

Department of Public Health
Faculty of Medicine
University of Helsinki
Finland

ALCOHOL DRINKING, HEALTH-RELATED FUNCTIONING AND WORK DISABILITY

Aino Salonsalmi

ACADEMIC DISSERTATION

To be presented, with the permission of the Faculty of Medicine of
the University of Helsinki, for public examination in Auditorium XII,
University main building, on 17 December 2016, at 10 o'clock.

Helsinki 2016

Supervisors

Professor Eero Lahelma
Department of Public Health
University of Helsinki

Docent Mikko Laaksonen
Finnish Centre for Pensions, Helsinki
and Department of Public Health
University of Helsinki

Professor Ossi Rahkonen
Department of Public Health
University of Helsinki

Reviewers

Docent Pia Mäkelä
National Institute for Health and Welfare, Helsinki

Docent Annina Ropponen
Finnish Institute of Occupational Health, Helsinki

Opponent

Professor Sami Pirkola
School of Health Sciences
University of Tampere

*Dissertationes Scholae Doctoralis Ad Sanitatem Investigandam
Universitatis Helsinkiensis*

ISSN 2342-3161 (pbk.)
ISSN 2342-317X (online)

ISBN 978-951-51-2700-6 (pbk.)
ISBN 978-951-51-2701-3 (PDF)

Unigrafia, Helsinki 2016

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ABSTRACT

Alcohol drinking is a major potentially preventable risk factor for health and wellbeing worldwide. Alcohol plays a significant role in the etiology of many diseases. Alcohol drinking has increased markedly from the late 1960s in Finland until 2007. Over the past few decades, women and the elderly have increased their consumption of alcohol while the percentage of non-drinkers has decreased. Although light drinking occasions and the consumption of wine and beer have increased, binge drinking is still common. The increased consumption, together with drinking patterns favouring binge drinking, adds to alcohol-related harms. Alcohol-related causes of death and morbidity are common, especially among the working-age population, but less is known about the associations between alcohol drinking and health-related functioning. The majority of Finnish heavy drinkers are employed and there is a need to assess the contribution of alcohol drinking to health-related functioning and work disability using longitudinal data including several drinking habits. The aim of this study was to examine the associations between alcohol drinking, health-related functioning and work disability among ageing municipal employees.

This study is part of the Helsinki Health study on middle-aged employees of the City of Helsinki. The baseline data were collected in 2000-02 by sending a postal questionnaire to 40-, 45-, 50-, 55- and 60-year-old employees of the City of Helsinki. Of those receiving a questionnaire, 8960 employees participated, yielding a response rate of 67%. A follow-up survey was conducted among the respondents of the baseline data collection in 2007 with a response rate of 83% (n=7332). The surveys included questions on socio-economic factors, family situation, working conditions, health behaviours and health. The survey data were linked with sickness absence data, derived from the employer's personnel register, and with data on disability retirement, derived from the Finnish Centre for Pensions, among 78% and 74% of participants consenting to internal and external data linkages.

Alcohol drinking was measured by weekly average drinking, frequency of drinking, binge drinking and problem drinking assessed by the CAGE scale. The first sub-study examined the associations between alcohol drinking and mental and physical functioning measured by the Short Form 36 survey. The second sub-study focused on the associations between alcohol drinking and subsequent self-certified and medically confirmed sickness absence from work, as well as the contributions of psychosocial and physical working conditions and work arrangements to these associations. The third sub-study examined changes in alcohol drinking and their contribution to subsequent sickness absence. Associations between alcohol drinking and all-cause disability retirement and disability retirement due to mental disorders and

musculoskeletal diseases were the focus of the fourth sub-study. Women and men were analysed mainly separately and a number of covariates, such as socioeconomic position, working conditions, other health behaviours and health, were controlled for. Logistic regression, Poisson regression and Cox regression were used in analysing the data.

The studied employees drank relatively little in terms of weekly average drinking but binge drinking and problem drinking were common. The associations between alcohol drinking and mental and physical functioning differed. All studied drinking habits were associated with poor mental functioning, whereas concerning physical functioning associations were found for problem drinking only and non-drinkers also had an increased risk. Heavy weekly average drinking, binge drinking and problem drinking were all associated with both self-certified and medically confirmed sickness absence from work with the exception of binge drinking among men. The association between weekly average drinking and medically confirmed sickness absence was U-shaped, both non-drinkers and heavy drinkers having increased risks compared to moderate drinkers. Working conditions had no major contributions to the associations, although psychosocial working conditions somewhat attenuated the associations, especially among men. When studying changes in alcohol drinking, associations were found for self-certified sickness absence more often than for medically confirmed sickness absence, as associations for the latter were mainly explained by health and other health behaviours. Also, reduced alcohol drinking and previous problem drinking increased the risk of sickness absence. Alcohol drinking was strongly associated with disability retirement due to mental disorders, whereas no associations were found for musculoskeletal diseases. Throughout the study, alcohol drinking showed the strongest associations with poor mental health. Problem drinking was the drinking habit with the most widespread associations with poor health-related functioning and work disability.

The results of the study indicate that alcohol drinking is a problem in the middle-aged working population with relatively moderate alcohol consumption in terms of weekly average drinking. Heavy drinking, binge drinking and problem drinking were all associated with poor health-related functioning and work disability, but problem drinking showed the strongest and most widespread associations. The study suggests that problem drinking should be assessed in addition to the overall amount of drinking in future studies and clinical settings. The study highlights the importance of alcohol drinking for poor mental health and calls for recognition and early prevention of heavy alcohol drinking among both the occupational and primary health care systems.

TIIVISTELMÄ

Alkoholinkäyttö on merkittävä, ehkäistävissä oleva riski terveydelle ja hyvinvoinnille. Alkoholilla on tärkeä osuus usean sairauden etiologiassa. Alkoholinkäyttö on lisääntynyt merkittävästi Suomessa 1960-luvun lopulta lähtien vuoteen 2007 saakka. Viime vuosikymmenten aikana raittius on vähentynyt ja ikääntyvien ja naisten alkoholin kulutus on lisääntynyt, vaikka miehet edelleen juovat selvästi naisia enemmän. Pienet kertakulutusmäärät ovat lisääntyneet ja oluen ja mietojen alkoholijuomien osuus kulutetusta alkoholista on kasvanut, mutta humalahakuinen juominen on edelleen yleistä. Alkoholin lisääntynyt kulutus yhdistettynä suomalaisiin juomatapoihin johtaa merkittäviin alkoholin käyttöön liittyviin haittoihin. Alkoholin aiheuttama kuolleisuus ja sairastavuus on yleistä työikäisten keskuudessa, mutta alkoholinkäytön vaikutusta toimintakykyyn ei juuri tunneta. Suurin osa alkoholin suurkuluttajista osallistuu Suomessa työelämään. Alkoholinkäytön vaikutuksesta terveyteen, toimintakykyyn ja työkykyyn tarvitaan pitkittäistutkimuksiin perustuvaa tietoa ja useita alkoholinkäytön mittareita. Tämän tutkimuksen tavoitteena on tarkastella alkoholinkäytön, toimintakyvyn ja työkyvyn yhteyttä keski-ikäisten kuntatyöntekijöiden keskuudessa.

Tutkimus kuuluu Helsingin kaupungin terveystutkimukseen (Helsinki Health Study) keski-ikäisistä Helsingin kaupungin työntekijöistä. Peruskysely toteutettiin vuosina 2000-2002 lähettämällä kyselylomake 40-, 45-, 50-, 55- ja 60-vuotiaille Helsingin kaupungin työntekijöille. 8960 työntekijää osallistui ja vastausprosentti oli 67 %. Seurantakysely toteutettiin vuonna 2007 ja vastausprosentti oli tuolloin 83 % (n=7332). Kyselyt sisälsivät kysymyksiä sosioekonomisista tekijöistä, perhetilanteesta, työoloista, terveystyötyymisestä ja terveydestä. Kyselytiedot yhdistettiin työntantajan sairauspoissaolorekisteritietoihin sekä Eläketurvakeskuksesta saatuihin eläketietoihin niiden vastaajien joukossa, jotka antoivat suostumuksensa tietojen yhdistämiseen (78 % koskien kaupungin sisäisiä rekistereitä ja 74 % koskien ulkoisia rekistereitä).

