Socioeconomic status plays an important role in oral health. However, little is known about the impact of employment status on oral health-related behaviors and oral health. This thesis assesses the role of employment status in oral health-related behaviors and clinical oral health and investigates whether unemployment predisposes poor oral health. The findings show that unemployment is a risk indicator for oral health-deteriorating behaviors and poor oral health in Finnish adults.
Employment status and its contribution in oral health-related behaviors and oral health
Employment status and its contribution in oral health-related behaviors and oral health

To be presented by permission of the Faculty of Health Sciences, University of Eastern Finland for public examination in CA102, Canthia building, University of Eastern Finland, Kuopio, on Friday, October 13th 2017, at 12 noon

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Institute of Dentistry, School of Medicine, Faculty of Health Sciences, University of Eastern Finland
Kuopio
2017
ABSTRACT:

Most European countries face various economic challenges and most importantly, the issue of unemployment. Nordic countries are not an exemption and experience similar challenges. With a sustained level of unemployment since 2000, Finland had to bear its financial, psychological and health-related burden. Extensive research was conducted on the detrimental effects of unemployment on general health and health-related behaviors. Nonetheless, there were some timid attempts to investigate the role of unemployment in oral health-related behaviors and oral health. This study assessed the role of employment status in oral health-related behaviors and clinically determined oral health and examined whether the findings support the hypothesis that unemployment predisposes poor oral health.

Two nationally representative surveys, the Health 2000 Survey and the Health 2011 Survey, were conducted to investigate the health and welfare of the population in Finland. These surveys included oral health examinations, interviews and questionnaires. The study examined Finns ≥ 29 years living in the mainland. In this study, cross-sectional and longitudinal analyses were employed. The study design, sampling, and weights were taken into account in statistical analyses. Data were analysed using conventional and mixed-effects regression models, which included logistic regression models (binary, multinomial and ordered) and count regression models (poisson and negative binomial).

Unemployment was inversely associated with beneficial oral health-related behaviors in terms of tooth brushing frequency at least twice a day, regular dental attendance and use of gum with xylitol on a daily basis. Unemployment was positively associated with daily smoking and frequent alcohol consumption. No association was found between unemployment and sugar consumption frequency. Regarding clusters of oral health-related behaviors, the unemployed had a higher risk of belonging to the cluster ‘overall unhealthy’ and a lower risk of belonging to the cluster ‘overall healthy’. Income and education affected the association of unemployment with oral health-related behaviors.

Unemployment was associated with higher numbers of missing teeth, filled teeth, decayed teeth and teeth with deepened periodontal pockets ≥ 4 mm and ≥ 6 mm. No association was found between unemployment and number of sound teeth. Oral health-related behaviors, income and education affected the association of unemployment and clinically determined oral health outcomes.

The findings of this study partially support the causation hypothesis, that is, unemployment predisposes poor oral health. This study concludes that unemployment is a risk indicator for oral health-deteriorating behaviors and poor oral health.
Al-Sudani, Fouad Younis Hussien
Työllisyden ja työttömyyden yhteys terveyskäyttäytymiseen ja suunterveyteen
Itä-Suomen yliopisto, terveyttieteen tiedekunta
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TIIVISTELMÄ
Useimmissa Euroopan maissa, Pohjoismaa ja Suomi mukaan lukien, erilaiset taloudelliset haasteet ja näiden seuraukset, kuten työttömyys ovat olleet arkipäivää 2000-luvulla. Työttömyyden haitallisista vaikutuksista terveyteen ja terveyskäyttäytymiseen on näyttejä, mutta työttömyyden roolista suun terveyskäyttäytymisessä ja suunterveydessä ei ole juuri tietoa.

Tässä tutkimuksessa arvioitiin työllisyyyden ja työttömyyden yhteyttä suun terveyskäyttäytymiseen ja kliinisesti määritettyyn suunterveyteen sekä arvioitiin sitä tukevatko löydökset olettamusta, jonka mukaan työttömyys altistaa huonolle suunterveydelle.


Työttömyyteen liittyi suuntervettä edistävän käyttäytyimen riittämättömyys, joka ilmeni harvempina hampaiden harjauskertoina, epäsäännöllisenä hammashäiriöisänä käymisenä ja vähäisempänä ksyilitoin käyttönä. Työttömyyteen liittyi muita useammin päivittäinen tupakointi ja tiheä alkoholinkäyttö. Työttömyyden ja sokerin käyttöihdyen välillä ei havaittu yhteyttä. Työttömiä todennäköisyys kuulua suunterveyden kannalta "yleisesti epäterveellisesti" käyttäytyvään ryhmään oli muita suurempi ja todennäköisyys kuulua "yleisesti terveelliseen" käyttäytyvään ryhmään maita pienempi. Tulot ja koulutus vaikuttivat työttömyyden ja suun terveyskäyttäytyimen yhteyteen. Työttömyyksen yhteydessä myös muita suurempaan puuttuvien tai paikattujen hampaiden määrään sekä sellaisten hampaiden määrään, joissa oli syventyneitä (≥ 4 mm ja ≥ 6 mm) ientaskuja. Työttömyyden ja terveiden hampaiden lukumäärän välillä ei havaittu yhteyttä. Suun terveyskäyttäytyminen, tulot ja koulutus vaikuttivat työttömyyden ja kliinisesti määritetyn suunterveydien yhteyteen.

Tämän tutkimuksen tulokset tukevat osittain olettamusta, jonka mukaan työttömyys ennustaa huonoa suunterveyttä. Päätelmänä todetaan työttömyyden olevan vakava vaaratekijä sekä riittämättömälle suun terveyskäyttäytytmiseelle että huonolle suunterveydelle.

Luokitus: WU 113, WU 30, WA 900
Yleinen Suomalainen asiasanasto: suun terveys; terveyskäyttäytyminen; työttömyys; terveysutkimus; pitkittäistutkimus
List of the original publications

This dissertation is based on the following original publications:


II Al-Sudani FY, Vehkalahti MM, Suominen AL. 2017. The role of employment status in 11-year changes of oral health-related behaviors – A multilevel longitudinal analysis. (Submitted).


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Abbreviations

OHRBs  Oral health-related behaviors
SEP    Socioeconomic position
DMFT   Decayed, Missing, Filled Teeth
SII    Social Insurance Institution
WHO    World Health Organization
OECD   The Organization for Economic Co-operation and Development
MT     Number of missing teeth
ST     Number of sound teeth
FT     Number of filled teeth
DT     Number of decayed teeth
PT ≥ 4 mm Number of teeth with deepened periodontal pockets ≥ 4 mm
PT ≥ 6 mm Number of teeth with deepened periodontal pockets ≥ 6 mm
ILO    International Labour Organization
ID     Personal data code for participants
1 Introduction

Unemployment represents individual and societal challenge to a person, particularly in European countries, where industrialization and employment became important parameters for economic prosperity and development sustainability. Unemployment has various consequences, which range from personal challenges and social disadvantages to health-related difficulties. Economic and governmental policy-makers recognize unemployment as a socioeconomic phenomenon that persists worldwide, even though plans and strategies were put to minimize it and its consequences. Nevertheless, segments of people in society, who are inevitably unemployed, are considered as a disadvantaged group who may need more attention in terms of social support and health care services. Similar to other European countries, Finland is also burdened by unemployment. After the 1990s financial recession, Finland witnessed stable unemployment rates, which remained under 10% (nearly quarter million citizens) of the working force to the present day (1).

Wide spectrum of disciplines (economy, psychology, public policy, management, and politics) investigated unemployment and its consequences. One important perspective is the public health and medical research. Numerous medical reports extensively examined the detrimental general health consequences of unemployment (2-5). Research also showed that unemployment influenced the general health-related behaviors, particularly smoking and use of alcohol (6-11).

Oral health is an essential and integrated part of general health that could be affected by the same environmental and individual factors as general health. In the early days of research on social determinants of health, one study concluded that clinical measures of oral health such as number of decayed, missing, and/or filled teeth or periodontal health index should be linked to measures of social outcome. Consequently, dental conditions would be placed within the broader context of health status to be relevant to policy makers (12). Since then, the social inequalities in oral health have been largely researched. Previous investigations focused mainly on education, income, and occupation as social determinants of oral health-related behaviors (OHRBs) and oral health. However, these studies mostly overlooked employment status as an integral part of socioeconomic position (SEP) (13, 14).

To summarize, limited number of studies have examined the association of unemployment with oral health. Unemployment was a risk factor for a higher number of missing teeth (15), decayed teeth (16, 17) and teeth with periodontal pockets of 5.5 mm or more in depth (18). Earlier literature on the association of unemployment with OHRBS was limited to specific indicators, for example dental attendance (19-21). Consequently, evidence on the effect of employment status on OHRBs and oral health is scarce and research in this specific area is needed.

