there was the one consistently significant interaction between quality of work and education level. Among the ELSA participants who had below degree qualification, low quality of work seemed to promote the adverse effect of low educational level on self-rated oral health and oral health related quality of life. For the additional interaction analyses examined, there was some evidence that suggests a moderating role for being in the middle age group (55-59 years old) for the relationship between control at work and quality of work with self-rated oral health. Additionally, the associations between both low control and low quality of work with OHRQoL appeared to be moderated by being in the oldest age group (60-65 years old). Previous studies on psychosocial work environment and oral health did not report any interaction analyses between psychosocial work environment and other oral health risk factors.

7.2.4 Hypothesis 1.4: Oral health risk factors contributed to the association between psychosocial work environment and oral health

The literature has suggested two explanatory pathways as plausible mechanisms for the association between psychosocial work environment and oral health: a biological and a behavioural pathway. The mechanisms by which such pathways operate along with the broader literature on both pathways were discussed in *Chapter 2*. Although the analysis of the biological pathway between psychosocial work environment and oral health was beyond the scope of this thesis, this was partly examined by adjusting for participants' smoking status in the final logistic regression model. The existence of the potential behavioural pathways can be predicted from the change in the odds ratios when adjusting for behavioural measures in the regression models. However, the analysis findings did not provide evidence for a behavioural pathway between psychosocial work measures and oral health. Adjustment for smoking status did not explain many of the associations between both measures of psychosocial work environment and oral health outcomes. Hence, the results suggested that the psychosocial work environment measures selected were related to oral health outcomes through pathways other than the unhealthy behaviour adjusted for in this present analysis. It is important to acknowledge that, in the analysis, adjustment for health-related behaviours was insufficient since it was limited to smoking only. Psychosocial work environment can promote other health-

related behaviours that are related to oral health, such as poor oral hygiene and unhealthy dietary patterns. Including such variables was not feasible in the current study as they were not available in the ELSA dataset.

Previous published studies on psychosocial work environment and oral health did not show evidence of the behavioural pathway when adjusting for sugar consumption and tooth brushing frequency (Marcenes and Sheiham, 1992). One study found evidence that smoking, self-rated general health, use of dental services, dental pain and tooth loss have mediated the relationship between job strain and self-perceived oral health (Scalco et al., 2013). It should be noted that the former study adjusted for socio-economic indicators at the same time as the health-related behaviour variable (smoking). Therefore, socio-economic status indicators could limit the explanatory role of smoking because psychosocial work environment is closely affected by the socio-economic status. This association was also supported in this thesis (Hypothesis 1.3), where socio-economic status indicators attenuate some of the odds ratios in the association between psychosocial work environment and oral health.

7.2.5 Hypothesis 2.1: Adverse psychosocial work environment measures were associated with poor oral health four years later

The results of the analysis in *Chapter 5* demonstrated evidence in support of this hypothesis using longitudinal data from ELSA waves 3 and 5. In line with the cross-sectional analysis, low quality of work at wave 3 was related to two measures of oral health status at wave 5, namely self-rated oral health and OHRQoL measure (OIDP). Both associations followed a stepwise pattern with a higher odds ratio of poor self-rated oral health and oral impacts as work quality declines. Edentate status was not significantly associated with quality of work.

Regarding work control, different levels of work control seemed to be associated with different oral health outcomes. Low level of work control was weakly associated with poor self-rated oral health and medium level of work control was associated with being edentate. However, neither of these associations remained significant in the final model.

Taken together, the findings of the longitudinal analysis suggested that quality of work might be a determinant of self-rated oral health and the OHRQoL. Evidence of such a longitudinal association has not been investigated previously in oral health literature.

7.2.6 Hypothesis 2.2: After adjusting for covariates at baseline, psychosocial work environment was associated with oral health at follow-up

In the longitudinal analysis, the thesis found some evidence that the association between quality of work and oral health status was independent from selected covariates. Similar to the cross-sectional analysis, adjusting for socio-economic status did not greatly change the associations between psychosocial work environment measures and oral health. Adding socio-economic indicators attenuated all associations, though they remained statistically significant, excluding the association between low control at work and poor self-rated oral health. The inclusion of the socio-economic indicators in the logistic regression models showed that income and education were confounders in this association. Although the crude association was marginally significant, adjusting for socio-economic variables fully explained the association.

In the longitudinal analysis, little evidence for the role of smoking as behavioural mediator was found. Out of the six regression models investigated for this hypothesis, there was only one association that was partially explained by smoking status. The association between medium control at work and edentulousness became marginally non-significant after adding smoking status into the regression model, albeit much of the odds ratio was decreased when socio-economic status was added into the model prior to smoking status.

7.2.7 Hypothesis 2.3: Repeated exposure to adverse psychosocial work environment was associated with poor oral health two years later

Measuring psychosocial work factors repeatedly enables the identification of participants who were recurrently exposed to adverse psychosocial work environment. Those may have higher risk of poor oral health compared to others who were exposed to work stress for shorter periods. To determine whether repeated exposure to psychosocial work environment factors was followed by poorer oral health, *Chapter 6* examined exposure to adverse psychosocial work environment at waves 3 and 4 in relation to oral health outcomes at wave 5. The addition of psychosocial work stressors at wave 4 was intended to capture the accumulative increase in risk of poor oral health that was hypothesised to be associated with adverse psychosocial work environment.

The findings of this analysis provided some evidence that moderately supports the hypothesis. Different patterns of association were found between different psychosocial

work environment measures and oral health outcomes and the findings were generally in line with the previous analyses. Quality of work at waves 3 and 4 was associated with OHRQoL at wave 5. The association between repeated exposure to low quality of work and oral impacts remained statistically significant even after taking into account the selected potential confounding variables. Additionally, a stronger significant association was found between a single exposure to quality of work with the OIDP. On the other hand, weaker and non-significant associations were found between repeated exposure to low work quality with the other two oral health measurements (self-rated oral health and edentulousness).

Repeated exposure to low control at work was not associated with any oral health outcome. Interestingly, a single exposure to low work control at either wave 3 or wave 4 was marginally associated with higher odds of poor self-rated oral health and oral impacts at wave 5. These associations were observed in the cross-sectional analysis but were marginally not significant in the longitudinal analysis.

In line with previous analyses, single and repeated exposures to adverse psychosocial work environment measures were not associated with edentate status. Bearing in mind the historic nature of the edentulousness, this finding was expected.

It is important to note here that firm conclusions cannot be drawn in terms of the associations between repeated exposure to low work control and oral health as the repeated exposure analysis was accompanied by a greatly reduced sample size since only individuals who participated in all three waves (waves 3, 4 and 5) were analysed. Additionally, the findings of this analysis should be viewed with caution as the repeated exposure measure combined both medium and low levels of work control into one. Therefore, a participant can be classified into the repeated exposure group with two reports of medium levels of work stress and the group may also include individuals with two reports of low levels of work stress. In the cross-sectional and longitudinal analyses, the scores of psychosocial work environment were derived from wave 3 of ELSA and divided into three groups based on variable tertile cut-offs, whereas cumulative scores from ELSA waves 3 and 4 were used in the repeated exposure analysis, whereby the lowest two levels were combined to assess exposure to adverse psychosocial work environment.

7.3 Interpretation of the results

7.3.1 Work control and oral health

In this study, there was weak evidence for the association between work control and oral health status measures. Although the cross-sectional analysis showed a strong association between different levels of work control with poor self-rated oral health and the OIDP, the evidence from *Chapter 6* showed only marginal associations between work control at one wave with oral health. The overall evidence regarding work control suggested that individuals with medium/low levels of work control were more likely to report poorer self-rated oral health and OHRQoL. However, the marginal associations suggest that these findings should not be over-interpreted.

The possible scenario to explain these marginal associations could be that there was little difference between the medium and low control at work groups. In the cross-sectional analysis, participants who reported low work control were significantly fewer than the reference group who had high work control. Sense of low control might be understated by the number of individuals who were exposed to low work control in the study. Consequently, the association with poor self-rated oral health and OHRQoL became clearer when the medium and low categories were combined. The limited number of participates who had low work control was expected, as a study by Siegrist and Wahrendorf (2011) suggested that continued employment at 60 years and above was more prevalent among those who experienced high sense of control at work. Therefore, it is very likely that individuals in more stressful jobs (indicated by low control) tend to leave the labour market prematurely and consequently would be excluded from the analysed sample.

Failure to support the hypothesised role of low work control in the longitudinal analysis could not be attributed solely to the differences between the prevalence of low work control versus high work control in the sample. The lack of association might also be related to the actual perceptions of participants who were at their late stage in the workforce. In such late stages, work control might not be important for some individuals and therefore it was not perceived as a source of stress among those employees. For example, older employees who are financially dependent upon their work have little option to change any stressful working situation they might be facing. Therefore, their coping style will differ from older employees who are financially

independent from their work (Peeters et al., 2008). That can consequently influence their perceptions towards their work conditions. Indeed, the widely used demand-control model has been linked to various health outcomes – including oral health – in previous studies. As suggested by Marcenes and Sheiham (1992) there might be uncontrolled variables that could interact with work control leading to spurious findings, such as social support from co-workers. Another possible explanation could be because this study merely used two items of Karasek's (1985) instrument, which focus on the authority to make decisions over their work and whether employees have the opportunity to develop new skills. Including more work control items might provide a better indicator of exposure to low work control.