Alkoholinkäyttöä mitattiin viikoittaisella keskikulutuksella, humalahakuisella juomisella ja ongelmajuomisella, jota mitattiin CAGE-kyselyn avulla. Ensimmäinen osatyö tarkasteli alkoholinkäytön ja Short Form 36-kyselyllä mitatun psyykkisen ja fyysisen toimintakyvyn välistä yhteyttä. Toinen osatyö keskittyi alkoholinkäytön ja itse ilmoitettujen ja lääkärin varmentamien sairauspoissaolojen välisen yhteyden tutkimiseen ja tarkasteli psykososiaalisten ja fyysisten työolojen sekä työjärjestelyjen vaikutusta tähän yhteyteen. Kolmannessa osatyössä tutkittiin alkoholinkäytön muutosten ja sairauspoissaolojen välistä yhteyttä. Neljännessä osatyössä keskityttiin alkoholinkäytön ja työkyvyttömyyseläkkeiden, mielenterveysyistä johtuvien

työkyvyttömyyseläkkeiden sekä tuki- ja liikuntaelinsairauksista johtuvien työkyvyttömyyseläkkeiden välisen yhteyden tutkimiseen. Miehiä ja naisia analysoitiin pääasiassa erikseen ja useita tekijöitä, kuten sosioekonominen asema, työolot, muut terveystyötyymisen muodot ja terveys huomioitiin analyysissa. Analyysimenetelminä käytettiin logistista regressiota, Poissonin regressiota ja Coxin regressiota.

Tutkituttujen työntekijöiden alkoholinkäyttö oli suhteellisen vähäistä mitattuna viikoittaisella keskikulutuksella. Humalahakuinen juominen ja ongelmajuominen oli yleistä. Alkoholinkäytön yhteys psyykkiseen ja fyysiseen toimintakykyyn oli erilainen. Kaikki tutkitut juomatavat olivat yhteydessä psyykkiseen toimintakykyyn, kun taas ainoastaan ongelmajuominen ja myös raittius olivat yhteydessä fyysiseen toimintakykyyn. Runsas keskikulutus, humalajuominen ja ongelmajuominen olivat kaikki yhteydessä itse ilmoitettuihin ja lääkärin varmentamiin sairauspoissaoloihin lukuunottamatta humalajuomista miehillä. Keskikulutuksen ja lääkärin varmentamien sairauspoissaolojen välin yhteys oli U:n muotoinen: Sekä runsaasti juovilla että raittiilla oli enemmän sairauspoissaoloja verrattuna kohtuullisesti alkoholia kuluttaviin. Työoloilla ei ollut suurta vaikutusta alkoholinkäytön ja sairauspoissaolojen väliseen yhteyteen, joskin psykososiaaliset työolot jonkin verran heikensivät yhteyttä etenkin miehillä. Alkoholinkäytön muutoksia tutkittaessa yhteyksiä havaittiin jonkin verran useammin itse ilmoitetuissa kuin lääkärin varmentamissa sairauspoissaoloissa; jälkimmäisiä koskevat yhteydet heikentyivät usein muita terveystyötyymismuotoja ja terveydentilaa vakioitaessa. Myös vähentynyt alkoholin juominen ja aiempi ongelmajuominen lisäsivät sairauspoissaolojen riskiä. Alkoholinkäyttö oli vahvasti yhteydessä mielenterveysyistä johtuviin työkyvyttömyyseläkkeisiin, kun taas yhteyksiä ei havaittu koskien tuki- ja liikuntaelinsyistä johtuvia työkyvyttömyyseläkkeitä. Alkoholinkäytöllä oli vahvimmat yhteydet mielenterveyteen. Ongelmajuomisella oli laaja-alaisimmat yhteydet heikentyneeseen terveyteen, toimintakykyyn ja työkykyyn.

Tutkimuksen tulokset osoittavat, että alkoholinkäyttö on ongelma myös keski-ikäisen työssäkäyvän väestön keskuudessa, vaikka alkoholinkäyttö oli suhteellisen vähäistä mitattuna viikoittaisella keskikulutuksella. Runsas keskikulutus, humalahakuinen juominen ja ongelmajuominen olivat kaikki yhteydessä heikentyneeseen toimintakykyyn ja työkykyyn. Ongelmajuomisen yhteydet olivat vahvimmat ja laaja-alaisimmat. Tulokset viittaavat siihen, että keskikulutuksen lisäksi tulisi mitata ongelmajuomista sekä tutkimuksissa sekä kliinisessä ympäristössä. Tutkimuksen tulokset painottavat alkoholinkäytön merkitystä mielenterveysongelmiin ja alkoholinkäytön tunnistamisen ja ennaltaehkäisyn tarvetta työterveyshuollossa, perusterveydenhuollossa ja työpaikoilla.

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications:

- I Salonsalmi A, Rahkonen O, Lahelma E, Laaksonen M. Alcohol drinking and health functioning – a prospective study among middle-aged employees. Submitted.
- II Salonsalmi A, Laaksonen M, Lahelma E, Rahkonen O. Drinking habits and sickness absence: The contribution of working conditions. *Scandinavian Journal of Public Health* 2009; 37: 846-854.
- III Salonsalmi A, Rahkonen O, Lahelma E, Laaksonen M. Changes in alcohol drinking and subsequent sickness absence. *Scandinavian Journal of Public Health* 2015; 43: 364-372.
- IV Salonsalmi A, Laaksonen M, Lahelma E, Rahkonen O. Drinking habits and disability retirement. *Addiction* 2012; 107: 2128-2136.

The publications are referred to in the text by their roman numerals.

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ABBREVIATIONS

BMI	body mass index
CI	confidence interval
CAGE	cutting down, annoyed, guilty, eye-opener
g	gram
ICD-10	International Classification of Diseases, 10th revision
HR	hazard ratio
MET	metabolic equivalent tasks
MCS	mental component summary
Mm-MAST	Malmö modification of the Brief Michigan Alcohol Screening Test
RR	rate ratio
OR	odds ratio
PCS	physical component summary
SF-36	the Short Form 36 survey
WHO	World Health Organization

1 INTRODUCTION

Alcohol drinking is a major threat to health and wellbeing worldwide. Alcohol drinking is the fifth leading cause of global disease burden and injury (Lim et al., 2012) and accounts for 6% of all deaths worldwide (WHO, 2014). Alcohol drinking plays a significant role in the etiology of many acute and chronic diseases including both somatic diseases and mental disorders (Rehm et al., 2010). As people live longer and chronic conditions become more common, increasingly more focus is put on coping with diseases and health-related functioning (WHO, 2002). Health-related functioning has been examined separately from specific diagnoses and it has been found to predict outcomes such as hospitalisation and mortality (Mayo et al., 2005; Myint et al., 2006; Myint et al., 2007) as it takes into account the consequences of health problems in individual's environment.

The burden of alcohol-related health problems falls to relatively young age groups (WHO, 2014). Alcohol drinking is also common among people who are employed and the majority of heavy drinkers are employed (Halme et al. 2008). As the age structure of the Finnish population changes and the healthcare and pension costs increase, there are demands to improve the health and ability to remain working among ageing employees. As a part of this process of lengthening work careers, increasing the retirement age and preventing sickness absence and early exit from work through disability retirement are important goals. Health behaviours such as alcohol drinking are potentially preventable and modifiable risk factors, thus paying attention to them might prevent work disability and promote healthy ageing.

The idea of alcohol drinking compromising health-related functioning and the ability to work is not new. Early studies examined those with known alcohol problems and their ability to work (Observer & Maxwell, 1959; Pell & D'Alonzo, 1970). These studies found that those with alcohol problems have poorer health functioning and a lower ability to work (Observer & Maxwell, 1959; Pell & D'Alonzo, 1970) compared to others. However, it was also found that many of those having alcohol problems were able to manage in their work life and did not have excess sickness absence (Pell & D'Alonzo, 1970). Although individuals with the heaviest drinking habits have a large number of adverse effects per person, the greatest societal burden of many adverse effects due to alcohol drinking falls to those drinking at moderate levels, as the group of moderate drinkers is much larger in number (Poikolainen et al., 2007). Thus, when examining alcohol-related harm, studies focusing on broad employee and general populations are needed. Studies on the associations between alcohol drinking, health-related functioning and work ability are however scarce and have produced inconsistent results.