The purpose of this doctoral thesis was to investigate the cross-sectional and longitudinal associations of employment status with OHRBs and clinically determined oral health among Finns aged ≥ 30 years, using data from two nationwide health surveys, the Health 2000 Survey and the Health 2011 Survey.
2 Review of Literature

2.1 EMPLOYMENT STATUS AS A SOCIAL DETERMINANT OF ORAL HEALTH-RELATED BEHAVIORS AND ORAL HEALTH

In their book “Social Determinants of Health”, Marmot and Wilkinson assembled the available evidence on health and labor market disadvantage, which includes unemployment, non-employment and job insecurity in industrialized nations (22). They concluded that there were two main possible hypotheses for the relationship between unemployment and ill health; causation hypothesis and selection hypothesis (either direct or indirect). The causation hypothesis states that unemployment causes or leads to ill health. This hypothesis is supported by various medical studies (23-26). Whereas, the direct selection hypothesis postulates that having poor health itself increases the risk of unemployment. Previous literature concurred with this hypothesis (27-30). The indirect selection hypothesis posits there is a third factor (i.e., confounder) that leads to both poor health and unemployment. For example, research revealed that education could affect both poor health and unemployment (31, 32). Overall, the related body of evidence agrees with both hypotheses. Nonetheless, the causation hypothesis seems more plausible than the selection hypothesis (33, 34). Besides these hypotheses, the evidence on the life-course accumulation of social and health disadvantage should not be disregarded (22, 35, 36).

Three possible explanations for the adverse effects of unemployment on health were suggested: financial strain, unemployment as a stressful life event, and changes in health-related behaviors at the time of unemployment (22). Some research supported the first reason, revealing that unemployment could lead to ill health due to financial strain or poverty, which indicates that income is a mediating factor between unemployment and ill health (2, 37). Other studies concurred with the second reason proposing that unemployment is characterized as a stressful life event, which means that unemployment is considered as psychosocial factor that could lead to ill health (3, 38). Meanwhile, another group of studies were in line with the third reason concluding that unemployment is associated with health-related behaviors (4, 39).

By adopting and applying the above-mentioned hypotheses, two oral health hypotheses could be investigated. The first is that unemployment might predispose or lead to poor oral health (causation hypothesis) either directly or indirectly. The second is that poor oral health could lead to unemployment (selection hypothesis) either directly or indirectly. The theoretical standpoint of this thesis is the causation hypothesis (either directly or indirectly via OHRBs). The empirical evidence from clinical and epidemiological studies and possible mechanisms of action on the association of unemployment with OHRBs and oral health will be discussed in the upcoming chapters.
2.2 EMPLOYMENT STATUS

The International Labour Organization (ILO) defined unemployment as “the unemployed comprise all persons above a specific age who during a reference period were without work, that is, were not in paid employment or self-employment, currently available for work, and seeking work, that is, had taken specific steps in a specified recent period to seek paid employment or self-employment.” (40). Statistics Finland defined the unemployed as “a person is unemployed if he/she is without work during the survey week (not in paid employment or working as self-employed), has actively sought employment in the past four weeks as an employee or self-employed and would be available for work within two weeks. A person who is without work and waiting for an agreed job to start within three months is also classified as unemployed if he/she could start work within two weeks. Persons laid off for the time being who fulfil the above-mentioned criteria are also counted as unemployed” (41).

The Department of Economic and Social Affairs of the United Nations defined status in employment as “status in employment refers to the type of explicit or implicit contract of employment with other persons or organizations that the employed person has in his or her job. The basic criteria used to define the groups of the classification are the type of economic risk, an element of which is the strength of the attachment between the person and the job, and the type of authority over establishments and other workers that the person has or will have in the job. Care should be taken to ensure that an employed person is classified by status in employment on the basis of the same job used for classifying the person by ‘occupation’, ‘industry’, ‘sector’” (42). Employment status differs from occupational status. The person could have a specific occupation but he/she may be at the same time employed or unemployed. Occupation was defined as “the type of work done in a job by the person employed (or the type of work done in the last job, if the person is unemployed), irrespective of the industry or the status in employment in which the person should be classified. Type of work is considered in terms of the main tasks and duties performed in the job” (42).

Length of unemployment was defined as “duration of unemployment refers to the duration of the period during which the person recorded as unemployed was seeking or available for work. The reported duration should consist of a continuous period of time up to the reference period.” (43). Both Finland and Europe defined long-term unemployment as unemployed persons who have been looking for work for one year or more (44, 45).

During the last two decades of the 20th century and the beginning of the 21st century, western societies witnessed two significant alterations in labor markets, that is, a steep rise in unemployment rates and the collapse of traditional industrial structures. These changes brought about more diverse classifications of employment status, which was traditionally classified into unemployed versus employed (46). These classifications included categories such as: duration of contract (temporary or permanent), working time (part-time or full-time), type of employer (employed by other or self-employed), skills (white-collar, blue-collar) and profession types (managers, non-manual workers, and manual workers).
2.3 UNEMPLOYMENT IN FINLAND

The Finnish population reached the highest level of unemployment rate (the ratio of 15-74-year-old unemployed persons to the active population of the same age) during the financial recession of the 1990s (all time high of 19.90% in 1994) (47). Thereafter, Finland witnessed relatively stable unemployment rates lower than 10% since 2000 (1), which counts for nearly quarter million unemployed persons (Figure 1). Since 1990, unemployment rates among females were almost close to those of the males. However, unemployment rates among females were lower than those among males since 2009 (Table 1). Unemployment rates were higher among youngsters (aged 15-24 years) compared to the total unemployment rates. Long-term unemployed people comprised nearly an average of 23% of the total unemployed individuals in Finland (Table 1).

![Unemployed](image)

**Figure 1.** Number of unemployed persons in Finland since 1990 (1)
Table 1. Percentages of unemployment rates in Finland since 2000 (1)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Males</th>
<th>Females</th>
<th>15-24 years of age</th>
<th>Long-term unemployed¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>9.8</td>
<td>9.1</td>
<td>10.6</td>
<td>21.4</td>
<td>27.2</td>
</tr>
<tr>
<td>2001</td>
<td>9.1</td>
<td>8.6</td>
<td>9.7</td>
<td>19.8</td>
<td>24.0</td>
</tr>
<tr>
<td>2002</td>
<td>9.1</td>
<td>9.1</td>
<td>9.1</td>
<td>21.0</td>
<td>23.1</td>
</tr>
<tr>
<td>2003</td>
<td>9.0</td>
<td>9.2</td>
<td>8.9</td>
<td>21.8</td>
<td>23.4</td>
</tr>
<tr>
<td>2004</td>
<td>8.8</td>
<td>8.7</td>
<td>8.9</td>
<td>20.7</td>
<td>22.3</td>
</tr>
<tr>
<td>2005</td>
<td>8.4</td>
<td>8.2</td>
<td>8.6</td>
<td>20.1</td>
<td>23.5</td>
</tr>
<tr>
<td>2006</td>
<td>7.7</td>
<td>7.4</td>
<td>8.1</td>
<td>18.7</td>
<td>23.7</td>
</tr>
<tr>
<td>2007</td>
<td>6.9</td>
<td>6.5</td>
<td>7.2</td>
<td>16.5</td>
<td>22.7</td>
</tr>
<tr>
<td>2008</td>
<td>6.4</td>
<td>6.1</td>
<td>6.7</td>
<td>16.5</td>
<td>18.0</td>
</tr>
<tr>
<td>2009</td>
<td>8.2</td>
<td>8.9</td>
<td>7.6</td>
<td>21.5</td>
<td>16.5</td>
</tr>
<tr>
<td>2010</td>
<td>8.4</td>
<td>9.1</td>
<td>7.6</td>
<td>21.4</td>
<td>23.4</td>
</tr>
<tr>
<td>2011</td>
<td>7.8</td>
<td>8.4</td>
<td>7.1</td>
<td>20.1</td>
<td>22.4</td>
</tr>
<tr>
<td>2012</td>
<td>7.7</td>
<td>8.3</td>
<td>7.1</td>
<td>19.0</td>
<td>21.5</td>
</tr>
<tr>
<td>2013</td>
<td>8.2</td>
<td>8.8</td>
<td>7.5</td>
<td>19.9</td>
<td>21.0</td>
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<tr>
<td>2014</td>
<td>8.7</td>
<td>9.3</td>
<td>8.0</td>
<td>20.5</td>
<td>22.8</td>
</tr>
<tr>
<td>2015</td>
<td>9.4</td>
<td>9.9</td>
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<td>22.4</td>
<td>24.9</td>
</tr>
<tr>
<td>2016</td>
<td>8.8</td>
<td>9.0</td>
<td>8.6</td>
<td>20.1</td>
<td>26.3</td>
</tr>
</tbody>
</table>

¹ Unemployed continuously for 12 months or longer

The social welfare of the unemployed in Finland is protected by the Finnish law and it is handled by the Social Insurance Institution (SII), which provides financial assistance in form of two types of social benefits: unemployment allowance (basic or earnings-related) and labor market subsidy. The unemployment allowance is paid for 500 days (for 5 days a week). If the individual does not meet the condition for the allowances, he/she may be eligible for labor market subsidy. Such subsidy is payable to unemployed job-seekers who join the labor market for the first time or otherwise have no recent work experience. It can also be paid to long-term unemployed individuals who have exhausted their 500-day eligibility for the basic or earnings-related allowance (48).