7.3.2 Work quality and oral health

Reviewing the findings from both the cross-sectional longitudinal analyses in tandem suggested that there was consistent evidence to support the hypothesised effect of work quality (assessed by the effort-reward imbalance model) on oral health status. In fact, this association between quality of work and oral health-related quality of life (OIDP) was the only consistent finding in the thesis.

In the cross-sectional and longitudinal analyses, the lowest level of work quality was associated with higher odds of poor self-rated oral health and of experience of oral impacts. It was also interesting to see a clear gradient in the odds ratio of poor oral health and oral impacts through work control categories; that is, a pattern that shows an association that goes through the distribution of the outcome and is not relevant to a particular category of work quality.

This consistent relationship could be because the broader aspects of work characteristics covered by the effort-reward imbalance model might better capture the consequences of stressful experience at work on oral health. Secondly, two of the five reward components provided a direct link with the labour market dynamics that are becoming increasingly relevant in a globalised economy: promotion prospects including job security and level of salary or wage (Siegrist et al., 2004). Thus, quality of work positively predicted subjective outcomes such as OHRQoL.

When combining medium and low quality of work groups, the analysis revealed that single and repeated exposures to the lowest levels of work quality were associated with increased likelihood of oral impacts. The estimates for the association between repeated

exposure to low work quality were smaller when compared to the estimates for a single exposure. That suggests that there was no cumulative effect of low quality of work in relation to OHRQoL. That could be expected as a key assumption of the repeated exposure analysis was that there was a prolonged exposure to adverse psychosocial work environment. However, within the context of this thesis, the two time points with a two-year gap between waves 3 and 4 of ELSA may not have been long enough to capture the accumulative effect of psychosocial work environment on oral health. Thus, despite the high risk of OIDP associated with subsequent addition of psychosocial work stressors at wave 4, the results from this analysis cannot be regarded as a form of dose-response relationship and the size of the estimates could be affected by the relatively short duration of the exposure measured.

On the other hand, quality of work was not associated with self-rated oral health in the repeated exposure analysis. This was different from previous analyses and could be because of the reduced sample size analysed in the repeated exposure analysis in *Chapter 6*. Additionally, since this association was only marginal in the previous analyses, it is not surprising that it deteriorated and thus became no longer significant in the reduced sample.

Further, the lack of association might be caused by other unobserved confounding factors that include occupational class, whereby low occupational class status could result in both adverse psychosocial work environment and poorer oral health. However, the study controlled for socio-economic indicators and they appeared to be important confounders in the association between psychosocial work environment and oral health. Section *7.3.4.1* further discusses this issue.

Finally, given that self-rated oral health and psychosocial work factors are both subjective constructs, they might be influenced by individual psychological traits and mental health status (Stansfeld, 2002; Ferguson et al., 2006). Differences in individual vulnerability to work stressors may be another reason for the different patterns of association in relation to self-rated oral health. It is possible that the individual's mental health status acted as a mediator between perceptions of psychosocial work environment and subjective oral health. The presence of other illnesses has previously been shown to be positively associated with oral health ratings among older people (Schützhold et al., 2014). Likewise, unhealthy people tended to report more negative outcomes in terms of psychosocial work environment. This may be supported by the

"perception" hypothesis, which suggests that "*changes in worker well-being may lead to an altered evaluation of existing job characteristics, even though the work environment itself may be unchanged*" (Tang, 2014). Two processes of this effect have been proposed: the "rosy" and the "gloomy" perception mechanisms (De Lange et al., 2005). The former suggests that healthy workers evaluate their work more positively over time, because they have sufficient resources to meet their work demands. Conversely, the latter mechanism suggests that unhealthy employees evaluate their work environment less positively over time due to their decreasing resources that make it more difficult for them to meet their work demands (De Lange et al., 2005). Thus, it should be noted that participants' perceptions might account for some of the variance in the associations between psychosocial work environment and subjective rating of oral health status. In the context of older adults, it is possible that repeated exposure to adverse psychosocial work environment coincides with adaptation to the work circumstances, especially if participants have been working in the same job for many years. Therefore, while some participants repeatedly reported low levels of work quality, they might not be exposed to stress as hypothesised. If this was the case, it might be helpful to separate psychosocial work environment from individual-related factors. However, this goes beyond the scope of this thesis.

7.3.3 Psychosocial work environment and oral health among older adults

The oral health measures used in this thesis included subjective oral health status (self-rated oral health), oral health related quality of life (OIDP) and a historic measure of lifetime exposure to oral health risk factors (edentulousness).

Self-rated oral health captures oral diseases along with current perceptions of oral health which is particularly important in older age (Ramsay et al., 2015). This measure is likely to be influenced by current experiences and well-being (Benyamini et al., 2004; Locker et al., 2005) and it may reflect on individuals' oral health-related quality of life score (Brennan and Singh, 2011; Locker et al., 2005). Therefore, it is likely that poor self-rated oral health can have an effect on the OIDP. However, it has been suggested that older people often rate their oral health as good or excellent, despite the experience of tooth loss (Slade and Sanders, 2011). That is because they are adapted to their circumstances and perhaps consider dental disease to be part of the normal ageing process (Macentee et al., 1997). This phenomenon might explain some of the findings

in the current analysis, as the odds ratios for the association between psychosocial work environment and oral health related quality of life were higher when compared with self-rated oral health.

Regarding edentulousness, the variable is rather crude and not without limitations. For a start, the group of dentate participants is not at all homogenous as it includes people with a complete and functional set of natural teeth as well as those with only one natural tooth. Therefore, grouping all dentate together and comparing to edentate is not ideal as some of the dentate are quite similar to edentate in terms of the number of teeth present while others differ considerably. In addition, thinking about those that are edentate, it is quite probable that individuals may have become edentate many years earlier than the survey. Thus, it may not be ideal to relate current experiences of adverse psychosocial work environment to this historic measure of oral health and it is expected that current levels of work stress cannot influence historical lifetime experiences that result in tooth loss. Likewise, repeated exposure to adverse psychosocial work environment did not predict edentate status. Nevertheless, edentulousness is considered to be a particularly important oral health indicator among older populations and has been linked to general health, morbidity, cognitive and physical function, changes in food preference and nutritional deficiency (Sheiham and Steele, 2001; Sheiham et al., 2001; Steele et al., 2004; Griffin et al., 2012; Tsakos et al., 2015).

The most likely explanation for the lack of association between psychosocial work environment measures and edentate status is that perceptions of psychosocial work environment might reflect a temporary or recent phenomenon, while edentate status reflects past experiences. Moreover, the resilience of older adults to their edentate status, especially if tooth loss happened a long time ago (Macentee et al., 1997), could also explain the lack of association between psychosocial work environment and edentulousness.

Bosma et al. (1998) argued that different psychosocial work models are related to different mechanisms linking work environment to health outcomes. Following this argument, it is reasonable to expect that psychosocial work environment would not predict all the different objective and subjective measures of oral health. Hence, it is not surprising that psychosocial work environment could not predict all the oral health outcomes included in this analysis. As discussed earlier, edentulousness is a measure of lifetime history of dental disease, oral hygiene care and dental treatment. Thus, a link

between edentulousness with current levels of psychosocial work environment among older adults would have been questionable. However, stronger associations between the psychosocial work environment and the subjective self-rating of oral health and quality of life measures would be expected through plausible psychosocial mechanisms. In line with this rationale, the analysis in this thesis found some evidence for the latter outcomes but little or no evidence for the former outcome.

Finally, the results of this thesis considered the role of psychosocial work environment as a determinant of oral health more precisely than has previously been done. The work contributes to the evidence that aims at better understanding and improving oral health and oral health-related quality of life in older populations with extended working life.

7.3.4 Socio-economic status, psychosocial work environment and health-related behaviours

This section is set to discuss the role of socio-economic status and behavioural factors on oral health, in order to better understand the association between psychosocial work environment and oral health. Exploring the link between socio-economic status, psychosocial work environment and health-related behaviours was suggested in the theoretical framework of this study as it is important to understand the mechanisms of the relationships examined in the thesis.

7.3.4.1 *Socio-economic status in the relationship between psychosocial work environment and oral health*

It is important to recognise that work environment is not independent of the social setting; thus psychosocial processes of work environment are embedded within employees' socio-economic status (Marchand et al., 2005). It might not be consistent across an individual's working life and the individual's perceptions of work environment may differ over their later working life. Hence, it is important to consider the wider social context of work environment as it may have important effects on older employees' health. In this thesis, the findings showed that there was attenuation in the estimates after adjustment for socio-economic variables.

Studies have argued that the association between psychosocial work characteristics and health, usually coronary heart disease, is due to confounding by socio-economic position (Stansfeld and Candy, 2006). That is, adverse psychosocial work characteristics

are considered as indicators for low socio-economic status. Low socio-economic position was hypothesised to partially confound the association between work and health. However, even after adjustment for socio-economic factors in previous studies, work environment was still an important determinant of periodontal diseases (Marcenes and Sheiham, 1992).