After the first studies on this area, the requirements of one's work life have changed and the physical demands of work have declined. Education

level has risen, work is more independent and social than before and the demands of work life have shifted from physical demands towards social and cognitive demands (Sutela & Lehto, 2014), thus the factors affecting work ability have also changed. The role of mental disorders with regards to work disability has increased and currently they are the most common reason for long-term work disability in Finland, followed by musculoskeletal diseases (Nyman, 2015). In modern work life, the role of alcohol drinking as a threat to work ability might have increased as the role of mental disorders causing work disability has risen and mental disorders are associated with alcohol drinking (Paljärvi et al., 2009; Rehm et al., 2010). Pressures of one's work life might also encourage alcohol drinking as an attempt to cope with work-related stress (Vasse et al., 2008; Heikkilä et al., 2012).

Understanding the contribution of alcohol in health-related functioning and work ability is important in Finland where alcohol drinking has almost continuously increased from the late 1960s. The peak was reached in 2005 to 2007 (Varis & Virtanen, 2016), after which there has been a slight decrease, especially among younger generations (Mäkelä et al., 2010). Traditionally, alcohol drinking among older people has been considered to be quite stable, but studies from Finland (Ilomäki et al., 2010; Mäkelä et al., 2010) and elsewhere (Kelfve et al., 2014) have challenged this finding. Now, elderly cohorts drink more than previous ones and alcohol drinking among women has markedly increased (Mäkelä et al., 2010). These phenomena provide big challenges for preventing alcohol-related mortality, morbidity and health-related functioning.

The total consumption of alcohol in Finland is approximately in the upper middle-level among European countries (Karlsson et al., 2013). In Finland, alcohol drinking has traditionally occurred on special occasions instead of regularly using small amounts during meals. Although light drinking occasions and drinking in domestic situations have increased, binge drinking is still common and has also increased during the past decades, according to the Finnish Drinking Habit Surveys (Mäkelä et al., 2010). In addition to the amount of alcohol consumed, drinking habits also contribute to the effects of alcohol drinking (Rehm et al. 2010) and Finnish consumption patterns favouring binge drinking might increase alcohol-related harms. Binge drinking has been associated with cardiovascular diseases, despite the total amount of alcohol consumed (Laatikainen et al. 2003, Sundell et al. 2008), whereas moderate consumption of alcohol has been associated with a reduced risk of cardiovascular disease (Rehm et al. 2010). Binge drinking has also been associated with mental disorders, irrespective of the total amount of alcohol consumption (Paljärvi et al., 2009).

This study examines the associations between alcohol drinking, health-related functioning and work disability among municipal employees of the City of Helsinki. The study population is female-dominated and includes employees aged 40 to 60 years at baseline in 2000 to 2002 and thus sheds light on the consequences of the current phenomena of increasing alcohol

drinking among older employees and women. Health-related functioning is examined in general and at occupational settings by mental and physical functioning, sickness absence and disability retirement. In addition to the amount of alcohol drinking, binge drinking and problem drinking are also examined. The purpose is to provide evidence regarding the extent of health functioning related to alcohol drinking among middle-aged municipal employees.

2 CONCEPTUAL FRAMEWORK

2.1 ALCOHOL DRINKING

By definition, alcohol drinking means consuming a beverage including ethyl alcohol. In Finland, alcohol is the only legal psychoactive substance, in addition to tobacco and prescribed psychotropic medication, and its use is regulated by the authorities by, for example, regulating the age limit of purchasing alcoholic beverages and the places and times alcohol can be sold.

Alcohol drinking and producing were invented thousands of years ago in different cultures. Alcohol has been used for different purposes, ranging from medicinal to thirst-quenching, as well as in different contexts: social or religious, during meals, special occasions and festivities (Hanson, 2013). There have been cultural differences in alcohol drinking that partly still exist today. For example, traditionally, in Southern Europe moderate wine consumption with meals has been common, whereas in Northern Europe alcohol drinking has been less frequent and amounts per drinking occasion have been more abundant, a drinking culture in favour of binge drinking (drinking several alcohol drinks on a single occasion) (Peltoniemi, 2013). Furthermore, non-drinking can be regarded as a drinking habit. In Islamic countries, non-drinking is the social norm and in many other countries non-drinking has been common especially among women. Drinking habits, however, change over time, due to, for example, intercultural influences, the amount of spare time and the availability and price of alcohol.

Alcohol is a psychoactive substance and it affects and depresses several functions regulated by the central nervous system. These effects depend on the percentage of blood alcohol concentration, although tolerance developed by repetitious alcohol drinking dampens these effects. Moderate blood alcohol concentration is often associated with effects such as enhanced mood and a decreasing of inhibition. These acute effects of alcohol drinking are often considered desirable and sought after by those drinking. As blood alcohol concentration increases, attention, coordination and reaction speed decline and sleepiness, impairment in memory, loss of consciousness and even death may occur. (Kiianmaa, 2003) In addition to affecting the central nervous system, alcohol also affects other organ systems and, for example, increases certain liver enzymes involved in alcohol metabolism, elevates blood pressure and the risk of cardiac arrhythmias. Besides acute effects, alcohol drinking also has chronic consequences. Some of them can be regarded as positive, such as the effects of alcohol on one's lipid profile (Rehm et al., 2010). U-shaped associations with both non-drinkers and heavy drinkers having poorer health compared to moderate drinkers has been suggested between alcohol drinking and different health outcomes (Wellmann et al., 2004; Rehm et al., 2010; Skogen et al., 2012). Most of the

known long-term effects are, however, negative. Alcohol has been causally linked with many diseases such as cardiovascular diseases, different types of cancer, infections and liver disease, as well as mortality (Rehm et al., 2010). Alcohol drinking is also associated with violence and many social problems (Warpenius et al., 2013) and causes considerable economic costs to society as well as human suffering to individuals. According to the total consumption model, the harms incurred by alcohol drinking are strongly related to population-level alcohol consumption and increase with increasing alcohol consumption (Warpenius & Tigerstedt, 2013).

There is no actual threshold after which alcohol drinking becomes damaging. Some more or less arbitrary limits for heavy drinking have been introduced and they differ between institutes and countries. In Finland, limits have often been set to 16 units of 100% alcohol per week for women and 24 units of 100% alcohol per week for men (Seppä et al., 2012), defining a unit of alcohol as 12 grams of pure alcohol. These limits are not, however, limits for safe drinking and harms may still occur with lower consumption. In fact, exceeding these limits calls for guidance from healthcare professionals on alcohol drinking, according to the Finnish recommendation (Seppä et al., 2012). The Finnish Current Care Guideline published in 2015 set the limits for heavy drinking, calling for intervention by healthcare professionals at 12 to 16 units per week for women and 23 to 24 units per week for men (Suomalaisen Lääkäriseuran Duodecimin ja Suomen Päihdelääketieteen yhdistyksen asettama työryhmä, 2015). Additionally, drinking habits contribute to the effects of alcohol drinking. In Finland, the limits of binge drinking are often set to 5 units per occasion for women and 7 units per occasion for men (Seppä et al., 2012). Binge drinking has been associated with many harmful outcomes despite the total amount consumed (Laatikainen et al., 2003; Paljärvi et al., 2009; Rehm et al., 2010).

Problem drinking can be divided into three separate categories: hazardous use, harmful use, and alcohol dependence (Suomalaisen Lääkäriseuran Duodecimin ja Suomen Päihdelääketieteen yhdistyksen asettama työryhmä, 2015). In the hazardous use of alcohol, limits for heavy drinking are exceeded but neither significant harms nor alcohol dependence have evolved. In harmful alcohol use, there is evidence of physical or mental harms due to alcohol drinking but no alcohol dependence. The severest form, alcohol dependence, is characterised by compulsive and continuous alcohol drinking despite harms, as well as increased tolerance and withdrawal symptoms. Alcohol dependence is regarded as a lifelong cerebral disease.

Assessing alcohol drinking is challenging both in clinical settings and scientific studies. People tend to underestimate their drinking, might not perceive mild beverages as alcohol and might attempt to hide their drinking. Questionnaires often inquire about typical drinking and thus heavier drinking occasions such as holidays and festivities are not included (Knudsen & Skogen, 2015). Furthermore, problem drinkers might be more likely to be non-respondents (Mäkelä & Huhtanen, 2010).