Finland is among the countries that follow the Nordic welfare model, which is characterized by comprehensive public policies, i.e. the social responsibility of the state towards the market and civil society. This model also ensures universal basic social rights in the form of services and financial benefits for all people. Universalism does not prevent these social rights to be individualized, that is, benefits are allocated and evaluated according to individual’s situation apart from the rest of the family (except for the benefits for families with children and social assistance) (49).

The Nordic welfare model also includes policies to encourage high employment and to combat unemployment, especially long-term unemployment. This model of welfare involves equality of opportunity and results, which means policies that help in increasing equality between different groups according to gender, age, class, family situation, ethnicity or region. The Nordic welfare requires high quality services, which are dependent on well-educated and trained employees in the social, health and education sectors. Lastly, this model of welfare includes generous social security for low-income groups to aid them in having an acceptable standard of living (50). As a result, The Nordic countries are
acquainted to have low inequality in the distribution of income and low poverty rates (51). Nonetheless, the Nordic welfare model faces challenges such as globalization, Europeanization, changing structures in the family and the labour market, a changing age composition, old and new social problems, and the popularity of the welfare state. These challenges are increasing income inequality and unemployment in the Nordic countries (49).

2.4 EMPLOYMENT STATUS AND ORAL HEALTH-RELATED BEHAVIORS

2.4.1 Tooth brushing
Little is known about tooth brushing habits and frequencies among the unemployed. A study which analysed a cross-sectional sample of Finnish individuals (n=4,417, aged 30-64) indicated that being employed is associated with a higher number of oral health-promoting behaviors (tooth brushing twice daily, fluoridated toothpaste used daily, electric toothbrush used daily, dental floss or interdental brush used daily) compared to the unemployed (52). A longitudinal study in New Zealand targeted behavioral intervention over 10 weeks among unemployed adults (n=171, aged 18-24). Recruits completed a baseline survey and then responded to a series of motivational text messages to increase tooth brushing frequency. The findings showed that self-reported tooth brushing frequency (twice or more per day) increased from 51% at baseline to 73% at week 9 follow-up (53). However, a study found that flexibility of working time schedule is related to high tooth cleaning frequency among dentate Brazilian workers (aged 25-44, n=471) recruited for cross-sectional study (54).

2.4.2 Dental attendance
Previous studies revealed conflicted results of the association of employment status with dental attendance. An American study analysed cross-sectional data from the National Health Interview Survey where participants were dentate and from different ethnic groups (n=49,687, aged 18-64 years). The findings indicated that employment status was not predictive factor for dental care utilization (20). An analysis of data randomly sampled from the central Finnish population register of the annual health surveys (years 1991-1994) also revealed that employment status was not a significant predictor for dental service utilization among non-institutionalized persons (n=3250, aged 25-79 years) (55). Males in employment had lower odds of visiting the dentist in the past year than those unemployed, an Irish cross-sectional study concluded based on a large random sample of adults recruits (n=10,364, aged ≥ 18 years). The study argued that the low odds of dental attendance for males in employment could indicate a lack of flexibility in taking time off work to visit a dentist (21).

However, another Finnish study showed that even though the differences in the use of services associated with occupation decreased from 1978 to 1997, the individuals who visited a dentist least often in 1997 were those who were unemployed. The analysis was based on data of repeated cross-sectional surveys from 1978 to 1997 (n=5,000, aged 15-64
Likewise, a cross-sectional study found that the employed had higher likelihood to have visited a dentist in the past year than the unemployed among Nigerian adults (n=358, aged 18-64 years) (56).

### 2.4.3 Sugar consumption and use of gum with xylitol

Few studies investigated the association of unemployment with sugar consumption or xylitol. Based on analyses of the Low Income diet and Nutrition Survey data of adults (n=2,796, aged ≥ 19 years) in the United Kingdom, a study concluded that there were no significant differences in non-milk extrinsic sugars consumption between employment groups (unemployed, employed, still in full-time education) (57). A Finnish study based on a cross-sectional sample of adults (n=4,417, aged 30-64), concluded that being employed was related with a higher number of oral health-promoting behaviors (no sugar in coffee or tea, other sugary drinks consumed less frequently than daily, xylitol chewing gum used three times or more daily) compared to the unemployed. (52).

### 2.4.4 Smoking

The smoking habits of the unemployed have been the focus of multiple research reports. Based on analysis of data collected as a part of the German randomized controlled trial of proactive alcohol interventions among job-seekers (n=7,906, aged 18-64), the study revealed that duration of unemployment was related to smoking as high proportions (58%) of current tobacco smokers were found among long-term unemployed individuals (6).

A repeated cross-sectional data analysis based on the Behavioural Risk Factor Surveillance System (BRFSS) survey for 2005-2010 revealed that the unemployed had a substantially higher observed smoking prevalence (30%) than the average American adult population (n=1,981,607, aged ≥ 18 years) (7). Similarly, the findings of a large cross-sectional data showed that smoking prevalence was higher among the job-seeking unemployed relative to the employed and non-job-seeking unemployed. The data were analysed from the 2007 and 2009 California Health Interview Surveys of non-institutionalized adults (n=68,501, aged 20-65) to examine the association of cigarette smoking with employment status. (8).

Unemployment was a risk factor for decreased quitting and smoking relapse. Nevertheless, insecure employment was an even stronger predictor of smoking behavior than unemployment. These findings were based on the Korean Labor and Income Panel Study among male respondents (n=1,877, aged 20-59 years) (58). In addition, the results of another research indicated that unemployment was associated with nearly twice the subsequent odds of smoking and increased cigarette consumption among male smokers. The study was based on eight waves of geocoded Framingham Heart Study Offspring Cohort data in United States from 1971 to 2008 (n=5,124) (59).

### 2.4.5 Alcohol consumption

Previous studies extensively researched the relationship between unemployment and alcohol consumption. The findings of one study indicated that problem drinking was more likely in communities with high unemployment rates. The study used a large random sample of older adolescents and adults (n=21,367, aged ≥15) who were pooled from the
Belgian Health Interviews Surveys 2001 and 2004 (9). Rising unemployment rate is associated with the number of days consuming at least 5 drinks per day but not associated with the quantity of alcohol consumed. A study concluded based on a combined data from the ongoing National Health Interview Survey (1997-2011) utilized to evaluate the ethnicity of the heavy-drinking behavior of American adults (n=20,075, aged 18-85) (60).

Job loss during past year leads to a corresponding increase in average daily ethanol consumption, binge drinking days and alcohol abuse possibly due to factors such as mental strain and financial pressure. These findings were based on a robust analysis of longitudinal study collecting information of individuals (n=14,406, aged ≥18 years) in the United States (10). A systematic review suggested that unemployment was strongly correlated with greater alcohol consumption, based on analysis of 35 scientific articles on how economic crises affect alcohol consumption and alcohol-related health problems in adult population (aged ≥18 years) (11).

2.4.6 Clustering of oral health-related behaviors

So far, the previously published research assessed the association of employment status with each of the OHRBs separately. However, there is evidence that OHRBs occur as clusters of behaviors (oral health-promoting behaviors versus oral health-deteriorating behaviors) (61-63). In a study based on a cross-sectional sample of Finnish citizens (n=4,417, aged 30-64), being employed indicated a higher number of oral health-promoting behaviors (tooth brushing twice daily, daily use of fluoridated toothpaste, electric toothbrush, dental floss or interdental brush, no sugar in coffee or tea, other sugary drinks consumed less frequently than daily, xylitol chewing gum used three times or more daily, dental check-ups undergone on a regular basis and non-smoking) compared to the unemployed (52).

2.5 EMPLOYMENT STATUS AND ORAL HEALTH

One indicator for clinical oral health is the number of missing teeth. The 1966 Birth Cohort was a large general population birth cohort study in Northern Finland. An analysis of the data were undertaken when the cohort had reached 31 years of age (n=8,690) in 1997-1998. The findings showed that tooth loss was associated with 5 times the odds of never being employed and 2 times the odds of being mostly unemployed, compared to those who were never unemployed (64). A cross-sectional study found that unemployment was a significant risk factor for missing teeth after adjusting for OHRBs among working-age German adults (n=2,501, aged 25-59 years) (15). One indicator of lower number of missing teeth is the retention of natural teeth. A random sample of Irish adults (n=2,888, aged ≥ 16) from the 2000-2002 national survey of adult oral health was used to investigate the non-biological factors of tooth retention. The findings implied that being in employment was associated with an increased number of retained natural teeth and sound untreated teeth (65).