On the other hand, a recent study suggested that adjusting for socio-economic position in the association between psychosocial work environment and ischemic heart disease may lead to over-adjustment (Theorell et al., 2016). As psychosocial work environment is linked to social class, thus adjustment for socio-economic factors could decrease the size of the observed association. That is, individuals who grew up in a poor socio-economic environment – particularly those who continued living in poor conditions in their adulthood – are more likely to be exposed to adverse working conditions than others. Such adverse psychosocial work conditions are closely linked with employees' socio-economic status and therefore indicate a higher risk of disease. To avoid the risk of over-adjustment when looking into the associations between psychosocial work environment and oral health, the analyses in this thesis did not consider occupational class in the adjustment process. Although occupational class has been found to be a risk factor of oral health outcomes, adjusting for this factor could underestimate the role of psychosocial work environment on oral health outcomes. One study examined the association between occupational characteristics and number of natural teeth retained among 500 older adults aged 50 and over in Israel. The authors found that the odds ratio for the number of natural teeth being less than 25 was 2.7 fold higher for individuals working in a hospital/commercial environment compared to those in an office environment (Zini et al., 2016). However, including additional variables such as occupational class in the analysis could result in a smaller sample and might lead to over-adjustment. This analysis went further into adjusting for type of work contract as an indicator assessing related-work variables. However, this adjustment did not change any of the associations.

7.3.4.2 Health-related behaviours in the relationship between psychosocial work environment and oral health

Some important oral health-related behavioural risk factors such as tooth brushing and sugar consumption were not measured in ELSA. Therefore, the analysis was limited to

examining smoking status as a potential behavioural mediator. In the analysis, adjusting for smoking status did not substantially change the associations between psychosocial work environment and oral health. The association between control at work and edentulousness status was the only association in the analyses that was explained by smoking status. However, although adjustment for smoking weakened the association and it became marginally non-significant, it is worth noting that the analysis adjusted for socio-economic status before smoking status was added into the logistic regression. Therefore, socio-economic status variables might moderate the explanatory role of smoking, as they contributed beforehand to the attenuation of the odds ratios.

A previous study supported the behavioural pathway via smoking, in the association between work stress and subjective oral health status (Scalco et al., 2013). A possible explanation for the contradictory finding is the different measures of health-related behaviours that were considered. For example, the current study used one indicator of health-related behaviours, namely smoking. In contrast, Scalco et al. (2013) supported the behavioural pathway through smoking, self-rated health, use of dental services, dental pain and tooth loss, in the association between work strain and self-rated oral health among Brazilian employees. However, Marcenes and Sheiham (1992) controlled for a number of oral health-related behaviours including sugar consumption, tooth brushing frequency, type of toothpaste and dental attendance. In that analysis, health-related behaviours did not explain the relationship between work-related mental demands and periodontal health.

Overall, the analysis in this thesis does not support the behavioural pathway through smoking in the association between psychosocial work environment and subjective oral health outcomes. Psychosocial work environment might be related to oral health through other pathways than the risk factor studies in the current analyses (smoking status).

7.4 Strengths and limitations of the study

7.4.1 Strengths

7.4.1.1 Longitudinal data

The main strength of this thesis is that it uses data from a large longitudinal cohort comprising both male and female older English adults, thus, providing an excellent opportunity for assessing different psychosocial work stressors and repeated measures of the psychosocial factors over several waves of follow-up that were two years apart. This allowed the use of longitudinal data to analyse the role of psychosocial work environment on subsequent oral health. It additionally allowed analysis of the repeated exposure to adverse psychosocial work conditions and oral health. The availability of high-quality longitudinal data in the ELSA provided an excellent setting for deeper assessment of the key research question.

7.4.1.2 Different measures and dimensions of psychosocial work environment

This study is the first to consider the two well-known psychosocial work environment measures in relation to oral health outcomes among a large, longitudinal and nationally representative sample of older employees in England. Psychosocial work environment was assessed based on the two main models of work stress, namely the job demand-control model and the effort-reward imbalance model. Even though the scales were not used in their original form, the derived variables of work control and effort-reward imbalance have shown high validity and reliability (see *Chapter 3*).

7.4.1.3 Different measures of oral health

The analysis used three different subjective measures of oral health with each measure reflecting a particular aspect of oral health. First, edentulousness: a historical and crude oral health measure that reflects the accumulation of oral disease and experience of dental treatment throughout the life course. Second, OIDP: an oral health-related quality of life measure that captures multidimensional concepts and incorporates the degree to which oral conditions affect social, psychological and physical aspects of daily living. The third measure was self-rated oral health, which provides an overall evaluation of participants' own oral health status. This measure reflects a contemporary account of both subjective and clinical aspects of oral health. A study found that those with better

dental health, established by clinical examination, tend to self-report good oral health when compared to others with poor clinical oral health (Nuttall et al., 2011).

7.4.1.4   Controlling for relevant confounders

The wide range of covariates included in the analysis enabled the adjustment of important confounders, including demographic and socio-economic characteristics, work-related variables and health-related behaviours. The availability of several potential confounding factors and health behaviours in the ELSA dataset provided an excellent setting for conducting multivariable analyses and calculating accurate estimates for the adjusted associations between psychosocial work environment measures and oral health outcomes.

7.4.2   Limitations

7.4.2.1   Selection bias

ELSA was designed to be representative of English adults aged 50 years and over. However, for the purposes of this study, only employed participants in ELSA were included in the analytical samples. Therefore, this could generate some selection bias associated with "the healthy worker effect" phenomenon (Li and Sung, 1999; Baillargeon, 2000). The healthy worker effect implies that participants could be relatively healthy in order to remain in the workforce and therefore they have better health status compared to the general population. Hence, the relatively healthy and younger profile of the participants who were included in the sample might lead to an underestimation of the number of poor oral health cases and limit inference of the results to the general working population in England. However, participants aged over 65 years were excluded from the analysis in order to address this concern. Although at the time the data was collected, 65 years was the state pension age for men but not for women, the analysis of effect modification did not show any differences in the results by gender.

Additionally, missing data in the sample could be another source of selection bias in the current study. In the analytical samples, there were a number of observations excluded from the analysis when some of the ELSA participants had missing data on selected variables. There were two main reasons for missing data in the analytical samples. At wave 3, some of the participants did not complete the part of the ELSA questionnaire

that contained data on the psychosocial work environment. Moreover, some participants were lost to follow-up between the waves. Participants who had missing data on psychosocial work environment or oral health variables at waves 4 and 5 were excluded from the analyses. The descriptive analysis of missingness suggested the characteristics of missing observations in the samples. Overall, older employees (aged between 60-65 years), participants with no education, those who were at the lowest income quintile and those who were smokers were more likely to be lost to follow-up in the longitudinal analytical samples.

7.4.2.2   Statistical power

Sample attrition represents another important limitation. The analytical sample was younger and healthier than excluded respondents. ELSA respondents who are still working at age 50 and over are likely to enjoy more favourable working conditions and be better educated compared to those who exited the labour market before age 50. Hence, the thesis results are generalisable only to employees aged 50-65 living in England.

Due to the relatively small number of participants in the analyses, there were few observations within the exposure variable categories in the repeated exposure analysis (*Chapter 6*). Additionally – in the outcome variables – there was a low prevalence of older working participants who were edentate and who reported at least one oral impact. Therefore, the power to detect statistically significant associations might have been insufficient in some parts of the analysis.

In *Chapter 6*, one of the main hypotheses of the analysis was that there was an effect of repeated exposure to work stress on oral health. Within the available data from the analysed sample, a limited number of participants reported exposure to work stress in two consecutive waves of ELSA. The use of a pen-and-paper questionnaire (self-completion questionnaire) might have impacted the response rate. That was because not every participant who had a CAPI interview completed the self-completion questionnaire in ELSA, which includes the psychosocial work environment questions. Hence, an analysis of missingness was performed to deal with the missing responses in all three analytical samples used in the thesis (see *chapters 4-6*). Further imputation analysis to deal with the missing data was beyond the scope of this thesis.

7.4.2.3   Length of follow-up

Additionally, the two-year gap between ELSA waves might have not been long enough to detect the effect of work stress exposure on oral health outcomes. Consequently, the lack of significant associations between repeated exposure to work stress and poor oral health outcome might have been due to the reduced number of participants who experienced chronic work stress/ chronically poor working conditions and the relatively short period of follow-up. Another reason could be due to the fact that the stressful work environment led the older employees to leave the workforce (Wahrendorf et al., 2013).

7.4.2.4   Residual confounding

Designing the study framework has highlighted the need to add more variables to support the multidimensional structure of the study assumptions. Studies have indicated that there is a possibility that early life mental illness increases the risk of an individual finding themselves working in a low-quality environment (Harvey et al., 2017). In addition, employees with underlying poor health may perceive and rate their jobs as more stressful (Frese and Zapf, 1988). There were an additional few potential confounding factors that the current study cannot adjust for, for example, oral health behaviours, biological stress responses and personality factors. Although biological stress response measures were collected in ELSA, the current analysis could not include such measures in order to minimise the risk of bias resulting from missing approximately half of the analytical data. The correlation between exposure to low work control or effort-reward imbalance and poor oral health outcomes could be confounded by the effect of health-damaging behaviours, or social class (Fishta and Backé, 2015). Hence, the analysis of this thesis took some important confounders into account, including smoking as a marker of unhealthy behaviours and education and income as a marker of socio-economic status. Furthermore, as analyses are based on a relatively healthy sample with low prevalence of poor oral health, the degree to which the observed associations were influenced by other factors is likely to be small.