2.2 HEALTH-RELATED FUNCTIONING

The World Health Organization (WHO) defines health as a state of complete physical, mental and social wellbeing, not merely the absence of disease or infirmity (WHO, 1948), and in 2001 introduced an international classification of functioning, disability and health that captures the consequences of disease or disability in individual's life (WHO, 2002). The definition of health does not rely strictly on medical health status but takes into account the relationship between the health status and its effects on an individual and the surrounding environment; these together form the concept of health-related functioning. Instead of contrasting as opposites to one another, functioning and disability are regarded as a continuum from good functioning to severe disability; most individuals having some degree of both. Functioning and disability can be seen as the result of interactions between health and contextual factors that can be divided into personal factors, such as gender, education and coping styles, and environmental factors, such as social attitudes and legal structures (WHO, 2002). Health-related functioning captures an individual's ability to perform activities at home and outside the home which allow for an independent life and active participation in a community. In addition to health-related functioning, specific medical conditions are important indicators of health but are not themselves accurate predictors of poor health outcomes, such as service needs, hospitalisation and receipt of disability benefits (WHO, 2002). Although the definition of health-related functioning is not based solely on a specific medical condition, it has been found to predict events such as hospitalisation (Mayo et al., 2005), disability retirement (Haukenes et al., 2014) and mortality (Mayo et al., 2005; Myint et al., 2006; Myint et al., 2007). Health-related functioning can be assessed by different measures. One of the most widely used instruments measuring general health functioning in everyday life is the Short Form 36 survey (Ware et al., 1994) from which composite measures of mental and physical functioning (mental and physical component summaries [MCS, PCS]) can be formed.

2.2.1 WORK DISABILITY

Work disability can be regarded as part of health-related functioning, focusing on occupational life. The definition of work disability has changed over time along with the changes in work life and society (Gould et al., 2008). The first definitions of work disability were tightly bound to medical conditions according to which it was estimated whether the employee was able to work or not. As physically strenuous jobs were no longer the standard and the forms of morbidity changed, the concept of work disability gradually broadened to include the balance between work tasks and the resources of an individual. This model includes the idea of the possibility to enhance the balance by supporting the employee or improving the working conditions.

Later, the concept of work disability has further broadened to multi-dimensional models where health is only one factor of a dynamic system alongside other factors, such as the work environment and environments outside of work life. Work disability is understood as a disturbance in the system and work ability and work disability are considered more as being along a continuum rather than opposites of each other. A medical condition, illness or injury must be present, however, at least from a juridical viewpoint (e.g. to be eligible for financial compensation). Compensation mechanisms and legislation vary between countries.

The idea behind financial compensation due to work disability has been to share the financial burden of illness between employees and to provide the employee with resources in recovering. Sickness absence is granted when an employee is temporarily unable to perform his/her work tasks due to illness, medical condition or injury. There are different conventions concerning sickness absence across different countries and employers. In many cases the employee is allowed to be absent from work by his/her own notification in the first days of illness, but when the sick days exceed a certain limit a medical certification is required. In Finland, employees receive financial compensation starting from the first day of sickness absence, but for example in Sweden, the first day of sickness absence spell has not been compensated since 1993. When work disability is considered to be more permanent, disability retirement can be granted. The criteria for disability retirement are more strict than those for sickness absence. Sickness absence and disability retirement can be regarded as a lack of health-related functioning in occupational life. Sickness absences of different lengths mirror the severity in one's decline in ability to work, and disability retirement indicates the ultimate lack of health-related functioning in occupational life.

2.3 ALCOHOL DRINKING, HEALTH-RELATED FUNCTIONING AND WORK DISABILITY

Alcohol drinking might affect health-related functioning and work disability by different mechanisms, and those mechanisms may differ or have unequal contributions between different forms of health-related functioning. A Swedish literature review on alcohol drinking and sickness absence introduced a model further developed from Babor's model on alcohol drinking, work life and sickness absence (Hensing et al., 2010). The model suggests that alcohol drinking can lead to work disability in different ways, including biological effects of alcohol drinking leading to chronic diseases, alcohol poisoning and problem drinking (Hensing et al., 2010).

Alcohol drinking is an etiological factor behind many acute and chronic, somatic and mental diseases (Rehm et al., 2010) that may lead to impaired health-related functioning and work disability. Both acute diseases, such as stroke and accidents, and chronic diseases, such as cancer and ischemic heart

disease, may lead to long-term poor health functioning and work disability (e.g. sickness absence of long duration or disability retirement). Alcohol drinking is associated with mental health problems (Rehm et al., 2010) that can cause both short-term work disability and, when prolonged and severe in nature, can lead to disability retirement. Alcohol drinking also enhances vulnerability to more short-term diseases such as infections that cause more short-term limitation in health functioning and work disability. In addition to specific diseases, alcohol drinking can impair both physical and mental functioning by incurring different symptoms such as gastrointestinal problems, sleep disturbances and difficulties in concentration. Alcohol drinking might co-occur with other health behaviours which might add to adverse health effects (Laaksonen et al., 2001). Heavy alcohol drinking, in particular, and smoking are highly associated with each other. Alcohol drinking might also for example limit time to engage in physical activity and healthy food habits. Alcohol contains a lot of calories which might result in obesity which is itself associated with poor health functioning (Roos, 2014).

Drinking habits are also important to health functioning and work disability (Österberg, 2006; Bacharach et al., 2010). Heavy average drinking is behind diseases such as cancer and chronic liver disease. These chronic diseases typically take a long time to develop and might be a reason for long-term poor health functioning and work disability and lead to disability retirement. Binge drinking adds to the risk of chronic diseases and may also lead to injuries, hangovers and continued bouts of drinking and thus limit health functioning and work ability. Employees might also choose to be absent from work in order to hide their alcohol drinking or due to not wanting to work with limited abilities due to alcohol drinking. These phenomena might lead to short-term limited functioning and work disability and be the reason for short, self-certified sickness absence. In Finland, absence due to intoxication or hangover is not financially compensated to the employee, but these types of absences might be the reason for self-certified sickness absence as well as medically-confirmed sickness absence if not recognised or properly recorded by the physician. Financial losses due to alcohol-related diseases and injuries are financially compensated for employees in Finland. Chronic heavy drinking may evolve into problem drinking and to its severest form, alcohol dependence, which is defined as a lifelong cerebral disease. Alcohol dependence can entitle an employee to financial benefits and disability retirement provided there are important somatic or mental complications or another somatic or mental disease markedly decreasing work ability or if the alcohol dependence is severe, if there are social consequences, and if treatment attempts have failed (Suomalaisen Lääkäriseuran Duodecimin ja Suomen Päihdelääketieteen yhdistyksen asettama työryhmä, 2015).

Additionally, the workplace and working conditions shape an employee's drinking habits (Hensing et al., 2010). There are different drinking cultures across workplaces and some work communities might even encourage

alcohol drinking during after-work gatherings and other social events. Occupations might differ from each other concerning drinking habits because of selection or the influence of the work environment. Work-related stress and strenuous working conditions might increase alcohol drinking as an attempt by the employee to cope (Vasse et al., 2008, Marchand et al., 2011). The work environment and occupational position might also play a role regarding whether alcohol drinking leads to work disability, sickness absence or disability retirement. Some workplaces and occupations have flexible work hours that enable absence due to alcohol drinking or recovering from its effects. Concerning alcohol-related diseases, the nature of the work and working conditions also influence the judgment of whether the employee is capable of working or not.

Health-related functioning and work disability may also contribute to alcohol drinking (Hensing et al., 2010). When absent from work, an employee may have more time to engage in alcohol drinking and feel there are no pressures to remain sober in order to work. Alternatively, there might be fewer occasions to drink and less money to spend on alcoholic beverages. In addition to one's work environment, one's personal life may also contribute to alcohol drinking and its association with health functioning and work disability. It has been suggested that being married is associated with reduced levels of drinking (Waldron et al., 2012). Additionally, different diseases might affect alcohol drinking. For example, medication and recovering from an illness may require abstinence and worries concerning one's medical condition might increase or decrease alcohol drinking.