Another indicator for clinical oral health is decayed teeth or caries. An Australian study included a random sample of adults (n=4,549, aged ≥ 18 years) to examine the role of
socioeconomic and psychosocial factors in oral health. The findings indicated that not being employed was associated with oral health in terms of higher number of decayed, missing and filled permanent teeth (DMFT) after controlling for demographic and behavioral factors (66). Similarly, a study included stratified random sample of young adults (n=2,300, aged 20-25 years) selected from the South Australian electoral roll to identify the risk factors of caries experience. The results showed that being on government’s benefits or unemployed were risk indicators for the presence of untreated cavitated decayed surfaces (16). Similarly, unemployment was found to be associated with untreated dental caries prevalence among a convenience sample of aboriginal Australian adults (n=312, aged 22-73 years) (17).

Periodontal status is considered as an important indication for clinical oral health. A British case-control study evaluated a wide range of live-events that could be linked to periodontitis among adults from different ethnicities (n=100, aged 30-59 years). It was concluded that being unemployed was associated with periodontitis in terms of any periodontal pocket of 5.5 mm or more in depth and with high levels of dental plaque after adjusting for OHRBs and socio-demographics (18).

2.6 POSSIBLE MECHANISMS OF ACTION

According to the theoretical concept of causation hypothesis and the empirical evidence on the association of SEP with OHRBs and oral health, unemployment could affect oral health through three possible pathways. The first pathway is that unemployment could influence oral health via OHRBs, i.e. OHRBs act as mediating factor between unemployment and oral health (20, 52). Unemployment could also influence OHRBs through financial strains, i.e. income acts as a mediating factor between unemployment and OHRBs (14, 67). In particular, a systematic review concluded that two behavioral mechanisms by which economic crises can influence alcohol consumption and alcohol-related health problems. The first mechanism posited that psychological distress caused by unemployment and income reductions can increase drinking problems. The second mechanism proposed that due to tighter budget constraints, individuals tend to spend less money on alcohol beverages (11).

The second pathway is psychosocial factors such as stress, distress or anxiety. Unemployment is a stressful life event that can lead to stress or anxiety. A robust evidence found consistent association of stress and distress with periodontal diseases (68, 69). Previous research also revealed that individuals with a higher SEP had fewer decayed and missing teeth than those in lower SEP. Such SEP differences in oral health outcomes could be due to the better capability of higher SEP groups to adopt and keep good oral health (70). Individuals from lower SEP groups such as the unemployed are more susceptible to stress, due to limited resources with which to cope than their higher SEP counterparts (71).

The third pathway is that unemployment might affect the income level of the individual which in turn influences oral health. In general, there is an income difference between the
employed and the unemployed people and epidemiological studies have found that income is a strong risk factor for poor oral health (72-74).

### 2.7 SUMMARY OF LITERATURE

Two theoretical hypotheses paved the way to investigate the association of unemployment with health and health-related behaviors. Oral health research followed through. Nonetheless, the few empirical studies that investigated employment status and oral health were mainly cross-sectional. There is a gap in information based on longitudinal data. Moreover, the previously published studies mainly used either one or two clinical oral health outcomes (caries or missing teeth) in their analyses. As for employment status and OHRBs, previous literature was mainly and understandably focused on smoking, alcohol and dental attendance. The evidence on the association of unemployment with higher frequency of smoking and alcohol consumption is overwhelming. Nonetheless, research on the association of employment status with tooth brushing frequency, sugar consumption, and xylitol consumption was limited.

A plethora of reports investigated the association of SEP with OHRBs and oral health in both cross-sectional and longitudinal settings. Nevertheless, these reports only included occupation, education and income as indicators for SEP, overlooking employment status as SEP component. Moreover, social gradient of oral health inequalities received great attention in published literature. Despite that, these studies did not include employment status in the analyses. The literature review in this study did not include the research that investigated the ORHBs and oral health of the homeless, who usually are unemployed most of the time (75-78) because these specific groups of individuals are more affected by homelessness than just being unemployed. However, one might argue that one way to change their situation is by providing them with employment opportunities but the complexities of their lives may prove otherwise.

Overall, the available empirical evidence from previous literature mainly supported the causation hypothesis more than the selection hypothesis in explaining the relationship of unemployment with OHRBs and oral health. Research found a direct association between unemployment and oral health, while other studies found that unemployment was related to oral health indirectly via OHRBs. Lastly, based on previous literature, Figure 2 summarizes the conceptual model of the relationships of employment status, SEP and OHRBS with oral health in reference to the relevant epidemiological and clinical studies.
Figure 2. Conceptual model of employment, oral health-related behaviors and oral health and their relationship with other factors drawn based on previous studies.
3 Aims of the study

The general aim of this thesis was to evaluate the role of employment status in oral health-related behaviors and oral health and to assess whether the findings from the present study support the causation hypothesis (i.e. unemployment leads to or predisposes oral health either directly or indirectly via oral-health-related behaviors).

The specific aims of this thesis were:

- To investigate the cross-sectional association of employment status with oral health-related behaviors and clinically determined oral health.
- To examine the longitudinal association of employment status with oral health-related behaviors and clinically determined oral health.
4 Population and methods

4.1 THE HEALTH 2000 AND 2011 SURVEYS

The National Institute for Health and Welfare (THL, previously the National Institute of Public Health, KTL) in Finland had the overall responsibility to conduct the two nationally representative surveys in 2000 and 2011. Multiple partners and collaborators were involved in different stages of the project (79, 80). In the Health 2000 Survey, a stratified two-stage cluster sampling design of 15 largest cities and 65 health districts in Finland was used (80). The total sample size of the Health 2000 Survey was 9,922. Of these, those aged ≥ 30 years (n=8,028) were invited to participate in the health examination. Data collection started with a health interview in which 7,087 subjects (88%) participated, followed by a health examination, including a clinical oral examination (n=6,335) (79%). In addition, subjects were requested to fill in self-administered postal questionnaires.

The Health 2011 Survey was a follow-up study of the Health 2000 Survey. All members of the Health 2000 survey sample (n=9,922), alive and living in Finland who had not refused to take part, were invited to participate in the follow-up survey (aged ≥ 29 years, n=8,135). The sample of those aged ≥ 30 years in 2011 comprised 7,964 adults, of whom 4,018 participated in the home interview. Only those adults living in southern or northern parts of Finland (2 of the 5 examination areas n=3,713) were invited to partake in the clinical oral examination, and 1,496 agreed (40%) (79).

This thesis comprises four studies; two cross-sectional (articles I and III) and two longitudinal (articles II and IV) based on two national surveys (the Health 2000 Survey and the Health 2011 Survey). Figure 3 shows the sample sizes of the two surveys and the exclusion criteria and the samples analysed in the present study.
Figure 3. Flow chart of the two surveys and final sample sizes of studies I-IV
4.2 EXPLANATORY MEASUREMENTS

The Health 2000 Survey and the Health 2011 Survey retrieved information either from interviews or from population registers about following items:

4.2.1 Employment status
Information about employment status was collected during the interview (80): “Which of the following alternatives best describes your current main activity?” The eight alternatives offered as answers were: “full time employment”, “part-time employment”, “student”, “retired”, “unemployed or laid off”, “management of own household or care of family members”, “conscript or non-military service”, or “others”. These answers were dichotomized into unemployed (or laid-off) and employed (all other options) in articles I-IV. Information about length of unemployment was obtained from the question: “How many months has your current unemployment or laid off period lasted?” Length of unemployment was classified into four categories: ≤1, >1-2, >2-5, and >5 years in articles I, III and IV. Long-term unemployment was defined as unemployment period longer than 12 months (45).

4.2.2 Demographics
Age and gender of participants were retrieved from population registers. Marital status was inquired in the interview and was recorded as follows: “married; living with your partner”, “divorced or living apart”, “widowed”, or “single”. In articles I and II, marital status was dichotomized into those who were married or cohabiting and those who were single, divorced or widowed. Information about urbanization was based on data from Statistics Finland, which comprised three categories: “urban”, “semi-urban”, and “rural”. The original categories were used in article III.

4.2.3 Socioeconomic position
Information about income was collected from self-reported monthly household income during the health interview, which was then formatted into the Organization for Economic Co-operation and Development (OECD) equivalence scale, which allocates a weight of 1 to the first household member, 0.7 to each additional adult, and 0.5 to each child aged under 18 years (81). The OECD income was categorized into “lowest”, “middle”, and “highest”. These three categories were employed in articles I-IV. The level of education of the participants comprised information about their basic and vocational education. The basic education question posed to the respondents included eight options for the highest level of education accomplished, ranging from “less than elementary school” to “matriculation examination”. The vocational education question instructed the participants to choose from 11 options of the highest level of education accomplished, ranging from “no vocational education” to “doctoral degree”. The educational level was then classified into three categories: “basic”, “intermediate”, and “higher”(80). These three categories were used in articles I-IV.
4.3 OUTCOME MEASUREMENTS

The Health 2000 Survey and the Health 2011 Survey collected information during interviews, questionnaires and health examinations about following items:

4.3.1 Oral health-related behaviors
Tooth brushing frequency was assessed by the question (82): “How often do you usually brush your teeth?” with options: (1) “more often than twice a day”, (2) “twice a day”, (3) “once a day”, (4) “less often than every day”, or (5) “never”. These responses were dichotomized into at least twice a day (1 and 2) or more seldom (3, 4 and 5) in article I, whereas the original 5 responses were used in article II.