7.4.2.5   Measures of psychosocial work environment

It is important to note that there is a limitation in relation to the psychosocial work environment measures considered in this thesis. A full assessment of the original scales

of the two work stress models (in particular the job demand-control model) was not possible due to limited measurement availability. The analysis used two measures of the psychosocial work environment from the short version of the job content questionnaire that was provided in ELSA, whereby only one dimension of the full job demand-control model measure was included. The multi-item scales employed in previous studies would provide additional in-depth analysis of the variables' constructs and strengthen the argument. However, the current short versions derived from the original scales were successfully applied in previous analyses explaining associations of poor quality of work with a wide range of health outcomes. Additionally, the shortened version of the effort-reward imbalance model showed a good psychometric quality including a statistical validation of the factorial structure of the theoretical construct (Leineweber et al., 2010). Further, the psychosocial work environment measures used in the analysis predicted oral health status among the studied population. Yet, it is possible that the observed associations would have been much stronger if the full range of questions were included.

Additionally, the categorisation of the psychosocial work environment measures might have affected the findings; the thesis used tertiles of work stress variables, where the upper tertile was defined as representing work stress in terms of low control or low quality of work and the middle tertile as representing medium levels of work stress. This categorisation was intended to characterise the intensity of exposure to adverse psychosocial work environment. However, this categorisation might have underestimated the role of work control due to the limited number of participants in each category.

Finally, while the variable on repeated exposure to work stress allowed for comparison between those without work stress, those with work stress at one ELSA wave and those with work stress at two waves, the category on the single exposure to work stress did not differentiate between participants who reported low levels of work control/quality at wave 3 and those that did so at wave 4. In other words, it did not consider the time between the outcome measurement and the single exposure to work stress (i.e. four years or two years prior to the outcome).

7.4.2.6   *Measures of oral health status*

The ELSA dataset lacked clinical oral health assessments of teeth and periodontal status. Therefore, as per most survey methods, the assessments of oral health outcomes were self-reported, which could be influenced by respondents' personality traits and emotional state (Locker et al., 2005). Subjective experience, however, reflects an individual's interpretation of their own perceptions towards their oral health and has been shown to modify health behaviours. The self-rated oral health measures used in this thesis are relevant indicators of oral health that have established associations with various health outcomes.

With regard to the dichotomous edentulousness variable, the dentate category may contain participants with few remaining natural teeth. Such individuals could have poorer oral health function compared with edentates with good-fitting dentures. On the other hand, participants within the edentate category who wear dentures might experience unmeasured oral health problems due to ill-fitting dentures compared to other edentates who wears good-fitting dentures. Furthermore, in the analyses, the inconsistency in the odds ratio of edentulousness in relation to psychosocial work environment measures was not particularly unexpected because edentate status is the result of disease levels and patterns of dental care throughout the life course. Thus, it is likely that the status of edentulousness would not be affected by the current psychosocial work characteristics to a great extent. Additionally, the very small number of observations in the edentate category might have contributed to the discrepancy observed in the estimates. Therefore, findings in relation to edentulousness need to be interpreted with caution, as the nature of this measure does not reflect disease incidence but rather prevalence of edentulousness. It is fairly plausible that a number of the edentate have been in this state for many years. The four-year gap considered in the analysis (assessing oral health between wave 3 and wave 5) is likely not to reveal an entirely genuine longitudinal association in terms of temporality.

Despite all the aforementioned issues, all three measurements in ELSA were derived from a recognised well-validated questionnaire and can be considered as valid and reliable and cost-effective oral health indicators (Locker and Miller, 1994; Gilbert et al., 1998).

7.5   Implications of the findings

From the discussion of the thesis findings, a few implications can be derived from both a theoretical and a practical perspective. This section covers the policy implications of the thesis and the research implications are covered in the next section (*7.6*).

7.5.1   Policy implications

Oral diseases share common risk factors with chronic diseases (Watt and Sheiham, 2012). Interventions targeted to improve the general health of older populations could incorporate interventions to improve oral health. Such programmes could also target the workplace as it is recognised as one of the priority settings for health promotion (WHO, 2010).

Psychosocial work environment addresses the upstream factors such as the wider social determinants of oral health rather than primarily focusing on health behaviours, in line with current oral health promotion strategies (Watt, 2007). Interventions that tackle stressful work environment may help to tackle oral health inequalities by improving the understanding of the factors that maintain health in stressful and adverse environments. In such environments, resources like social support might prove instrumental in developing future oral health promotion strategies. Despite a general lack of evidence on the effectiveness of job stress interventions, studies have recommended programmes that are aimed at the employees themselves and involve instruction in techniques to manage and cope with stress (Giga et al., 2003).

7.6   Future research

The research presented within this thesis provides valuable information about the links between psychosocial work environment and oral health outcomes among older adults. However, there are a few ideas for extensions to this work that could provide further insights into the topic.

In terms of methodology, future work should take into account biological measures that are recognised to be related to stress, in order to provide a more precise picture of the pathways involved in the relationship with psychosocial work environment. The physiological stress mechanisms of the association between psychosocial work environment and oral health remain unclear. Therefore, research into the biological

processes linking psychosocial work environment to oral health could help clarify the magnitude of the association. It would also be interesting to examine the extent to which behavioural and biological covariates may explain the findings obtained from the current analyses.

A second extension to this study could include further analysis of trajectories of oral health over the retirement period. One of the key implications for research is to understand the lifetime processes that are involved in the associations observed in this study. One of the consistent findings in the thesis was the strong role of work quality on self-rated oral health and oral health-related quality of life. However, the current study included only participants who were in the workforce at the time of data collection, and therefore the analysis looks at prevalence of oral health before retirement. Due to low sample numbers, particularly among those in poor control at work, it was not possible to further breakdown the groups into two. However, the availability of more waves of data would allow analysis of how change from low-quality employment into retirement affects trajectories of oral health. Such a study would be beneficial to the understanding of the real perceptions of psychosocial work environment among adults in later working life.

The addition of other measurements of psychosocial work environment (for example, work demands and support) is another area for consideration. The short version of the self-reported job content questionnaire provided in ELSA is limited to some aspects of psychosocial work environment; therefore, it was not possible to consider a different aspect of the beneficial effect of the psychosocial work environment on oral health.

In terms of the outcome measurements, the thesis used two repeat measures of oral health. An additional wave of oral health data would increase the power and the precision of the observed estimates. Further longitudinal research is needed, which could include longer follow-up intervals, more measurements of psychosocial work environment, additional subjective and clinical oral health outcomes, a wide range of covariates to explore the underlying pathways and the use of more complex statistical approaches to further analyse the associations.

7.7   Conclusion

This thesis aimed to examine the cross-sectional and longitudinal associations between psychosocial work environment and oral health among working older adults living in England. This study provided evidence for a weak but persistent association between adverse psychosocial work environment and poor oral health among older adults. Failed reciprocity, characterised by an imbalance between efforts and rewards in the workplace was consistently associated with higher risk of poor self-rated oral health and oral impacts in the cross-sectional and longitudinal analyses.

Little evidence was found for an association between low control at work and oral health outcomes. In addition, poor OHRQoL was found to be associated with repeated exposure to low quality of work. The main conclusion is that some aspects of psychosocial work environment are considered as determinants of oral health status and OHRQoL among older employees. This association needs to be considered as a potential important part of the wider association between socio-economic status and oral health outcomes.

Health behaviour considered in this analysis, namely smoking, did not provide any explanation for the role of psychosocial work environment on oral health status, probably due to the complexity of the broader determinants of health behaviours. Other potential factors or pathways linking psychosocial work stressors to oral health need to be investigated in order to strengthen the case for association in the current analysis.

Altogether, the thesis findings highlight new directions for future research in the oral health field; that is, the need to search beyond traditional oral health risk factors and consider the broader psychosocial determinants of oral health.

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Appendices

Appendix A: Table of content of the ELSA interview at wave 3

Household Demographics – collection or updating of demographic information about everyone living in the household, including sex, age and relationships to each other, and collection or updating of information about children. This module also checks the eligibility for ELSA of all current household members (including New Partners).

Individual Demographics – collection or updating of details about respondents' legal marital status, parent's age and cause of death, and number of living children.

Health – collection or updating of self-reported general health, chronic illness or disability; eyesight, hearing; specific diagnoses and symptoms; pain; difficulties with activities of daily living (ADLs); smoking; mental health, urinary incontinence; falls and fractures; quality of healthcare respondents received for particular health conditions. New questions at Wave 3 record respondents' dental health and the help they have received for daily activities.

Social Participation – covers the use of public transport. New questions at Wave 3 record how often respondents use taxis, get lifts from family/friends, or use transport provided by a hospital, day centre or lunch club.

Work and Pensions – collection or updating of current work activities; current and past pensions; reasons for job change and health-related job limitations. New questions for Wave 3 relate to pension statements sent by the Department for Work and Pensions (used to forecast state pension at retirement).

Income and Assets – assessment of the income that respondents received from a variety of sources over the previous 12 months: wages, state pensions, private pensions, other annuity income and state benefits; and collected financial and non-financial assets. Couples decided who the respondent would be for a single financial unit, although the interviewer was instructed to suggest to the couple that the person who answered the IA module in wave 2 did so again in wave 3.

Housing – collection or updating of current housing situation (including size and quality), housing- related expenses, ownership of durable goods and cars; consumption including food in and out of home, fuel, durables, leisure, clothing and transfers. Only one eligible ELSA respondent in the household answered the module.

Cognitive Function – measured different aspects of the respondent's cognitive function, including memory, speed and mental flexibility. Questions used to measure literacy were dropped for Wave 3. All other tests remained the same. However, interviewers now have the option to specify why some tests could not be completed (i.e. due to poor eyesight, difficulty using a pen etc.).

Expectations – measured expectations for the future in a number of dimensions; financial decision-making and relative deprivation. There were minor changes to this module, including the deletion of questions on subjective views of ageing.