3 REVIEW OF THE LITERATURE

3.1 ALCOHOL DRINKING IN FINLAND

Compared to other Western European countries, alcohol consumption was relatively low in Finland until the late 1960s (Mäkelä et al., 2010). Alcohol consumption increased almost continuously from the late 1960s until 2007, with the exception of the economic downturn of the early 1990s during which alcohol consumption decreased by about 10%. The rise was fastest in the early 1970s following the 1969 change in legislation which allowed for, for example, medium strength beer to be sold in grocery stores and coffee shops and lowered the legal age limit for purchasing alcohol from 21 to 18 years for mild beverages and from 21 to 20 years for spirits (Mäkelä et al., 2010). Another rapid increase of 10% in total alcohol consumption took place in 2004. At this time, alcohol taxes were lowered and traveler's tax free import quotas from other European Union countries were abolished in order to inhibit the import of alcoholic beverages and the establishment of grey markets and to maintain the tax base of alcoholic beverages after Estonia joined the European Union (Mäkelä & Österberg, 2009). In 1965, yearly alcohol consumption per inhabitant 15 years old and over was 4.3 litres of 100% alcohol; consumption reached its highest points thus far in 2005 and 2007 with the consumption of 12.7 litres (Varis & Virtanen, 2016). In the late 2000s there was an economic downturn and additionally a tightening regarding alcohol taxation was introduced (Varis & Virtanen, 2016), thus, after 2007 alcohol consumption has declined and was at 10.8 litres in 2015 (Varis & Virtanen, 2016). Alcohol consumption in Finland is now in the European upper average level and, together with Denmark, somewhat higher than in other Nordic countries (Karlsson et al., 2013).

As alcohol consumption has increased drinking habits have also undergone changes. Strong spirits were the most common source of alcohol until the late 1980s when they were replaced by beer (Mäkelä et al., 2010). Since the mid-1990s, the consumption of mild wine, cider and long drink has increased, whereas the consumption of beer, spirits and strong wine has decreased, although beer still is the most popular alcohol beverage (Varis & Virtanen, 2016). According to the Finnish Drinking Habit Surveys, conducted every eight years starting from 1968, the large increase in alcohol drinking has been due to a decreased amount of non-drinkers, increased amounts of alcohol consumed during the drinking occasions and an increased frequency of alcohol drinking (Mäkelä et al., 2010). Alcohol consumption among women has increased markedly and although women still drink under one third of the alcohol consumed, their relative alcohol consumption has increased more compared to men (Mäkelä et al., 2010). Since 1992 the proportion of non-drinkers has remained quite stable at 10% among men,

whereas among women it has decreased from 20% to 10% (Karlsson et al., 2013). Additionally, older people have increased their alcohol drinking (Ilomäki et al., 2010; Mäkelä et al., 2010). This is partly due to younger heavier drinking cohorts replacing the older ones (Mäkelä et al., 2010) but people have actually also increased their alcohol consumption as they get older (Ilomäki et al., 2010). Light drinking occasions have increased and alcohol is consumed increasingly at home instead of in restaurants (Mäkelä et al., 2010). Although the number of drinkers has increased, the top 10% of drinkers drinks half of the alcohol consumed (Karlsson et al., 2013), and despite the increase in light drinking occasions, binge drinking has also increased (Mäkelä et al., 2010). Furthermore, drug use and misuse of pharmaceuticals often co-occur with heavy alcohol drinking. Almost one in three of the heaviest drinking tenth has used drugs and almost 15% have misused pharmaceuticals (Hakkarainen & Metso, 2005). However, there are some signs that may indicate future declines in alcohol consumption. Among the young, binge drinking has decreased and non-drinking increased (Mäkelä et al., 2010; Kinnunen et al., 2015). Compared to the mid-1990s, attitudes towards alcohol drinking have not seemed to liberate further and have tightened regarding alcohol policy (Mäkelä et al., 2010).

Alcohol drinking and problem drinking are common among Finnish employees. According to the Health 2000 Survey which examined a national representative sample of Finns aged 30 to 64 years, 85% of hazardous drinkers and 70% of those suffering from alcohol dependence were employed (Halme et al., 2008). Another study using the Health 2000 Survey included 30- to 55-year-old participants who had been occupationally active during the preceding 12 months (Kaila-Kangas et al., 2015). The majority were light or moderate drinkers, whereas 7.1% were heavy drinkers (drinking over 24 [men] or 16 [women] units per week) and 5.5% were problem drinkers, according to the computerised version of the Composite International Diagnostic Interview (Kaila-Kangas et al., 2015). The 10 Town Study was conducted among municipal workers in 1997 with a mean age of 46.1 years for men and 44.8 years for women; 13% of men and 2% of women were classified as heavy drinkers, drinking over 275 grams of pure alcohol per week (Vahtera et al., 2002). The Health and Support Study examined work-aged Finns aged 20-24, 30-34, 40-44 and 50-54 years at baseline in 1998 (Harkonmäki et al., 2008). Participants aged 40-44 years drank most alcohol with a weekly consumption of 89 grams. The 50- to 54-year-old participants had the second highest weekly alcohol consumption but reported the least adverse effects, such as hangovers. Binge drinking was common; 9.7–32.8% had experienced a hangover at least 2–3 times per month.

3.2 EMPIRICAL EVIDENCE ON THE ASSOCIATIONS BETWEEN ALCOHOL DRINKING AND MENTAL AND PHYSICAL FUNCTIONING

Studies on the associations between alcohol drinking and mental and physical functioning examining general populations are few; the longitudinal studies are gathered in Table 1. Cross-sectional studies are presented in Appendix 1. Longitudinal studies are scarce and have produced inconclusive results. Studies have often focused on elderly people. An Australian study on women aged 70 to 75 years measuring alcohol drinking by a quantity-frequency method found that non-drinkers and rare drinkers had lower scores on general health, physical functioning, mental health and social functioning subscales compared to those drinking one to two units per day, three to six days per week (Byles et al., 2006). A Finnish study (Strandberg et al., 2004) examined a cohort of elderly men with high socioeconomic positions and, in contrast to the Australian study (Byles et al., 2006), found no differences in either mental or physical functioning as measured by average weekly alcohol drinking. Additionally, when death during follow-up was taken into account heavy drinkers had the poorest mental and physical functioning (Strandberg et al., 2004). Furthermore, beverage-type preference was analysed and those preferring wine had the best scores in mental health and general health subscales (Strandberg et al., 2007), after adjusting for age and smoking. However, instead of positive health effects existing from drinking wine the association might have been due to other characteristics common to wine drinkers. A Spanish study examined women aged 60 years or older and was able to adjust for baseline health functioning (Ortola et al., 2016). No association between alcohol drinking and health functioning was found in longitudinal analyses.

Two longitudinal studies have examined middle-aged people and suggested that both non-drinkers and heavy drinkers have poorer health functioning compared to moderate drinkers. An Australian study examined middle-aged women regarding current alcohol drinking measured by the quantity-frequency method, as well as changes in alcohol drinking and the contribution of the changes to the women's general health score as measured by the SF-36 survey (Powers & Young, 2008). Moderate drinkers drinking 1 to 14 units per week had better general health than non-drinkers, occasional drinkers or heavy drinkers. A decrease in alcohol drinking and variation between measurements of alcohol drinking were associated with a decline in general health among baseline moderate drinkers (Powers & Young, 2008). Additionally, a Danish study examined middle-aged people and included both men and women (Pisinger et al., 2009). In cross-sectional analyses, those drinking within recommendations (e.g. under 15 units per week among women and under 22 units among men) had the best physical health functioning, whereas non-drinkers had the worst physical health functioning. Concerning mental health functioning, both non-drinkers and heavy drinkers

had lower scores compared to moderate drinkers. When analysing changes in alcohol drinking, no associations were found between changes in drinking and improved health functioning. Many cross-sectional studies have also found poorer health functioning among non-drinkers (Van Dijk et al., 2004; Green et al., 2004; Saito et al., 2005; Stranges et al., 2006; Valencia-Martin et al., 2013), whereas results concerning heavy drinkers have been inconclusive: some studies suggesting poorer health functioning among heavy drinkers (Bendtsen et al., 2003) and other studies suggesting that heavy drinking is associated with better health functioning (Van Dijk et al., 2004; Chan et al., 2009; Valencia-Martin et al., 2013).

Only a few studies have focused on employees. A Swedish cross-sectional study examined women employed as metalworkers, nurses, assistant nurses or medical secretaries and found that women with self-perceived excessive alcohol consumption had lower scores in vitality, social role functioning, emotional role functioning and mental health, compared to others (Bendtsen et al., 2003). A Japanese cross-sectional study found that among male employees moderate drinkers had better health functioning compared to non-drinkers, but there was no association between heavy drinking and poor health functioning (Saito et al., 2005).