Dental attendance was inquired by asking (82): “Do you usually go to a dentist…” with options: (1) “regularly for check-up”, (2) “only when you have toothache or some other trouble”, or (3) “never”. These answers were dichotomized into regularly (1) or irregularly or never (2 and 3) in article I, whereas the original 3 responses were utilized in article II.

Use of sugar in coffee or tea and use of xylitol in chewing gum were queried with the question (82): “How often do you consume the products listed below? Answer separately for each product”. Eight different products were presented with five options: (1) “three times a day or more often”, (2) “once or twice a day”, (3) “from two to five times a week”, (4) “more rarely”, or (5) “never”. The responses for both use of sugar in coffee or tea and use of xylitol were classified into use on a daily basis (1 and 2) or less often than daily (3, 4 and 5) in article I, whereas the original 5 responses were used in article II.

Smoking was assessed by a question with options (80): “daily”, “occasionally” or “not at all” after the respondents had answered questions about whether they had smoked ever in their lifetime (yes/no) and whether they had smoked at least 100 times (yes/no). Daily smokers were those who reported to have smoked over 100 times in their lifetime and chose the option “daily” to the question about smoking. Occasional smokers were those who reported to have smoked more than 100 times in their lifetime but not currently daily smokers, in addition to those who had quit smoking. The non-smokers included those who reported no current smoking and those who reported never to have smoked in their lifetime, or those who reported to have smoked fewer than 100 times in their lifetime. Smoking was dichotomized into daily smoker and occasional or non-smoker in article I, whereas original categories were used in article II.

The information about alcohol use was collected in the questionnaire (80), which also included items regarding frequency of alcohol consumption; frequency of drinking beer, cider or premixed drinks; and the amount ordinarily consumed per day. The questionnaire also included a question concerning average alcohol consumption during the previous 12 months, in bottles per week. Corresponding questions on frequency and quantities were asked for wine consumption and for consumption of spirits. Alcohol use over the risk limit was defined as maximum amounts of alcohol used (over seven portions for men and over four portions for women) during any one drinking occasion within the past 12 months [one portion equals one bottle (333 ml) of beer, a glass (120 ml) of mild wine, a glass (80 ml) of...
strong wine, or a glass (40 ml) of spirits or other strong alcohol]. In article I, alcohol consumption was dichotomized into ‘alcohol consumption exceeding the risk limits > 7 doses for men and > 4 doses for women on one occasion, with answers yes or no’ was used. The amount of alcohol consumption (grams/week) was utilized as covariate in regression analyses.

4.3.2 Clinically determined oral health

Five calibrated dentists with the aid of a dental nurse or an oral hygienist performed the clinical oral examination. A dental chair, a portable dental unit, a high-powered suction motor, and a fiber-optic headlamp were used. The dental instruments that were used in the study were a dental mirror, a fiber-optic light, and a World Health Organization (WHO)-approved periodontal probe (82). Tooth identification and determination of its status were performed based on the methodology of the Mini-Finland Survey (83) as well as on the WHO guidelines (84).

The presence of teeth was recorded tooth by tooth and included all teeth or tooth remnants that were visible and tactile in the mouth. The teeth were blown dry before the status of all tooth surfaces was examined, and observations were recorded for each tooth as follows: sound; decayed (either primary or secondary caries cavities extending into the dentine, separately for coronal or root surfaces or both); filled (no caries lesion); fractured; and residual root, with or without caries. In this thesis, the number of missing teeth was calculated by subtracting the number of teeth present from the maximum number of teeth (28 teeth). Thus, subjects with ≥ 28 teeth were considered having no missing teeth. Except for the wisdom teeth, periodontal pocket depth was measured on four sites of each tooth, and the highest value for each tooth was recorded as follows: 0, no pockets; 1, at least one pocket ≥ 4 mm; and 2, at least one pocket ≥ 6 mm. The percentage agreement between examiners and the reference examiner was 77% in the assessment of periodontal pockets by tooth (k= 0.41) and 93% (k = 0.87) (n = 269) in dental status by tooth (82).

4.4 METHODS

4.4.1 Statistical analyses

For the descriptive analyses, parametric tests (Pearson’s chi-squared) were employed in articles I, II and non-parametric tests (Wilcoxon rank-sum, Kruskal Wallis rank) were employed in articles III, IV, respectively. Logistic regression models (binary, multinomial and ordered) were employed in articles I, II. Poission (due to the skewed nature of data) and negative binomial regression models (due to over dispersions of the models’ fitted values) were applied in articles III and IV, respectively. Latent Class Analysis was utilized in article I (for the sub analysis of clusters of OHRBS).

The analyses in this study took into account data with unequal sampling probabilities and correcting the effects of non-response (unit and item non-response) by using the sample weights in models used in articles I-IV. Number of teeth present as offset variable was used in articles III and IV, except for number of missing teeth. Stratification of unemployment
and clinically determined oral health by OHRBs was employed in article III. Covariates were added sequentially to the models, starting with demographics factors followed by SEP then OHRBs. In addition, in articles II and IV, gender and income at baseline (income information for the follow-up study was not available) were considered as time-invariant covariates, while age, year of examination, education, dental attendance, tooth brushing frequency, smoking, and amount of alcohol used (grams/week) or alcohol consumption frequency were considered as time-variant covariates.

In the longitudinal analysis of the Health 2000 Survey and the Health 2011 Survey, mixed-effects models of both negative binomial and logistic regression were employed in articles II and IV. In mixed-effects models, exposures, outcomes and covariates were used as fixed effects, whereas three clustering levels were used as random effects. However, stratum was excluded from survey weights and random effects due to no convergence. The study included clustering levels; level one: strata (15 largest towns and 5 university hospital districts), level two: health center districts, and level three: individual level (articles II and IV). Clustering influences the outcome estimates due to the hierarchical structure of the collected data at baseline and follow-up (85). Multilevel mixed-effects models handle well the clustering effects of panel data, correlation of repeated measures of the same individual, missing data, irregularly spaced measures, and time-invariant and time-variant covariates, making full use of all available data from each subject (86, 87). Using mixed-effects models, valid estimates of exposure can often be obtained even when the missing values are not completely random, so that additional methods for handling missing data, such as multiple imputations, are generally not required. One advantage is that missing data in the outcome measure can be ignored if the missing responses can be explained either by covariates in the model or by the responses available from a given subject (88).

SPSS 17.0 (IBM Corp., NY, USA), SAS-Callable SUDAAN (Research Triangle Institute, Research Triangle Park, NC, USA) and STATA version 12.1 and 14.0 (Stata, College Station, TX, USA) software programs were used in data analyses of articles III, I, II, and IV respectively. Additionally, Latent Class Analysis for clustering of OHRBs (LCA, version 1.3.2; The Methodology Centre, Pennsylvania State University, State College, PA, USA) was employed in article III.

4.4.2 Ethical considerations
The Ethical committee for Research in Epidemiology and Public health at the Hospital District of Helsinki and Uusimaa in Finland approved the Health 2000 Survey plan. A separate permission was granted for the Health 2011 Survey plans and protocols by the same committee. Personal data were replaced by examination codes; hence, even researchers who would analyse the data have no access to subjects’ identity. Participants received an information letter about the survey and signed the written informed consent form (79, 80). The data of Health 2000 Survey and Health 2011 Survey used in articles I-IV were accessed after receiving the approval of the research plan from the research group of the National Institute for Health and Welfare (THL). The researcher signed a research plan agreement to use the data solely for the purpose of writing and publishing scientific reports.
and thesis concerning the proposed topic. The data and published reports will be delivered to the National Institute for Health and Welfare (THL) upon completion. The researcher declares no conflict of interests with any aspects of the studies of this thesis.
5 Results

5.1 EMPLOYMENT STATUS AND ORAL HEALTH-RELATED BEHAVIORS

5.1.1 Cross-sectional analysis
Tooth brushing at least twice a day, regular dental attendance, use of sugar in coffee or tea less often than daily, use of gum with xylitol on a daily basis and non- or occasional smoking were less prevalent among unemployed compared to the employed. The unemployed individuals were not that different from the employed in terms of risky use of alcohol. Findings in article I (Table 1) are summarized here in Figure 4.

![Tooth brushing frequency chart](chart1.png)

![Dental attendance chart](chart2.png)
Sugar consumption frequency

Use of gum with xylitol
There were differences in dental attendance and use of gum with xylitol between different lengths of unemployment, but not with other OHRBs (Table 2, article I). Socioeconomic position weakened the association of unemployment with tooth brushing frequency at least twice a day and use of sugar in coffee or tea less often than daily. Unemployment was
negatively associated with regular dental attendance, use of gum with xylitol on a daily basis and risky use of alcohol. Unemployment was also negatively associated with non- or occasional smoking, only alcohol consumption frequency attenuated the association. (Table 3, article I).