Psychosocial Health – measured how the respondent viewed his or her life across a variety of dimensions. The questions about when the respondent thinks middle age ends and old age starts, which were in Wave 1, were added back in at Wave 3.

Effort and Reward – assessed motivations behind voluntary work and caring for others; and the relationship between effort and reward.

Final questions and consents – collection of any missing demographic information and updating of respondents' contact details, stable address, details of any proxy informants and requests permission to link to health and economic data from various administrative sources. At wave 3 there were changes to the consent procedure and there were new questions to set up the Life History Interview.

Walking ('gait') speed test – all respondents aged 60 years and over completing the main interview on their own behalf were eligible for the walking speed test. The test involved timing how long it took to walk a distance of eight feet at the respondents usual walking pace.

Self-completion questionnaire (administered by paper) – covering quality of life, social participation, mobility, control at work, life satisfaction, social networks and alcohol consumption. There are three self-completions included in Wave 3. The main self-completion covers quality of life, social participation, mobility, control at work, life satisfaction, social networks and alcohol consumption. Some questions, which were asked in the Wave 1 self-completion, were added back in and some Wave 2 questions were taken out of the main self-completion for this wave.

Appendix B: Self-completed questionnaire for ELSA at wave 3

ELSA English Longitudinal Study of Ageing

P2496/BLUE

UCL · IFS Institute for Fiscal Studies · NatCen National Centre for Social Research

Serial number									CK	Person	First name	Card
1-9									10	11-12		0 2
												13-14 Batch 15-19

Health and lifestyles of people aged 50 and over

Self-Completion Questionnaire
In Confidence

HOW TO FILL IN THIS QUESTIONNAIRE

Please answer the questions by:

Ticking a box like this ☑

Or writing a number in a box like this **3**

Sometimes you will find an instruction telling you which questions to answer next like this:

Yes ☐

No ☑ Go to **1**

HOW TO RETURN THIS QUESTIONNAIRE

If the interviewer is still in your home when you have completed the questionnaire, please hand it back to them. If not, please return the completed questionnaire in the pre-paid envelope as soon as you possibly can.

PLEASE START THE QUESTIONNAIRE AT QUESTION **1** ON THE NEXT PAGE

THANK YOU AGAIN FOR YOUR HELP

1 **Which of these statements apply to you?**   20-35

Tick all that apply

I voted in the last General Election ☐ 01

I read a daily newspaper ☐ 02

I have a hobby or pastime ☐ 03

I have taken a holiday in the UK in the last 12 months ☐ 04

I have taken a holiday abroad in the last 12 months ☐ 05

I have gone on a daytrip or outing in the last 12 months ☐ 06

I use the internet and/or email ☐ 07

I own a mobile phone ☐ 08

None of these statements apply to me ☐ 09

2 **Are you a member of any of these organisations, clubs or societies?**   36-51

Tick all that apply

Political party, trade union or environmental groups ☐ 01

Tenants groups, resident groups, Neighbourhood Watch ☐ 02

Church or other religious groups ☐ 03

Charitable associations ☐ 04   → Go to **3**

Education, arts or music groups or evening classes ☐ 05

Social clubs ☐ 06

Sports clubs, gyms, exercise classes ☐ 07

Any other organisations, clubs or societies ☐ 08

No, I am not a member of any organisations, clubs or societies ☐ 09   Go to **4**

3 **Thinking about all the organisations, clubs or societies that you are a member of, how many committee meetings, if any, do you attend in a year?**   52-53

Please write the number in this box ☐

4 Now some questions about your social activities. How often, if at all, do you do any of the following activities?

Tick one box on each line

	Twice a month or more	About once a month	Every few months	About once or twice a year	Less than once a year	Never	
Go to the cinema	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	54
Eat out of the house	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	55
Go to an art gallery or museum	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	56
Go to the theatre, a concert or the opera	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	57

5 Would you like to do any of the following activities more often but feel that, for whatever reason, you cannot?

Tick one box on each line

	Yes	No	
Go to the cinema	☐ 1	☐ 2	58
Eat out of the house	☐ 1	☐ 2	59
Go to an art gallery or museum	☐ 1	☐ 2	60
Go to the theatre, a concert or the opera	☐ 1	☐ 2	61

6 **We should like to know how your health has been in general over the past few weeks**

Have you recently…   *Tick <u>one</u> box on each line*

	Better than usual	Same as usual	Less than usual	Much less than usual	
…been able to concentrate on whatever you're doing?	□ 1	□ 2	□ 3	□ 4	62

	Not at all	No more than usual	Rather more than usual	Much more than usual	
…lost much sleep over worry?	□ 1	□ 2	□ 3	□ 4	63

	More so than usual	Same as usual	Less useful than usual	Much less useful	
…felt you were playing a useful part in things?	□ 1	□ 2	□ 3	□ 4	64

	More so than usual	Same as usual	Less so than usual	Much less capable	
…felt capable of making decisions?	□ 1	□ 2	□ 3	□ 4	65

	Not at all	No more than usual	Rather more than usual	Much more than usual	
…felt constantly under strain?	□ 1	□ 2	□ 3	□ 4	66

	Not at all	No more than usual	Rather more than usual	Much more than usual	
…felt you couldn't overcome your difficulties?	□ 1	□ 2	□ 3	□ 4	67

	More so than usual	Same as usual	Less so than usual	Much less than usual	
…been able to enjoy your normal day-to-day activities?	□ 1	□ 2	□ 3	□ 4	68

	More so than usual	Same as usual	Less able than usual	Much less able	
…been able to face up to your problems?	□ 1	□ 2	□ 3	□ 4	69

	Not at all	No more than usual	Rather more than usual	Much more than usual	
…been feeling unhappy and depressed?	□ 1	□ 2	□ 3	□ 4	70

	Not at all	No more than usual	Rather more than usual	Much more than usual	
…been losing confidence in yourself?	□ 1	□ 2	□ 3	□ 4	71

	Not at all	No more than usual	Rather more than usual	Much more than usual	
…been thinking of yourself as a worthless person?	☐ 1	☐ 2	☐ 3	☐ 4	72

	More so than usual	About same as usual	Less so than usual	Much less than usual	
…been feeling reasonably happy, all things considered?	☐ 1	☐ 2	☐ 3	☐ 4	73

7 Please say how much you agree or disagree with the following statements.

*Tick **one** box on each line*

	Strongly agree	Agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Disagree	Strongly disagree	
In most ways my life is close to my ideal	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	74
The conditions of my life are excellent	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	75
I am satisfied with my life	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	76
So far I have got the important things I want in life	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	77
If I could live my life again, I would change almost nothing	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	78

8 Here are some questions about how you feel about your life in general. Please say how much you agree or disagree with the following statements.

*Tick **one** box on each line*

	Strongly agree	Moderately agree	Slightly agree	Slightly disagree	Moderately disagree	Strongly disagree	
At home, I feel I have control over what happens in most situations	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	79
I feel that what happens in life is often determined by factors beyond my control	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	80
In general, I have different demands that I think are hard to combine	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	81
In general, I have enough time to do everything	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	82
Considering the things I have to do at home, I have to work very fast	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	83

9 **Here is a list of statements that people have used to describe their lives or how they feel. How often, do you feel like this?**

Tick <u>one</u> box on each line

	Often	Some-times	Not Often	Never	
My age prevents me from doing the things I would like to	1	2	3	4	84
I feel that what happens to me is out of my control	1	2	3	4	85
I feel free to plan for the future	1	2	3	4	86
I feel left out of things	1	2	3	4	87
I can do the things that I want to do	1	2	3	4	88
Family responsibilities prevent me from doing what I want to do	1	2	3	4	89
I feel that I can please myself what I do	1	2	3	4	90
My health stops me from doing things I want to do	1	2	3	4	91
Shortage of money stops me from doing the things I want to do	1	2	3	4	92
I look forward to each day	1	2	3	4	93
I feel that my life has meaning	1	2	3	4	94
I enjoy the things that I do	1	2	3	4	95
I enjoy being in the company of others	1	2	3	4	96
On balance, I look back on my life with a sense of happiness	1	2	3	4	97
I feel full of energy these days	1	2	3	4	98
I choose to do things that I have never done before	1	2	3	4	99
I feel satisfied with the way my life has turned out	1	2	3	4	100
I feel that life is full of opportunities	1	2	3	4	101
I feel that the future looks good for me	1	2	3	4	102

244

10 The next questions are about how you feel about different aspects of your life. For each one, please say how often you feel that way.

Tick one box on each line

	Hardly ever or never	Some of the time	Often	
How often do you feel you lack companionship?	☐ 1	☐ 2	☐ 3	103
How often do you feel left out?	☐ 1	☐ 2	☐ 3	104
How often do you feel isolated from others?	☐ 1	☐ 2	☐ 3	105
How often do you feel in tune with the people around you?	☐ 1	☐ 2	☐ 3	106
How often do you feel lonely?	☐ 1	☐ 2	☐ 3	107

11 How do you feel about your local area, that is everywhere within a 20 minute walk or about a mile of your home? Please tick one box on each line.
The closer your tick is to a statement the more strongly you agree with it.