Most of the previous studies have focused on the volume of drinking and other drinking habits have been included only seldom. A U.S. cross-sectional study included several measures of alcohol drinking and found that current drinkers had better health functioning than non-drinkers. Drinking to intoxication was associated with worse health functioning. Among women, a preference for beer was associated with better mental health, whereas among men preferring spirits was associated with poor physical health. (Green et al., 2004)

Table 1. Longitudinal studies on the associations between alcohol drinking and mental and physical functioning.

Reference and setting	Data on alcohol drinking	Data on health functioning	Statistical methods, covariates	Main results
Strandberg et al. 2004 1808 Finnish men born in 1919-34 in leading positions in private companies Questionnaire and clinical examination in 1974 and a follow-up survey in 2000	Average weekly alcohol drinking (g/week) during the past year: -non-drinkers -moderate drinking (1-349 g/week) -high drinking (over 349 g/week)	The Finnish version of the SF-36 survey -PCS, MCS	Analysis of covariance Age, smoking, blood pressure, cholesterol, BMI Death during follow-up	No significant differences in PCS or MCS between alcohol consumption groups When adjusted for death during follow-up, PCS and MCS were poorer among high drinkers
Byles et al. 2006 70-75-year-old women selected randomly from the Australian national health insurance database 12,432 women surveyed in 1996; 69% resurveyed in 1999 and 2002 Response rate of 37-40% at baseline	Usual weekly alcohol consumption: -non-drinkers -rare drinkers (less than every week, maximum 14 units) -low intake 1 (1-2 units/day on 1-2 days/week) -low intake 2 (1-2 units/day on 3-6 days/week) ref. -low intake 3 (1-2 units/day every day) -low intake 4 (maximum 3 units/day up to 14 units/week) -high intake (+15 units/week)	The Australian version of the SF-36 survey -8 subscales	The generalised estimating equation model Area of residence, smoking, education, BMI, comorbidity, time	Non-drinkers and rare drinkers had lower scores on general health and physical functioning subscales compared to the low intake 2 group Non-drinkers had lower scores on mental health and social functioning subscales compared to the low intake 2 group
Strandberg et al. 2007 1127 Finnish men born in 1919-34 in leading positions in private companies Questionnaire, clinical examination in 1974; Follow-up survey in 2000 Response rate of 80%	Alcohol beverage preference: -beer -wine -spirits -no single preference Those with known alcoholism or psychiatric disturbances excluded at baseline	The Finnish version of the SF-36 survey -8 subscales	Two-tailed tests Age, baseline smoking	Those with wine preference had the best scores in general health and mental health

<p>Powers & Young 2008</p> <p>45-50-year-old women selected randomly from the Australian national health insurance database</p> <p>13,585 women surveyed in 1996; 69% resurveyed in 1998, 2001 and 2004</p> <p>Response rate of 53-56% at baseline</p>	<p>Usual weekly alcohol consumption:</p> <ul style="list-style-type: none"> -non-drinkers -occasional drinkers (less than once/week) -moderate drinkers (1-14 units/week) -heavy drinkers (14+ units/week) <p>Change in alcohol drinking was classified as:</p> <ul style="list-style-type: none"> -no change -decreased consumption -increased consumption -variable change in consumption 	<p>The Australian version of the SF-36 survey</p> <ul style="list-style-type: none"> -general health subscale 	<p>Random coefficient models</p> <p>Age, area of residence, education, ability to manage on available income, smoking, BMI, chronic condition (diabetes, heart disease, stroke, osteoporosis, breast or cervical cancer), depression</p>	<p>General health was better among moderate drinkers compared to non-drinkers (mean difference 4.3, standard error 0.61), occasional drinkers (3.1, 0.52) and heavy drinkers (2.1, 1.00)</p> <p>A decrease or variation in alcohol drinking was associated with a decline in general health among moderate drinkers</p> <p>Recent non-drinkers and intermittent drinkers did not differ from longer-term non-drinkers</p>
<p>Pisinger et al. 2009</p> <p>30- to 69-year-old individuals drawn from the Civil Registration System from a defined area of Copenhagen</p> <ul style="list-style-type: none"> -high-intensity intervention group (n=6091) -low-intensity intervention group (n=693) -control group (n=3324) <p>Questionnaires for all participants, additional assessment and intervention for intervention groups</p> <p>Baseline 1999-2001; follow-up 2000-2006</p>	<p>Mean consumption (unit/week)</p> <ul style="list-style-type: none"> -recommended (under 15 units/week for women and under 22 units/week for men) -above recommendations (more than recommended but under 5 units/day) -heavy use (5 units/day or more) <p>Change in alcohol drinking</p> <ul style="list-style-type: none"> -much more/a little more -unchanged -a little less -much less 	<p>SF-12 survey</p> <ul style="list-style-type: none"> -MCS, PCS <p>Measured at baseline and at every follow-up</p> <p>Improved score defined as higher than baseline score at 5-year follow-up</p>	<p>Analysis of variance</p> <ul style="list-style-type: none"> -cross-sectional, baseline situation <p>Logistic regression analyses</p> <ul style="list-style-type: none"> -longitudinal, only high-intensity intervention group included <p>Age, baseline SF-12 score, gender, vocational training, employment</p>	<p>Those drinking within recommendations had the highest PCS, non-drinkers had the lowest PCS</p> <p>Non-drinkers and heavy drinkers had the lowest MCS scores</p> <p>No association between change in alcohol consumption and improved PCS</p> <p>No association between change in alcohol consumption and improved MCS</p>
<p>Ortola et al. 2016</p> <p>2163 community-dwelling individuals aged 60 years or over selected by stratified cluster sampling of the non-institutionalised adult population in Spain</p> <p>Baseline data collection in 2008-10 and follow-up in 2012</p>	<p>Habitual alcohol consumption according to validated diet history:</p> <ul style="list-style-type: none"> -non-drinkers (including occasional drinkers) ref. -ex-drinkers -moderate drinkers -heavy drinkers (40g/day or over for men; 24g or over for women) <p>Beverage preference</p> <p>Drinking with meals</p> <p>Mediterranean drinking pattern</p>	<p>SF-12 survey</p> <ul style="list-style-type: none"> -PCS, MCS 	<p>Linear regression, beta coefficients, 95% CIs</p> <p>Gender, age, education level, smoking, BMI, time watching TV, physical activity, diet quality, morbidity, functional limitations in instrumental activities of daily living, baseline PCS and MCS</p>	<p>In cross-sectional models, moderate drinkers and heavy drinkers had somewhat better PCS scores and adherence to Mediterranean drinking pattern was associated with better PCS score compared to non-drinkers</p> <p>In prospective models, almost no associations were found: women who drank only with meals had better PCS scores than those who drank only outside meals</p>

3.3 EMPIRICAL EVIDENCE ON THE ASSOCIATIONS BETWEEN ALCOHOL DRINKING AND SICKNESS ABSENCE

Aggregate-level and prospective studies on the associations between alcohol drinking and sickness absence are gathered in Table 2. Aggregate-level studies have been conducted in Sweden (Norström, 2006) and in Norway (Norström & Moan, 2009). These studies have demonstrated that alcohol drinking is positively associated with increase in sickness absence. In both studies, a 1-litre increase in total alcohol consumption was associated with a 13% increase in sickness absence among men. No statistically significant association was found among women in either study. The study conducted in Norway included manual workers only. The country's economic situation during the study periods was taken into account by adjusting for unemployment in both studies and also for real wages in the study conducted in Sweden.