Length of unemployment (>2-5 years and >5 years) is inversely associated with tooth brushing at least twice a day and regular dental attendance. Income and education rendered the association with tooth brushing to non-significant but being unemployed for >5 years remained negatively associated with regular dental attendance (Table 4, article I). In the sub-analyses of clusters of OHRBs, the unemployed had a higher risk of belonging to the cluster ‘overall unhealthy’ and lower risk of belonging to the cluster ‘overall healthy’. Demographic factors and SEP attenuated the association of the unemployed with higher risk of belonging to the cluster ‘oral health and alcohol’. (Table 7, article I).

5.1.2 Longitudinal analysis
Both at the baseline and the follow-up, the employed reported to brush their teeth more frequently, to regularly visit a dentist more often, to smoke daily less often, and to use alcohol more often than did the unemployed. Findings in article II (Table 1) are summarized here in Figure 5.
Figure 5. Frequency of oral health-related behaviors according to employment status and year of examination.
Being unemployed at baseline was associated with irregular dental attendance, more frequent use of sugar in coffee or tea, and smoking than those who were employed. Income and education attenuated the association of unemployment at baseline with tooth brushing frequency and use of sugar and alcohol consumption frequency. Unemployment at baseline remained associated with dental attendance and smoking when further adjusted for smoking and alcohol consumption frequency (excluding smoking when smoking is the outcome) (Table 2, article II). Unemployment at baseline was not associated with the rate of change of all oral health-related behaviors (Table 3, article II).

The change from being employed to unemployed was negatively associated with the rate of change in tooth brushing frequency (from never to more often than twice a day) when adjusted for demographic factors, income and education. The association was no longer significant when further adjusted for smoking and alcohol consumption frequency. The change from being employed to unemployed was positively associated with the rate of change in alcohol consumption frequency (from not at all to often) when adjusted for demographic factors, income, education and smoking. The associations of change of employment status with rate of change in dental attendance, use of sugar, and smoking were not statistically significant in any of the models (Table 4, article II).
Table 2. Summary of findings of the association of unemployment with oral health-related behaviors

<table>
<thead>
<tr>
<th>Tooth brushing at least twice a day</th>
<th>Regular dental attendance</th>
<th>Use of sugar in coffee or tea less often than daily</th>
<th>Use of gum with xylitol on a daily basis</th>
<th>Non or occasional smoking</th>
<th>Risky use of alcohol / alcohol consumption frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>No*</td>
</tr>
</tbody>
</table>

Cross-sectional study (I)
Type of association with unemployment
Factors affected the association:
- Age, gender, marital status, urbanization
  - No
- Income, education
  - Yes
- Smoking
  - No
- Alcohol consumption
  - No

Longitudinal study (II)
Type of association with unemployment
Factors affected the association:
- Age, gender, marital status
  - No
- Income and education
  - Yes
- Smoking
  - No
- Alcohol consumption
  - No
- Unemployment#year
  - No

Factors affected the year association:
- Age, sex marital status and year
  - -
- Income, education
  - -
- Smoking, alcohol consumption frequency
  - -

* No association with unemployment

5.2 EMPLOYMENT STATUS AND ORAL HEALTH

5.2.1 Cross-sectional analysis
The employed had better oral health than the unemployed both in men and women, except for PT ≥ 4 mm among women. Findings in article III (Table 2) are summarized here in Figure 6.
Unemployment was associated with higher MT and PT ≥ 6 mm, which was only attenuated by smoking. Regular dental attendance attenuated the association of unemployment with DT. Socioeconomic position weakened the association of unemployment with FT and PT ≥ 4 mm. No association was found between unemployment and ST. (Table 3, article III). OHRBs had no effect on the association of unemployment with MT and PT ≥ 6 mm. Unemployment remained associated with higher DT, but smoking attenuated the association. Tooth brushing frequency and smoking attenuated the association of unemployment with higher PT ≥ 4 mm. No association was found between unemployment and ST (Table 4, article III).

In stratified analyses according to OHRBs, dental attendance, tooth brushing frequency and smoking modified the association of unemployment with MT, DT, and PT ≥ 6 mm, but not for FT and ST. Dental attendance modified the association with PT ≥ 4 mm (Table 5, article III). Length of unemployment over 2 years was associated with lower FT and PT ≥ 6 mm. Unemployment for over 5 years was associated with higher ST. (Table 6, article III). There were gender differences in the association of length of unemployment with indicators of clinically determined oral health. Women’s long-term unemployment was associated with higher ST, DT and PT ≥ 6 mm and lower FT. These associations were not present among men (Table 7, article III).
5.2.2 Longitudinal analysis
At both surveys, the unemployed at baseline had higher mean of MT, DT, PT ≥ 4 mm and PT ≥ 6 mm than the employed. There were no differences in oral health according to the length of unemployment in either of the surveys. Findings in article IV (Table 1) are summarized here in Figure 7.

Figure 7. Means of oral health indicators according to employment status and year of examination

The main effect model showed that being unemployed was positively associated with MT and PT ≥ 4 mm and negatively associated with FT and ST when adjusted for sex, age, and year of examination. When further adjusted for income, education and OHRBs, employment status remained associated with FT only, but this association reversed. Unemployed adults had greater FT than those who were employed (Model 1, Table 2, article IV).

The interaction of employment status with the year of examination was added to the main effects model to indicate the effect of employment status on the change in clinically determined oral health over 11 years. When adjusted for sex, age, and year of examination, this model showed that unemployment was negatively associated with the rate of change in MT and FT. That is, the increment in the number of MT and FT was lower in
unemployed than in employed adults. Only the association with the rate of change in MT remained statistically significant when further adjusted for income, education, dental attendance and tooth brushing (Model 2, Table 2, article IV).

Those who were stable unemployed (i.e., who were unemployed in both surveys) had a higher DT and PT ≥ 4 mm in 2011 when adjusted for age, sex and baseline oral health. However, income and education weakened the associations with DT and PT ≥ 4 mm. Those who were unemployed at baseline and became employed at follow-up had a higher PT ≥ 4 mm in 2011, when adjusted for income and education. However, smoking and the use of alcohol attenuated the association with PT ≥ 4 mm (Table 3, article IV).

Length of unemployment at baseline was inconsistently associated with clinically determined oral health measures. Compared to those who were unemployed for ≤1 year, those who had been unemployed for >2-5 years had lower MT and those unemployed >1-2 years had higher ST. In addition, those who had been unemployed over 5 years had a lower FT and a higher ST and PT ≥ 6 mm. (Table 4, article IV).

Table 3. Summary of findings of the association of unemployment with oral health

<table>
<thead>
<tr>
<th>Cross-sectional study (III)</th>
<th>MT</th>
<th>ST</th>
<th>FT</th>
<th>DT</th>
<th>PT ≥ 4 mm</th>
<th>PT ≥ 6 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of association with unemployment</td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
</tr>
</tbody>
</table>
| Factors affected the association:
  | Age, gender, marital status, urbanization | No | - | No | No | No | No |
  | Income and education | No | - | Yes | No | Yes | No |
  | Dental attendance | No | - | - | Yes | - | No |
  | Tooth brushing frequency | No | Yes | Yes | No | Yes | No |
  | Sugar use | No | Yes | Yes | No | No | No |
  | Gum with xylitol | No | Yes | Yes | No | No | No |
  | Smoking | No | Yes | Yes | Yes | Yes | Yes |
| Longitudinal study (IV) | MT | ST | FT | DT | PT ≥ 4 mm | PT ≥ 6 mm |
| Type of association with unemployment | Positive | Negative | Negative | No* | Positive | No* |
| Factors affected the association:
  | Age, gender, year of examination, income, education, dental attendance, tooth brushing, smoking, alcohol consumption frequency | Yes | No | Yes | - | Yes | - |
  | Unemployment#year | Negative | Negative | No | No | No | No |
| Factors affected the association:
  | Age, gender, year of examination, income, education, dental attendance, tooth brushing, smoking, alcohol consumption frequency | No | Yes | - | - | - | - |

* No association with unemployment

MT: Number of missing teeth  DT: Number of decayed teeth
ST: Number of sound teeth  FT: Number of filled teeth
PT ≥ 4 mm: Number of teeth with deepened periodontal pockets ≥ 4 mm
PT ≥ 6 mm: Number of teeth with deepened periodontal pockets ≥ 6 mm
- Indicates the direct association (i.e., not affected by other factors)
- - - Indicates the indirect association (i.e., affected by other factors)

MT: Number of missing teeth  DT: Number of decayed teeth
ST: Number of sound teeth  FT: Number of filled teeth
PT ≥ 4 mm: Number of teeth with deepened periodontal pockets ≥ 4 mm
PT ≥ 6 mm: Number of teeth with deepened periodontal pockets ≥ 6 mm

Figure 8. Diagram illustrates the relation of unemployment with oral health-related behaviors and oral health based on results of studies I-IV
6 Discussion

6.1 RESULTS

The main finding of this thesis is that unemployment was associated with detrimental oral health-related behaviors and clinically determined poor oral health. Oral health-related behaviors affected the association of unemployment with oral health outcomes. Further, income and education affected the association with some of OHRBs and oral health outcomes. These results were partially consistent in both cross-sectional and longitudinal settings.