Tick one box on each line

	1 2 3 4 5 6 7		
I really feel part of this area	☐☐☐☐☐☐☐	I feel that I don't belong in this area	108
Vandalism and graffiti are a big problem in this area	☐☐☐☐☐☐☐	There is no problem with vandalism and graffiti in this area	109
I often feel lonely living in this area	☐☐☐☐☐☐☐	I have never felt lonely living in this area	110
Most people in this area can be trusted	☐☐☐☐☐☐☐	Most people in this area can't be trusted	111
People would be afraid to walk alone after dark in this area	☐☐☐☐☐☐☐	People feel safe walking alone in this area after dark	112
Most people in this area are friendly	☐☐☐☐☐☐☐	Most people in this area are unfriendly	113
People in this area will take advantage of you	☐☐☐☐☐☐☐	People in this area will always treat you fairly	114
This area is kept very clean	☐☐☐☐☐☐☐	This area is always full of litter and rubbish	115
If you were in trouble, there are lots of people in this area who would help you	☐☐☐☐☐☐☐	If you were in trouble, there is nobody in this area who would help you	116

12 **Do you have a husband, wife or partner with whom you live?** 117

Tick one box

Yes ☐ ₁ **Go to 13**

No ☐ ₂ **Go to 15**

13 **We would now like to ask you some questions about your spouse or partner. Please tick the box which best shows how you feel about each statement.**

Tick one box on each line

	A lot	Some	A little	Not at all	
How much do they really understand the way you feel about things?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	118
How much can you rely on them if you have a serious problem?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	119
How much can you open up to them if you need to talk about your worries?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	120
How much do they criticise you?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	121
How much do they let you down when you are counting on them?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	122
How much do they get on your nerves?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	123

14 **How close is your relationship with your spouse or partner?** 124

Tick one box

Very close ☐ ₁

Quite close ☐ ₂

Not very close ☐ ₃

Not at all close ☐ ₄

15 **Do you have any children?**

*Tick **one** box*

125

Yes ☐ ₁ **Go to** **16**

No ☐ ₂ **Go to** **19**

16 **We would now like to ask you some questions about your children.**
Please tick the box which best shows how you feel about each statement.

*Tick **one** box on each line*

	A lot	Some	A little	Not at all	
How much do they really understand the way you feel about things?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	126
How much can you rely on them if you have a serious problem?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	127
How much can you open up to them if you need to talk about your worries?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	128
How much do they criticise you?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	129
How much do they let you down when you are counting on them?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	130
How much do they get on your nerves?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	131

17 **On average, how often do you do each of the following with <u>any</u> of your children, not counting any who live with you?**

*Tick **one** box on each line*

	Three or more times a week	Once or twice a week	Once or twice a month	Every few months	Once or twice a year	Less than once a year or never	
Meet up (include both arranged and chance meetings)	☐ ₁	☐ ₂	☐ ₃	☐ ₄	☐ ₅	☐ ₆	132
Speak on the phone	☐ ₁	☐ ₂	☐ ₃	☐ ₄	☐ ₅	☐ ₆	133
Write or email	☐ ₁	☐ ₂	☐ ₃	☐ ₄	☐ ₅	☐ ₆	134

18 **How many of your children would you say you have a close relationship with?**

135-136

Please write the number in this box ☐

19 Do you have any other immediate family, for example, any brothers or sisters, parents, cousins or grandchildren?

137

*Tick **one** box*

Yes ☐ ₁ **Go to 20**

No ☐ ₂ **Go to 23**

20 We would now like to ask you some questions about these family members. Please tick the box which best shows how you feel about each statement.

*Tick **one** box on each line*

	A lot	Some	A little	Not at all	
How much do they really understand the way you feel about things?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	138
How much can you rely on them if you have a serious problem?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	139
How much can you open up to them if you need to talk about your worries?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	140
How much do they criticise you?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	141
How much do they let you down when you are counting on them?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	142
How much do they get on your nerves?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	143

21 On average, how often do you do each of the following with **any** of these family members, not counting any who live with you?

*Tick **one** box on each line*

	Three or more times a week	Once or twice a week	Once or twice a month	Every few months	Once or twice a year	Less than once a year or never	
Meet up (include both arranged and chance meetings)	☐ ₁	☐ ₂	☐ ₃	☐ ₄	☐ ₅	☐ ₆	144
Speak on the phone	☐ ₁	☐ ₂	☐ ₃	☐ ₄	☐ ₅	☐ ₆	145
Write or email	☐ ₁	☐ ₂	☐ ₃	☐ ₄	☐ ₅	☐ ₆	146

22 How many of these family members would you say you have a close relationship with?

147-148

Please write the number in this box ☐

23 **Do you have any friends?**   149

Tick __one__ box

Yes ☐ ₁ **Go to** **24**

No ☐ ₂ **Go to** **27**

24 **We would now like to ask you some questions about your friends. Please tick the box which best shows how you feel about each statement.**

Tick __one__ box on each line

	A lot	Some	A little	Not at all	
How much do they really understand the way you feel about things?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	150
How much can you rely on them if you have a serious problem?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	151
How much can you open up to them if you need to talk about your worries?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	152
How much do they criticise you?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	153
How much do they let you down when you are counting on them?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	154
How much do they get on your nerves?	☐ ₁	☐ ₂	☐ ₃	☐ ₄	155

25 **On average, how often do you do each of the following with __any__ of your friends, not counting any who live with you?**

Tick __one__ box on each line

	Three or more times a week	Once or twice a week	Once or twice a month	Every few months	Once or twice a year	Less than once a year or never	
Meet up (include both arranged and chance meetings)	☐ ₁	☐ ₂	☐ ₃	☐ ₄	☐ ₅	☐ ₆	156
Speak on the phone	☐ ₁	☐ ₂	☐ ₃	☐ ₄	☐ ₅	☐ ₆	157
Write or email	☐ ₁	☐ ₂	☐ ₃	☐ ₄	☐ ₅	☐ ₆	158

26 **How many of your friends would you say you have a close relationship with?**   159-160

Please write the number in this box ☐

27 **Were you in paid employment last month?**

161

Tick one box

Yes ☐ ₁ **Go to** **28**

No ☐ ₂ **Go to** **30**

28 **Here are some statements people might use to describe their work. We would like to know how strongly you think these apply to the paid employment you did in the last month.**

Tick one box on each line

	Strongly agree	Agree	Disagree	Strongly disagree	
All things considered I am satisfied with my job	☐ ₁	☐ ₂	☐ ₃	☐ ₄	162
My job is physically demanding	☐ ₁	☐ ₂	☐ ₃	☐ ₄	163
I receive the recognition I deserve for my work	☐ ₁	☐ ₂	☐ ₃	☐ ₄	164
My salary is adequate	☐ ₁	☐ ₂	☐ ₃	☐ ₄	165
My job promotion prospects are poor	☐ ₁	☐ ₂	☐ ₃	☐ ₄	166
My job security is poor	☐ ₁	☐ ₂	☐ ₃	☐ ₄	167
I am under constant time pressure due to a heavy workload	☐ ₁	☐ ₂	☐ ₃	☐ ₄	168
I have very little freedom to decide how I do my work	☐ ₁	☐ ₂	☐ ₃	☐ ₄	169
I have the opportunity to develop new skills	☐ ₁	☐ ₂	☐ ₃	☐ ₄	170
I receive adequate support in difficult situations	☐ ₁	☐ ₂	☐ ₃	☐ ₄	171
At work, I feel I have control over what happens in most situations	☐ ₁	☐ ₂	☐ ₃	☐ ₄	172
Considering the things I have to do at work, I have to work very fast	☐ ₁	☐ ₂	☐ ₃	☐ ₄	173

29 **At what age would you like to retire?**

174-176

Write in years ☐☐☐

I have already retired ☐ 996

30 Think of this ladder as representing where people stand in our society. At the top of the ladder are the people who are the best off – those who have the most money, most education and best jobs. At the bottom are the people who are the worst off – who have the least money, least education, and the worst jobs or no jobs. The higher up you are on this ladder, the closer you are to the people at the very top and the lower you are, the closer you are to the people at the very bottom.

Please mark a cross on the <u>rung</u> on the ladder where you would place yourself.

Example:
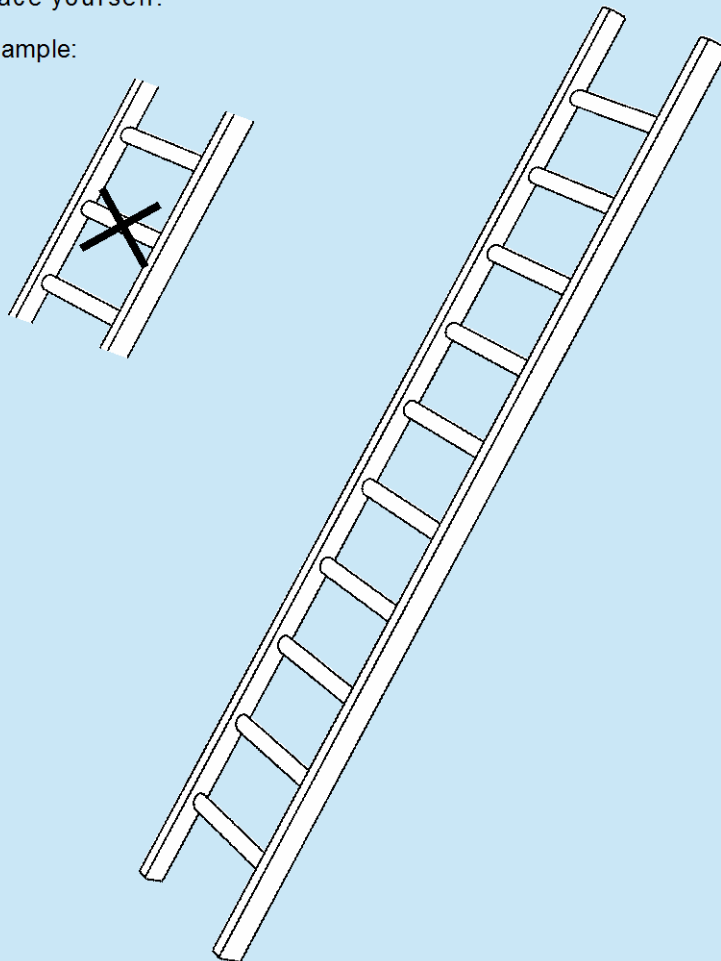
177-179

31 Has your position on the ladder changed within the last two years?

180

Tick <u>one</u> box

Yes, I have moved up   ☐   1

Yes, I have moved down   ☐   2

No, my position has not changed   ☐   3

32 Thinking now about all kinds of drinks, how often have you had an alcoholic drink of any kind during the last 12 months?