There are only a few large-scale longitudinal studies using register-based data on sickness absence. These studies have often found that both non-drinkers and heavy drinkers have more sickness absence compared to moderate drinkers. Associations have been found more often among men than women. A UK study on civil servants found that among men both non-drinking and heavy drinking, measured by frequency of drinking, were associated with self-certified sickness absence spells among men (Marmot et al., 1993). For women, the risk for non-drinkers was also elevated compared to moderate drinkers, but no association was found for heavy drinkers. When alcohol drinking was measured by the amount of alcohol used in the previous 7 days, heavy drinking was associated with self-certified sickness absence among men, but not women. Non-drinking women had an elevated rate of self-certified sickness absence. The results were adjusted for age and employment grade. Measured by the amount or frequency of drinking, heavy drinking was not associated with medically-confirmed sickness absence. Another UK study examined young executive officers and suggested that those drinking over 30 units per week had both more self-certified and more medically-confirmed sickness absence (Jenkins, 1986). Other studies have not included both self-certified and medically-confirmed sickness absence spells. A Swedish study measured sickness absence by an average number of at least 60 sick days per year during follow-up and found that among men, both non-drinking and heavy drinking were associated with sickness absence when drinking was measured by either usual consumption or consumption during the past week (Upmark et al., 1999). Additionally, female heavy drinkers had an increased risk of sickness absence when measured by consumption during the past week. A Finnish study examined public sector employees and focused on medically-confirmed sickness absence and found that never drinking women, former drinkers and heavy drinkers had an increased risk for sickness absence (Vahtera et al., 2002). Not all studies

examining the amount of drinking have found associations between heavy drinking and sickness absence (Morikowa et al., 2004; Christensen et al., 2007). A Danish longitudinal study examined the associations between health behaviours and sickness absence spells with a duration of eight consecutive weeks or more and found no association concerning alcohol drinking (Christensen et al., 2007). Variation in the length of sickness absence spells and in follow-up times between studies, however, decreases the comparability between the studies.

Drinking habits other than the amount of drinking have been studied less frequently. A Swedish longitudinal study also examined problem drinking, measured by the CAGE-scale, and found that among men, problem drinking was associated with sickness absence (Upmark et al., 1999). The study on British civil servants sought to examine binge drinking by a combination measure of the amount of alcohol and drinking frequency. Among men, the sickness absence rates did not differ between infrequent and frequent drinkers, whereas for women the sickness absence rates were higher, although not always statistically significant for infrequent drinkers (Marmot et al., 1993). A Finnish study examined different beverage types separately and found a curvilinear trend of both non-drinkers and heavy drinkers having increased sickness absence for all beverages combined, wine only and for beer only but not for spirits (Vahtera et al., 2002). The population-level study conducted in Norway also separated different beverage types and found a statistically significant association for spirits only but not for beer and wine (Norstöm & Soan, 2009).

Some studies have tried to identify the association between alcohol drinking and sickness absence that is directly linked to alcohol drinking by examining day-to-day associations between alcohol drinking and sickness absence, or by examining alcohol-related sickness absence defined by self-reports. A U.S. study with 280 participants found that alcohol drinking was associated with absenteeism one day after drinking but not the day of drinking or two days after drinking (McFarlin et al., 2002). The absence data was derived from the employer's records. An Australian study examined self-reported days absent from work due to alcohol use and due to any illness or injury in the 3 months prior to the survey (Roche et al., 2008). Short-term high-risk drinkers were up to 22 times more likely to be absent from work due to alcohol use, compared to low-risk drinkers. Short-term risk drinking was also associated with absenteeism due to illness or injury. Younger and male employees had more alcohol-related absence than older employees and women (Roche et al., 2008). A cross-sectional Norwegian study focused on young employees and found that frequent drinking, heavy drinking episodes and drinking to intoxication were all associated with self-reported alcohol-related sickness absence (Schou et al., 2014). Men were almost twice as likely to be absent from work because of drinking compared to women (Schou et al., 2014). Heavy drinkers were responsible for 19% of total alcohol-related sickness absence in the study.

Table 2. Aggregate-level and longitudinal studies on the associations between alcohol drinking and sickness absence

Reference and setting	Data on alcohol drinking	Data on sickness absence	Statistical methods, covariates	Main results
Aggregate-level studies				
Norström 2006 Swedish female and male population, 1935-2002 and 1963-2002	Sales of 100% alcohol per inhabitant 15 years or older	Number of days of illness recorded per insured person based on health insurance data (includes only sickness absence covered by the insurance) Sickness absence according to the labor force survey (based on survey data)	The Box-Jenkins method for time-series analyses Unemployment, real wages, female sickness absence (when analyzing men)	Among men, a 1-litre increase in alcohol consumption was associated with an increase in sickness absence of 11-14% and even 21% (sickness absence according to labor force surveys, not adjusted for female sickness absence) For women, no statistically significant associations
Norström & Moan 2009 Norwegian male and female manual workers, 1957-2001	Sales of 100% alcohol per inhabitant 15 years or older, beverage-specific indicators for beer, spirits and wine	The percentage of reported days of sickness absence of all working days	The Box-Jenkins method for time-series analysis Unemployment rate	Among men, a 1-litre increase in total consumption was associated with a 13-14% increase in sickness absence Regarding beverage types, only spirits were associated with sickness absence among men For women, no statistically significant associations
Individual-level longitudinal studies				
Jenkins 1986 A weighted sample of 20- to 35-year-old executive officers in the Home Office, UK 190 men, 138 women, response rate of 81% Data collection June-Oct 1980	Alcohol consumption for the last 7 days: -0 -1-14 -15-29 -30+ units/week	Derived from the Home Office records -for the 12 months preceding and following the clinical assessment uncertified absences (1-2 days), certified absence (over 2 days)	Analysis of variance	Both men and women who reported drinking more than 30 units in the last week took longer and more frequent spells of both certified and uncertified absence compared to those drinking less than 30 units
Marmot et al. 1993 Civil servants aged 35-55 years in 20 London-based departments, UK N=8506, 67% men Response rate of 73% Baseline data collection 1985-88; follow-up of sickness absence until Dec 1988 Mean follow-up time of 1.7 years	Frequency of drinking in the past 12 months The amount consumed in the last 7 days (cut-point for heavy drinking 31+ units for men and 21+ units for women)	Derived from civil service payroll centres Number of sickness absence per person-year Self-certified (1-7 days) and medically confirmed sickness absence (7+ days)	Poisson regression, RRs 95% CIs Age, employment grade Additionally adjusted for: health status, smoking, work characteristics and difficulty paying bill -> did not change the associations (data not shown)	Frequency of drinking (ref. 1-2 times/week) Short sickness absence Men: never-drinkers 1.18 (1.03-1.35), >daily 1.18 (1.02-1.36) Women: never-drinkers 1.20 (1.04-1.39) Long sickness absence Men: NS Women: 1-2/month 1.21 (1.01-1.44) Amount of drinking (ref 1-10 units/week for men, 1-6 units for women) Short sickness absence Men: 31+ units 1.12 (1.02-1.24) Women: 0 units 1.10 (1.01-1.20) Long sickness absence NS