6.1.1 Oral health-related behaviors

Unemployment was initially associated with tooth brushing frequency at least twice a day in both cross-sectional and longitudinal settings. However, income and education weakened this association. In longitudinal setting, baseline unemployment was not associated with the rate of change of tooth brushing frequency (from never to more often than twice a day) over 11 years. Nonetheless, change from employed to unemployed was negatively associated with the rate of change in tooth brushing frequency (from never to more often than twice a day). Only smoking and alcohol consumption frequency weakened this association. This indicates that a higher socioeconomic position (higher income and education) and favorable health-related behaviors (non-smoking and avoidance of alcohol) could minimize the possible effect of being unemployed on non-beneficial tooth brushing frequency. Overall, these results are partially in line with earlier studies that found unemployment to be associated with non-beneficial tooth brushing frequency (52, 53).

An important finding of this study is that unemployment was inversely associated with regular dental attendance in both cross-sectional and longitudinal settings. None of the sociodemographic and socioeconomic factors or OHRBs affected the inverse association of unemployment with regular dental attendance. This finding supports previous studies which found positive association of unemployment with irregular dental attendance (19, 56). Contrary to these findings, other studies found that unemployment was not a predictor for dental care utilization (20, 55). These contradictory results could be originated from different oral health care systems applied in the countries where these studies were conducted. In Finland, oral health services for the adults are provided both by the public and private sectors. Public oral health care services within health centers are available throughout the country and they are managed by municipalities. Private oral health care services are provided by both private dentists and dental technicians. Under the Primary Healthcare Act in 1972, most adults had to use the private sector for oral health care, but public services were free for children. Since mid-1980s, adults have gradually been entitled to use public oral health care services or get partial reimbursements from private care. Prior to 2000, only those who were born in 1956 or later gained access to subsidized care meanwhile the rest were not covered by the system. Under the Oral Care Reform in 2002,
all Finns were given access to subsidized oral health services. Approximately 50% of adults were treated by public oral health care and the other 50% in private sector (89). However, the waiting lists for the public oral health care services have been long after the reform and therefore access to public oral health care was difficult. The Care Guarantee legislation was enacted in 2005 to ease this problem. The act stated that emergency care should be provided immediately or within three days and non-emergency care such as examinations and treatment within six months in public sector. However, lack of personnel in many health centers has caused problems to fulfill the aims of the reform. This legislation did not include the private sector (90) where the costs of care for the customer has, however, been substantially higher than in the public oral health care even after reimbursements. Overall, costs of oral health care services are increasing, which makes care even more expensive for the customer in Finland. The unemployed Finns could find it hard to afford oral health care regularly, in spite of the social benefits and partial reimbursements of some costs of oral health treatments from the Social Insurance Institution. Long periods of not visiting a dentist could lead to deterioration in oral health status, particularly if the unemployed person is not able to maintain proper self-care such as recommended tooth brushing frequency or do not decrease smoking, sugar and alcohol intake.

In this study, the initial association of unemployment with sugar consumption frequency was attenuated by income and education in both cross-sectional and longitudinal settings. This indicates no association finally exists between unemployment and sugar consumption frequency. This finding concurs with the British study, which found no significant differences in extrinsic sugar consumption between unemployed and employed or still in full-time education (57). Whereas this finding is at odds with the Finnish study which found that being employed was related with higher number of oral-health promoting behaviors (less frequently than daily consumption of sugar in coffee or tea or other sugary drinks and use of xylitol chewing gum three time or more daily) (52). However, this study’s finding concurs with the same study in regard to the negative association between unemployment and daily use of gum with xylitol.

The unemployed had higher odds of smoking daily than the employed in both cross-sectional and longitudinal settings. This finding was expected as previous studies showed that the unemployed smoke more frequently than those employed (7, 8). It is evident that the unemployed smoke more, even though there is an increased tax on smoking products. The cost does not hinder the unemployed from buying cigarettes because they are still supported financially through unemployment benefits especially in Nordic countries. The unemployed also have more flexible timetables and are not restricted to workplace rules such as a smoke-free workplace. In contrary, the employed spend most of the weekdays at smoke-free workplaces. One could argue that the employee could smoke outside workplace during breaks. However, few work breaks may limit the frequency and amount of smoking a worker could have during worktime (91).

Unemployment had higher odds of risky use of alcohol (alcohol use > 7 doses for men and > 4 doses for women) in cross-sectional setting. Unemployment at baseline was initially
associated with alcohol consumption frequency (often) in longitudinal setting. Nonetheless, income and education attenuated this association. Moreover, unemployment at baseline was not associated with the rate of change of alcohol consumption frequency (from not at all to often). However, the change from being employed to unemployed was positively associated with the rate of change in alcohol consumption frequency (from not at all to often). These findings support the extensive literature on the association of unemployment with alcohol consumption, either for risky use (10, 11) and for frequency (9, 60). It is obvious that the unemployed are more susceptible to consume more alcohol and more frequently than the employed despite that alcohol products are generally expensive. Income and education plays an important role in alcohol consumption even though the person might be unemployed. Those highly educated with good income are probably more conscious of the harmful consequences of risky alcohol consumption.

Regarding clusters of OHRBs, the unemployed had a higher risk of belonging to the cluster ‘overall unhealthy’ and a lower risk of belonging to the cluster ‘overall healthy’. This finding is in line with previous literature that found that the OHRBs clusters are associated with socioeconomic position (61-63). In addition, SEP weakened the association of unemployment with a higher risk of belonging to the cluster ‘oral health and alcohol’. These findings support the available evidence on the effect of SEP on OHRBs (14, 61).

6.1.2 Clinically determined oral health
Unemployment was associated with a higher number of missing teeth (MT), only smoking attenuated the association in cross-sectional setting. The association of unemployment with MT was weakened by SEP and OHRBs in longitudinal setting. These findings appeared to be plausible and in line with previous reports which found that unemployment is a risk factor for missing teeth (15, 64). Nevertheless, in longitudinal setting, unemployment was negatively associated with rate of change in MT. That is, the increment in number of MT was lower in unemployed than in employed adults. This finding is rather unexpected and inconsistent with the former findings. One possible reason could be the long period between the baseline and follow-up studies, in which information of employment status and its change were available for only two time-points. That is, the movement from being employed to unemployed and vice versa during 11 years and how often those changes could happen. The second possible reason could be that the unemployed might neglect those badly carious teeth, which need dental treatment such as extraction and he or she prefers to keep them in this status. Therefore, they were recorded as carious teeth or roots during the follow-up study.

No association was found between unemployment and ST in both cross-sectional and longitudinal settings. This finding disagrees with a study which found being employed was associated with increased number of sound untreated teeth (65). To date, there are no other studies available on the association of unemployment with ST.

Income and education attenuated the inverse association of unemployment with FT in cross-sectional setting. That was not the case in longitudinal setting, as unemployment was positively associated with FT. Moreover, unemployment was negatively associated with
rate of change in FT. That is, the increment in number of FT was lower in unemployed than in employed adults. However, SEP and OHRBs attenuated this association. Number of filled teeth could be an indicator of both poor and good oral health. Filled teeth mean that the unemployed had carious teeth before, which means poor oral health. On the other hand, filled teeth might mean that the unemployed used oral health services seeking for dental treatment for carious teeth. These findings are partially in line with one study that found being not employed was associated with higher number of DMFT (66).

The initial association between unemployment and higher DT was weakened by regular dental attendance in cross-sectional setting. It is evident that having regular dental attendance decreases DT among those unemployed as carious teeth will be treated accordingly. In longitudinal setting, unemployment was not associated with DT nor with its rate of change. Moreover, those who were unemployed in both surveys had higher DT at follow-up. Nonetheless, income and education weakened this association. These findings agree partially with previous studies that found unemployment as a risk indicator for decayed teeth (16, 17).

Income and education weakened the association of unemployment with number of teeth with periodontal pockets (PT) ≥ 4 mm in both the cross-sectional and longitudinal settings. Unemployment was not associated with rate of change in PT ≥ 4 mm in longitudinal setting. Moreover, those who were unemployed at both surveys had higher PT ≥ 4 mm at the follow-up. This association was attenuated by income and education. Furthermore, those who were unemployed at baseline and became employed at follow-up had higher PT ≥ 4 mm at follow-up. Smoking and alcohol consumption frequency attenuated this association. No previous studies that have examined the association of unemployment with PT ≥ 4 mm can be found in literature to compare the findings with this study.