181

Tick <u>one</u> box

Almost every day ☐ 1

Five or six days a week ☐ 2

Three or four days a week ☐ 3

Once or twice a week ☐ 4 → Go to **33**

Once or twice a month ☐ 5

Once every couple of months ☐ 6

Once or twice a year ☐ 7

Not at all in the last 12 months ☐ 8 Go to **36**

33 Did you have an alcoholic drink in the seven days ending yesterday?

182

Tick <u>one</u> box

Yes ☐ 1 **Go to 34**

No ☐ 2 **Go to 36**

34 On how many days out of the last seven did you have an alcoholic drink?

183

Tick <u>one</u> box

One ☐ 1

Two ☐ 2

Three ☐ 3

Four ☐ 4 → **Go to 35**

Five ☐ 5

Six ☐ 6

Seven ☐ 7

35 Please think about <u>the day in the last week on which you drank the most.</u>
(If you drank the same amount on more than one day, please answer about the most recent of those days.)
From this list, please tick all the types of alcoholic drink which you drank <u>on that day</u>.
For the ones you drank, write in how much you drank <u>on that day</u>.
EXCLUDE NON-ALCOHOLIC OR LOW-ALCOHOL DRINKS, EXCEPT SHANDY.

Write in how much drunk on that day

Tick all drinks drunk on that day			Glasses (Count doubles as 2 singles)	Pints	Large cans or bottles	Small cans or bottles	
		184-199					
<u>Normal</u> strength beer, lager, stout, cider or shandy (less than 6% alcohol) – exclude bottles/cans of shandy	☐	01		☐	☐	☐	200-207
<u>Strong</u> beer, lager, stout or cider (6% alcohol or more, such as Tennants Extra, Special Brew, Diamond White)	☐	02		☐	☐	☐	208-215
Spirits or liqueurs, such as gin, whisky, rum, brandy, vodka, or cocktails	☐	03	☐				216-217
Sherry or martini (including port, vermouth, cinzano, dubonnet)	☐	04	☐				218-219
Wine (including babycham and champagne)	☐	05	☐				220-221
Alcoholic soft drinks or 'alcopops' (such as Barcardi Breezer, Smirnoff Ice)	☐	06				☐	222-223
Other kinds of alcoholic drink **Write in name of drink**							
1 [_____]	☐	07	☐	☐	☐	☐	224-225
2 [_____]	☐	08	☐	☐	☐	☐	226-227

36 **Using the measures below, how much of the following did you eat yesterday?**
Please read through the whole list before answering.
For each food type, write '0' if none eaten.

Write in number

Salad (cereal bowlfuls) [ ][ ] 228-229

Tablespoons of vegetables (raw, cooked, frozen or tinned) [ ][ ] 230-231
Include peas and greens. Do not include potatoes

Tablespoons of pulses such as baked beans, red kidney beans, lentils [ ][ ] 232-233

Tablespoons of other dishes mainly made from vegetables or pulses, such as vegetable lasagne or vegetable curry [ ][ ] 234-235

37 **Using the measures below, how much of the following did you eat yesterday?**
Please read through the whole list before answering.
For each food type, write '0' if none eaten.

Write in number

Average handfuls of very small fruit, such as grapes, berries [ ][ ] 236-237

Small fruit, such as plums, satsumas [ ][ ] 238-239

Medium fruit, such as apples, bananas, oranges [ ][ ] 240-241

Half a large fruit, such as grapefruit [ ][ ] 242-243

Average slices of a very large fruit, such as melon [ ][ ] 244-245

Tablespoons of frozen or tinned fruit [ ][ ] 246-247

Tablespoons of dried fruit, such as raisins, apricots [ ][ ] 248-249

Tablespoons of other dishes made mainly from fruit such as fruit salad or fruit pies [ ][ ] 250-251

Small glasses of fruit juice [ ][ ] 252-253

38 **If there is anything else you would like to tell us, please write in the space below. We shall be very interested to read what you have to say.** 254

[blank box]

Thank you very much for taking the time to answer our questions.
Please give the questionnaire to the interviewer or post it back in the envelope provided. All your answers will remain confidential.

Appendix C: The cross-sectional models using Chapter 5 analytical sample

Table C-1: Association between psychosocial work environment and poor self-rated oral health at wave 3 (2006-07): Sequentially adjusted logistic regression models, OR (95% CI), N=1,542

Predictors (psychosocial work environment) wave 3 (2006-07)	OR (95% CI) for poor self-rated oral health wave 3 (2006-07)		
	High (ref)	Medium	Low
Control at work			
Model 1 (crude)	1	**1.54 (1.13-2.09)****	1.45 (0.98-2.13)
Model 2 (Model1+age+gender)	1	**1.54 (1.13-2.01)****	1.43 (0.97-2.11)
Model 3 (Model2+income+education)	1	**1.44 (1.05-1.98)***	1.31 (0.88-1.95)
Model 4 (Model3+work type)	1	**1.48 (1.08-2.04)***	1.35 (0.91-2.01)
Model 5 (Model4+smoking)	1	**1.48 (1.08-2.04)***	1.37 (0.92-2.04)
Quality of work			
Model 1 (crude)	1	1.22 (0.87-1.70)	**1.49 (1.07-2.08)***
Model 2 (Model1+age+gender)	1	1.20 (0.86-1.67)	**1.45 (1.04-2.03)***
Model 3 (Model2+income+education)	1	1.15 (0.82-1.63)	1.38 (0.98-1.94)
Model 4 (Model3+work type)	1	1.17 (0.83-1.65)	1.39 (0.99-1.97)
Model 5 (Model4+smoking)	1	1.16 (0.82-1.63)	1.36 (0.97-1.92)

* $p < 0.05$, ** $p < 0.01$, $p \geq 0.05$

Table C-2: Association between psychosocial work environment and edentulousness at wave 3 (2006-07): Sequentially adjusted logistic regression models, OR (95% CI), N=1,542

Predictors (psychosocial work environment) wave 3 (2006-07)	OR (95% CI) for edentate status wave 3 (2006-07)		
	High (ref)	Medium	Low
Control at work			
Model 1 (crude)	1	**2.01 (1.22-3.30)****	1.09 (0.52-2.29)
Model 2 (Model1+age+gender)	1	**1.97 (1.19-3.24)****	1.08 (0.51-2.27)
Model 3 (Model2+income+education)	1	1.59 (0.96-2.64)	0.85 (0.40-1.81)
Model 4 (Model3+work type)	1	1.55 (0.93-2.59)	0.83 (0.39-1.78)
Model 5 (Model4+smoking)	1	1.51 (0.90-2.54)	0.85 (0.40-1.82)
Quality of work			
Model 1 (crude)	1	0.74 (0.41-1.34)	1.34 (0.78-2.28)
Model 2 (Model1+age+gender)	1	0.77 (0.42-1.41)	1.48 (0.86-2.55)
Model 3 (Model2+income+education)	1	0.70 (0.38-1.29)	1.31 (0.75-2.29)
Model 4 (Model3+work type)	1	0.69 (0.37-1.28)	1.30 (0.74-2.27)
Model 5 (Model4+smoking)	1	0.68 (0.37-1.25)	1.21 (0.69-2.13)

* $p < 0.05$, ** $p < 0.01$, $p \geq 0.05$

Table C-3: Association between psychosocial work environment and Oral Impacts on Daily Performance at wave 3 (2006-07): Sequentially adjusted logistic regression models, OR (95% CI), N=1,542

Predictors (psychosocial work environment) wave 3 (2006-07)	OR (95% CI) for Oral Impacts on Daily Performance wave 3 (2006-07)		
	High (ref)	Medium	Low
Control at work			
Model 1 (crude)	1	1.41 (0.85-2.32)	1.65 (0.92-2.98)
Model 2 (Model1+age+gender)	1	1.41 (0.85-2.32)	1.73 (0.96-3.14)
Model 3 (Model2+income+education)	1	1.45 (0.87-2.43)	1.76 (0.96-3.21)
Model 4 (Model3+work type)	1	1.50 (0.89-2.51)	1.81 (0.99-3.33)
Model 5 (Model4+smoking)	1	1.50 (0.90-2.52)	1.83 (1.00-3.37)
Quality of work			
Model 1 (crude)	1	1.15 (0.65-2.04)	**1.89 (1.11-3.22)****
Model 2 (Model1+age+gender)	1	1.21 (0.68-2.15)	**1.99 (1.16-2.42)****
Model 3 (Model2+income+education)	1	1.21 (0.68-2.16)	**1.96 (1.14-3.38)****
Model 4 (Model3+work type)	1	1.25 (0.70-2.22)	**2.02 (1.17-3.50)****
Model 5 (Model4+smoking)	1	1.22 (0.68-2.19)	**1.99 (1.15-3.44)****