In cross-sectional setting, unemployment was associated with PT ≥ 6 mm and smoking only weakened the association. This finding is in accordance with one previous study that found unemployment associated with periodontal pockets of 5.5 mm or more in depth (18). However, in the longitudinal setting, unemployment was not associated with PT ≥ 6 mm or its rate of change. Moreover, change in employment status was not associated with rate of change in PT ≥ 6 mm.

6.1.3 Length of unemployment
To date, no previous studies were found that investigated the association of length of unemployment with OHRBs and oral health. Hence, these findings can be considered the first ones to report the association of length of unemployment with OHRBs and clinical oral health. In cross-sectional setting, length of unemployment over 2 years and over 5 years were inversely associated with tooth brushing frequency at least twice a day and regular dental attendance. These associations disappeared for tooth brushing frequency, but length of unemployment over 5 years remained negatively associated with regular dental attendance after adjustment for sociodemographic and socioeconomic factors and OHRBs. In both cross-sectional and longitudinal settings, length of unemployment over 2 years was associated with lower FT. Those unemployed over 5 years had higher ST and lower FT. In
longitudinal setting, the unemployed over 5 years had higher $\text{PT} \geq 6 \text{ mm}$. In cross-sectional setting, the unemployed over 2 years had higher $\text{PT} \geq 6 \text{ mm}$. Among women, the unemployed over 2 years had higher $\text{ST}$ and $\text{PT} \geq 6 \text{ mm}$ and lower $\text{FT}$. The unemployed over 5 years had higher $\text{ST}$ and lower $\text{FT}$ among women. No such association was observed among men.

### 6.1.4 Various pathways to better oral health

Overall in relation to the theoretical background, the findings of this thesis partially support the causation hypothesis, i.e., unemployment predisposes poorer oral health. The results indicated that the unemployment affected oral health indirectly through oral health-related behaviors. This finding, therefore, also supports the behavioral pathway between unemployment and oral health. In addition, unemployment affected oral health-related behaviors indirectly via income and education. Income and education thus played an important role in the association of unemployment with OHRBs and oral health. Such role supports further the socioeconomic pathway (financial strains) for the relationship between unemployment and oral health (Figure 8). The role of society in terms of allowances and other kind of financial support is emphasized.

Tackling the non-financial consequences of unemployment is equally important in pursuing healthy a lifestyle for individuals. Unlike older adults, who may have experienced previous periods of unemployment and therefore have developed coping mechanisms, unemployment hits hard most likely on young adults, who do not have the sufficient and strong adaptability tools to face an unemployment period. The movement of in and out of employment will continue according to the local, regional and global job markets. Eventually, some of those unemployed will find job opportunities and could become employed, while other employed could lose their jobs. Strong economy surely would decrease the rate of unemployment to the possible minimum but not to zero unemployment. In fact, the issue of unemployment is there to stay as a socioeconomic burden and a risk factor for poor health of individuals.

### 6.2 METHODOLOGY

The studies included in this thesis used various methodological approaches to examine the cross-sectional and longitudinal associations of unemployment with OHRBs and oral health, taking sociodemographic and socioeconomic factors into consideration. Despite being known as general health-related behaviors, smoking and alcohol consumption were considered as part of OHRBs due to their detrimental effects on oral health. The strategies used in studies I-IV included: a) the stratification of the association of unemployment with oral health by OHRBs, b) adding each factor alone to the main model, c) adding factors sequentially to the main model to examine the accumulative effects, d) interaction of employment with time of examination in longitudinal study to measure the change in oral health outcome, e) examining change in employment status (unemployed at both surveys, employed at both surveys, unemployed at baseline and employed at follow-up, employed
An important issue in oral epidemiology is the determination of confounders, mediators and effect-modifiers in the relationship between exposure and outcome. The criteria to determine a confounder includes three features: firstly a confounder is a risk factor for the outcome, independent of the exposure. Secondly it is associated with the risk factor and thirdly it is not in the causal pathway between exposure and outcome. The main difference between confounder and mediator is that confounder affects both the exposure and the outcome, whereas the mediator lies between the causal pathway of the exposure and the outcome. On the other hand, effect modification happens when exposure has different effect among different subgroups. Hence, effect modifier is associated with the outcome but not with the exposure (92, 93).

In this thesis, the findings showed that income and education influenced the association of unemployment with OHRBs in terms of tooth brushing frequency, alcohol consumption frequency, and sugar use in coffee or tea. This suggests that income is a mediator for this association as income cannot affect unemployment, whereas education is considered as confounder as it affects both unemployment and OHRBs (Figure 8).

The findings of this thesis showed that OHRBs and SEP affected the association of unemployment with oral health. This proposes that income, tooth brushing frequency, dental attendance, and smoking are mediators between unemployment and oral health in terms of MT, DT, PT ≥ 4 mm and PT ≥ 6 mm. Education could affect both unemployment and oral health, therefore it is considered as a confounder for this association. Alcohol can be considered as a mediator (unemployment could lead to more alcohol consumption which in turn leads to poor oral health) or as a confounder (alcohol could lead to unemployment and poor oral health. Nonetheless, the findings showed that alcohol consumption frequency affected only the association of unemployment and PT ≥ 4 mm. Sugar consumption frequency and xylitol consumption frequency could be considered as potential effect-modifiers for oral health, however the findings of this thesis did not support that (Figure 8).

6.2.1 Strengths and limitations
Strengths of this study are the nationally representative surveys of the Finnish adult population, which were carefully designed and conducted. The Health 2000 Survey also had exceptionally high response rate. Another additional strength of this study is the longitudinal data over 11 years, which in population level are rare. The articles included in this thesis used multiple indicators of OHRBs as well as several indicators of clinically determined oral health. Robust statistical procedures such as multilevel mixed-effects models were employed to account for the studies’ designs and clustering effects. Multiple relevant covariates including demographic factors and SEP, oral and general health-related behaviors were controlled for in the analyses. In article III, sub analyses tested the
stratification of the association of employment status with oral health by OHRBs and examined the clustering of OHRBs and its association of employment status.

In this thesis, the selection hypothesis (i.e. poor oral health could predispose or lead to unemployment either directly or indirectly) was not tested as the related body of evidence supported more the plausible causation hypothesis (33). Clinically, limited scenarios where poor oral health could lead to unemployment. These cases could be due to accident, non-curable diseases, trauma or loss of functionality such as proper speech (94). However, the health selection hypothesis should not be disregarded in future research, especially in cohort studies, where direction of effect could be determined and selection hypothesis could be tested. This thesis did not examine the association of employment status with progression of periodontal pockets (i.e. from teeth with healthy periodontium to PT ≥ 4 mm or from PT ≥ 4 mm to PT ≥ 6 mm). This thesis also did not investigate the association of employment status with self-rated (perceived) oral health or oral health-related quality of life. This study did not assess other forms of employment status such as re-employment, non-employment, job insecurity, or underemployment. This study also did not assess the association of occupation types (managers, white-collars, blue-collars, workers, and drivers) with oral health and OHRBs, as they were considered among the category of the employed.

The analyses in this study did not include psychosocial factors (sense of coherence, stress and anxiety), general health status (cardiovascular diseases, hypertension and obesity) and other general health-related behaviors such as diet. Nonetheless, items such as sugar, gum with xylitol, smoking and alcohol were included in the analyses. Alcohol was not included only in the analyses of article III but also, alcohol consumption and frequency were used in the analyses of articles I, II, and IV. The studies of this thesis were undertaken in Finland, where unemployment rates were under 10% since 2000, which are considered within the average European levels of unemployment. Future dental research is recommended in European countries where unemployment rates are higher such as Spain and Greece. Such research would provide more information and comparative findings on the effect of unemployment on oral health and OHRBs in western society. Future research in the above-mentioned areas that this thesis did not cover is recommended.
7 Conclusions and implications to policy makers

Unemployment can be considered as a risk factor for detrimental oral health-related behaviors and poor oral health. Unemployment mainly affects oral health through oral health-related behaviors pathway, whereas unemployment influences oral health-related behaviors through socioeconomic pathway. Length of unemployment was inconsistently associated with oral health-related behaviors and oral health.

The unemployed people can be considered as a risk group for oral health-deteriorating behaviors and poor oral health. Social and health programs should be put forward to minimize the burden of unemployment. One method is targeting those unemployed individuals with easy access behavioral intervention programs to motivate them to improve and sustain favorable dental self-care, which includes brushing teeth twice a day with fluoridated toothpaste, minimizing sugar and alcohol consumption, quitting or decreasing smoking for smokers, and visiting dentist regularly for check-ups (53).
8 References


91. Fichtenberg CM, Glantz SA. Effect of smoke-free workplaces on smoking behaviour: systematic review. BMJ. 2002;325(7357):188.
Socioeconomic status plays an important role in oral health. However, little is known about the impact of employment status on oral health-related behaviors and oral health. This thesis assesses the role of employment status in oral health-related behaviors and clinical oral health and investigates whether unemployment predisposes poor oral health. The findings show that unemployment is a risk indicator for oral health-deteriorating behaviors and poor oral health in Finnish adults.