* $p < 0.05$, ** $p < 0.01$, $p \geq 0.05$

Appendix D: The cross-sectional and longitudinal models using Chapter 6 sample

Table D-1: Association between psychosocial work environment and poor self-rated oral health at wave 3 (2006-07): Sequentially adjusted logistic regression models, OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07)	OR (95% CI) for poor self-rated oral health wave 3 (2006-07)		
	High (ref)	Medium	Low
Control at work			
Model 1 (crude)	1	1.36 (0.92-2.01)	1.32 (0.81-2.15)
Model 2 (Model1+age+gender)	1	1.34 (0.90-1.99)	1.23 (0.75-2.02)
Model 3 (Model2+income+education)	1	1.19 (0.79-1.79)	1.10 (0.66-1.84)
Model 4 (Model3+work type)	1	1.20 (0.79-1.81)	1.12 (0.67-1.88)
Model 5 (Model4+smoking)	1	1.20 (0.79-1.81)	1.14 (0.67-1.91)
Quality of work			
Model 1 (crude)	1	1.44 (0.94-2.20)	**1.69 (1.11-2.58)****
Model 2 (Model1+age+gender)	1	1.44 (0.93-2.21)	**1.65 (1.07-2.53)****
Model 3 (Model2+income+education)	1	1.35 (0.87-2.09)	1.52 (0.98-2.35)
Model 4 (Model3+work type)	1	1.35 (0.87-2.09)	1.53 (0.98-2.37)
Model 5 (Model4+smoking)	1	1.34 (0.86-2.08)	1.47 (0.95-2.29)

* p < 0.05, ** p < 0.01, p ≥ 0.05

Table D-2: Association between psychosocial work environment and edentulousness at wave 3 (2006-07): Sequentially adjusted logistic regression models, OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07)	OR (95% CI) for edentate status wave 3 (2006-07)		
	High (ref)	Medium	Low
Control at work			
Model 1 (crude)	1	**2.13 (1.16-3.82)***	1.36 (0.58-3.21)
Model 2 (Model1+age+gender)	1	**2.08 (1.13-3.85)***	1.38 (0.58-3.28)
Model 3 (Model2+income+education)	1	1.65 (0.88-3.09)	1.07 (0.44-2.58)
Model 4 (Model3+work type)	1	1.61 (0.86-3.02)	1.04 (0.43-2.51)
Model 5 (Model4+smoking)	1	1.57 (0.83-2.96)	1.05 (0.43-2.53)
Quality of work			
Model 1 (crude)	1	0.64 (0.30-1.34)	1.32 (0.69-2.50)
Model 2 (Model1+age+gender)	1	0.66 (0.31-1.40)	1.41 (0.74-2.69)
Model 3 (Model2+income+education)	1	0.61 (0.28-1.32)	1.29 (0.66-2.52)
Model 4 (Model3+work type)	1	0.61 (0.28-1.30)	1.27 (0.65-2.49)
Model 5 (Model4+smoking)	1	0.59 (0.28-1.28)	1.21 (0.62-2.38)

* p < 0.05, ** p < 0.01, p ≥ 0.05

Table D-3: Association between psychosocial work environment and Oral Impacts on Daily Performance at wave 3 (2006-07): Sequentially adjusted logistic regression models, OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07)	OR (95% CI) for Oral Impacts on Daily Performance wave 3 (2006-07)		
	High (ref)	Medium	Low
Control at work			
Model 1 (crude)	1	1.29 (0.69-2.41)	1.72 (0.85-3.50)
Model 2 (Model1+age+gender)	1	1.28 (0.68-2.40)	1.80 (0.88-3.69)
Model 3 (Model2+income+education)	1	1.25 (0.66-2.38)	1.70 (0.82-3.12)
Model 4 (Model3+work type)	1	1.31 (0.68-2.50)	1.78 (0.86-3.72)
Model 5 (Model4+smoking)	1	1.32 (0.70-2.53)	1.81 (0.86-3.80)
Quality of work			
Model 1 (crude)	1	1.36 (0.66-2.83)	**2.40 (1.22-4.71)****
Model 2 (Model1+age+gender)	1	1.46 (0.70-3.05)	**2.56 (1.30-5.06)****
Model 3 (Model2+income+education)	1	1.44 (0.69-3.02)	**2.42 (1.22-4.82)****
Model 4 (Model3+work type)	1	1.49 (0.71-3.11)	**2.51 (1.26-5.00)****
Model 5 (Model4+smoking)	1	1.49 (0.71-3.14)	**2.48 (1.24-4.96)****

* p < 0.05, ** p < 0.01, p ≥ 0.05

Table D-4: Association between psychosocial work environment at wave 3 (2006-07) and poor self-rated oral health at wave 5 (2010-11): Sequentially adjusted logistic regression models, OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07)	OR (95% CI) for poor self-rated oral health wave 5 (2010-11)		
	High (ref)	Medium	Low
Control at work			
Model 1 (crude)	1	1.11 (0.73-1.68)	**1.65 (1.03-2.65)***
Model 2 (Model1+age+gender)	1	1.10 (0.72-1.67)	1.55 (0.96-2.50)
Model 3 (Model2+income+education)	1	0.99 (0.64-1.52)	1.35 (0.83-2.19)
Model 4 (Model3+work type)	1	0.99 (0.65-1.52)	1.35 (0.83-2.21)
Model 5 (Model4+smoking)	1	0.98 (0.64-1.52)	1.36 (0.83-2.23)
Quality of work			
Model 1 (crude)	1	1.37 (0.88-2.12)	**1.78 (1.16-2.74)****
Model 2 (Model1+age+gender)	1	1.34 (0.86-2.08)	**1.73 (1.12-2.66)****
Model 3 (Model2+income+education)	1	1.26 (0.80-1.96)	1.56 (1.00-2.42)
Model 4 (Model3+work type)	1	1.26 (0.81-1.96)	**1.56 (1.01-2.43)***
Model 5 (Model4+smoking)	1	1.25 (0.80-1.96)	1.54 (0.99-2.39)

* p < 0.05, ** p < 0.01, p ≥ 0.05

Table D-5: Association between psychosocial work environment at wave 3 (2006-07) and edentulousness at wave 5 (2010-11): Sequentially adjusted logistic regression models, OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07)	OR (95% CI) for edentate status wave 5 (2010-11)		
	High (ref)	Medium	Low
Control at work			
Model 1 (crude)	1	**2.38 (1.26-4.54)****	1.87 (0.81-4.28)
Model 2 (Model1+age+gender)	1	**2.33 (1.22-4.45)****	1.85 (0.79-4.28)
Model 3 (Model2+income+education)	1	1.88 (0.97-3.63)	1.42 (0.60-3.39)
Model 4 (Model3+work type)	1	1.84 (0.95-3.56)	1.38 (0.58-3.30)
Model 5 (Model4+smoking)	1	1.80 (0.93-3.51)	1.40 (0.59-3.35)
Quality of work			
Model 1 (crude)	1	0.64 (0.28-1.44)	1.67 (0.86-3.25)
Model 2 (Model1+age+gender)	1	0.66 (0.29-1.49)	1.81 (0.92-3.57)
Model 3 (Model2+income+education)	1	0.64 (0.28-1.48)	1.73 (0.85-3.50)
Model 4 (Model3+work type)	1	0.64 (0.27-1.47)	1.70 (0.84-3.46)
Model 5 (Model4+smoking)	1	0.63 (0.27-1.46)	1.63 (0.89-3.30)

* p < 0.05, ** p < 0.01, p ≥ 0.05

Table D-6: Association between psychosocial work environment at wave 3 (2006-07) and Oral Impacts on Daily Performance at wave 5 (2010-11): Sequentially adjusted logistic regression models, OR (95% CI), N=1,058

Predictors (psychosocial work environment) wave 3 (2006-07)	OR (95% CI) for Oral Impacts on Daily Performance wave 5 (2010-11)		
	High (ref)	Medium	Low
Control at work			
Model 1 (crude)	1	0.74 (0.40-1.35)	1.27 (0.67-2.41)
Model 2 (Model1+age+gender)	1	0.72 (0.39-1.33)	1.21 (0.64-2.31)
Model 3 (Model2+income+education)	1	0.69 (0.37-1.29)	1.16 (0.60-2.23)
Model 4 (Model3+work type)	1	0.72 (0.38-1.34)	1.21 (0.62-2.34)
Model 5 (Model4+smoking)	1	0.72 (0.38-1.33)	1.22 (0.63-2.36)
Quality of work			
Model 1 (crude)	1	**1.91 (0.104-3.51)***	**1.95 (1.06-3.62)***
Model 2 (Model1+age+gender)	1	**1.90 (1.03-3.49)***	**1.92 (1.03-3.56)***
Model 3 (Model2+income+education)	1	**1.89 (1.02-3.48)***	1.83 (0.98-3.41)
Model 4 (Model3+work type)	1	**1.94 (1.05-3.59)***	1.87 (1.00-3.51)
Model 5 (Model4+smoking)	1	**1.94 (1.05-3.59)***	1.86 (0.99-3.49)

* p < 0.05, ** p < 0.01, p ≥ 0.05