<p>Webb et al. 1994</p> <p>506 male employees of an industrial plant in New South Wales, Australia employed from May 1986 to June 1986</p>	<p>7-day retrospective diary (units/week)</p> <p>-non-drinkers -moderate drinkers -heavy drinkers (42 or more for men; 28 or more for women)</p> <p>Problem drinking (the Mortimer-Filkins test)</p> <p>Binge drinking (8 or more units on one occasion)</p>	<p>Self-reported data on days absent from work due to work injuries for 12 months following the survey</p> <p>-at least one injury-related absence</p>	<p>Logistic regression, ORs 95% CIs</p>	<p>No association for heavy drinking</p> <p>No association for binge drinking</p> <p>Problem drinking 2.7 (1.2-6.4)</p>
<p>Upmark et al. 1999</p> <p>4 out of 42 primary health care districts in Stockholm County</p> <p>985 women, 870 men meeting inclusion criteria out of randomly drawn 6217 subjects; at baseline 20- to 52-year-old participants</p> <p>Postal survey in 1984 and health examination</p> <p>Follow-up of sickness absence, 1986-92</p>	<p>Usual alcohol consumption (ref. below 10g/day for men and 7 g/day for women)</p> <p>Consumption during the previous week (ref. below 10g/day for men and 7 g/day for women)</p> <p>Cut-point for high consumption: 35g/day for men and 25g/day for women</p> <p>Problem drinking measured by the CAGE-scale</p>	<p>Derived from the National Swedish Social Insurance Board</p> <p>An average number of at least 60 sick days per year during follow-up</p>	<p>Logistic regression, relative risks, 95% CIs</p> <p>Age, smoking, socioeconomic group, self-rated health</p>	<p>Univariate models, those marked with * statistically significant also in multivariate models</p> <p>Usual consumption: Men: Abstainers 2.2 (1.1-4.4), High consumption 3.7 (1.8-7.6)* Women: NS</p> <p>Consumption during the past week: Men: Abstainers 3.0 (1.6-5.6)*, High consumption 2.5 (1.1-5.7) Women: High consumption 3.2 (1.7-6.1) *</p> <p>Problem drinking: Men: 3.7 (1.8-7.5) Women: NS</p>
<p>Kivimäki et al. 2001</p> <p>447 Finnish physicians (44% women) and 446 controls (head nurses, ward sisters) from 3 hospital districts employed by the hospital both in 1997 and 1998</p> <p>Follow-up of sickness absence from the beginning of 1997 until the end of 1998</p>	<p>Alcohol consumption/week</p> <p>-Non-drinkers -Moderate (1-260g for men; 1-210g for women) ref. -High (>260g for men; >210g for women)</p>	<p>Derived from employer's register</p> <p>Short (1-3 days) and long (>3 days) sickness absence spells</p> <p>Long sickness absence spells required a medical certificate</p>	<p>Poisson regression, RRs, 95% CIs</p> <p>Age, gender, income, levels of income, work characteristics, social support, and size of social network.</p>	<p>Short sickness absence Physicians Non-drinkers: NS High consumption: NS Controls Non-drinkers: 1.40 (1.17-1.67) High consumption: NS</p> <p>Long sickness absence Physicians Non-drinkers: NS High consumption: NS Controls Non-drinkers: NS High consumption: 1.55 (1.11-2.18)</p>
<p>Vahtera et al. 2002</p> <p>1490 male and 4952 female permanent municipal employees from 10 Finnish municipalities, response rate of 67%</p> <p>Mean age for 46 years for men and 45 years for women</p> <p>Survey in 1997, follow-up of sickness absence 1997-2000, mean follow-up time 3.5 years</p>	<p>Habitual weekly average alcohol consumption:</p> <p>-never drinkers -former drinkers, -1-50g -51-100g (ref.) -101-275g -over 275g</p> <p>Beer, wine, spirits asked separately</p>	<p>The number of medically-confirmed (over 3 days) sickness absence spells from employer's records</p>	<p>Poisson regression, RRs, 95% CIs</p> <p>Age, income, behavioural and biologic risk factors, psychosocial risk factors and cardiovascular diseases</p>	<p>Men: Unadjusted model Former drinkers: 1.73 (1.51-1.99) 101-275g/week: 1.22 (1.11-1.33) >275g/week: 1.26 (1.12-1.41) Fully adjusted model Former drinkers: 1.41 (1.20-1.65)>275g/week: 1.17 (1.03-1.33)</p> <p>Women: Unadjusted model Never drinkers: 1.21 (1.10-1.34) Former drinkers: 1.27 (1.20-1.34) 1-50g/week: 1.07 (1.02-1.11) 101-275g/week: 1.11 (1.04-1.18) >275g/week: 1.24 (1.10-1.39) Fully adjusted model Never drinkers: 1.22 (1.10-1.36) Former drinkers: 1.22 (1.15-1.29) 1-50g/week: 1.06 (1.01-1.11) >275 g/week: 1.24 (1.10-1.40)</p>

<p>Morikowa et al. 2004</p> <p>2504 male Japanese workers aged 35-55 years in a sash and zipper factory in Toyama, Japan; survey in 1990, response rate of 89%</p> <p>6290 British male civil servants in London, aged 35-55 years; survey in 1985-88, response rate of 73%</p> <p>Follow-up time until the end of 1998</p>	<p>Frequency of drinking/week</p> <p><1/week ref. 1-3/week >=3/week</p>	<p>Derived from the employers' registers</p> <p>First occurrence of sickness absence over 7 calendar days (medical certificate required)</p>	<p>Cox regression, HRs, 95% CIs</p> <p>Age</p>	<p>Japanese cohort 1-3/week: NS >=3/week: NS</p> <p>British cohort 1-3/week: 0.76 (0.69-0.84) >=3/week: 0.72 (0.65-0.80)</p>
<p>Christensen et al. 2007</p> <p>5020 Danish employees aged 18-60 years</p> <p>Survey in 2000, follow-up of sickness absence Jan 2001 to June 2002, follow-up time of 18 months</p>	<p>Weekly alcohol consumption -non and moderate drinkers (ref.) -heavy drinkers (over 21 units/week for men and over 14 units/week for women)</p>	<p>Derived from a national register on social transfer payments</p> <p>Sickness absence defined as 8 consecutive weeks</p>	<p>Cox regression, HRs 95% CIs</p> <p>Age, family status, socioeconomic status, education, presence of diagnosed disease, physical and psychosocial work environment</p>	<p>Alcohol consumption was not associated with sickness absence</p> <p>Adjusted for age Men Heavy: 1.34 (0.88-2.03)</p> <p>Women Heavy: 1.11 (0.72-1.71)</p>
<p>Skillgate et al. 2009</p> <p>6532 employees classified as having "good health for working" working in the public sector in the southern, middle and northern parts of Sweden</p> <p>Response rate of 84%</p> <p>82% women, mean age 45 years</p> <p>Survey 1999-2000, Follow-up time of 3 years</p>	<p>Frequency of drinking</p> <p>The number of drinks per month -quartile 1 (<2) -quartile 2 (2-4) -quartile 3 (5-10) -quartile 4 (>10)</p>	<p>Reported by the employer or the occupational health service</p> <p>Continuous absenteeism from work due to unspecific pain in the back or neck for 28 or more days in a row</p> <p>First spell of long-term sickness absence</p>	<p>Cox regression, HRs, 95% CIs</p> <p>Pain, socioeconomic class, age, smoking, gender, living alone, born abroad, low education, poor financial situation, pain from back or neck, health-related quality of life, burn-out syndrome, sense of coherence, job strain, physically demanding work, no physical exercise, bad sleep and recuperation, BMI, snuff use, geographical area</p>	<p>Frequency of drinking Crude model Once/month or less: (ref.) Twice/month or more: 0.6 (0.4-0.8) 2-4 times/month: 0.6 (0.5-0.9) Twice/week or more: 0.3 (0.2-0.6) Adjusted model NS</p> <p>Amount of drinking Crude model Quartile 1: (ref.) Quartile 4: 0.3 (0.2-0.6) Adjusted model NS</p>
<p>Bacharach et al. 2010</p> <p>470 urban transit workers, a random sample of workers employed at least 1 year by the employer</p> <p>Response rate of 43%, 69% men, mean age of 46 years</p> <p>A survey, 1 year follow-up of sickness absence</p>	<p>Modal level of alcohol drinking (calculated from frequency and quantity of drinking)</p> <p>Frequency of episodic heavy drinking (5 drinks or more in the past month)</p>	<p>Derived from the employer's personnel archives -missed days other than approved vacation in the 12-month period</p>	<p>Negative binomial model</p> <p>Gender, age, marital status, tenure, household income, average hours per week worked, depression, number of discipline charges filed against the employee by the employer, division</p> <p>Co-worker support, supervisory support</p>	<p>Modal consumption had positive, linear association with sickness absence but the association was explained by heavy episodic drinking</p> <p>Heavy episodic drinking was positively associated with sickness absence, even after adjusting for modal drinking</p> <p>Co-worker support attenuated and supervisory support amplified the link between the frequency of heavy episodic drinking and sickness absence</p>

3.4 EMPIRICAL EVIDENCE ON THE ASSOCIATIONS BETWEEN ALCOHOL DRINKING AND DISABILITY RETIREMENT

Prospective studies on the associations between alcohol drinking and disability retirement with register-based data on disability retirement have been scarce, but in recent years more studies have been published alongside this study. These studies have been conducted mainly in Finland, Sweden and Norway. Table 3 gathers more detailed data of the studies on the associations between alcohol drinking and disability retirement.

The majority of studies have examined associations between the amount of alcohol drinking and disability retirement, producing somewhat inconsistent results. Three Finnish studies have found that both non-drinking and heavy amounts of drinking increase the risk of disability retirement (Harkonmäki et al., 2008; Korhonen et al., 2015; Böckerman et al., 2016). Korhonen et al. and Böckerman et al. both examined large dataset on Finnish twin pairs born before 1958. Böckerman et al. measured alcohol drinking in 1990 and followed disability retirement until the end of 2014, whereas the study by Korhonen et al. had a rather long follow-up of disability retirement with the measurement of alcohol drinking in 1970 until the end of 2004. Studying twin pairs allowed for controlling of familial confounding and the associations between heavy drinking and disability retirement remained (Böckerman et al., 2016). Additionally, Harkonmäki et al. (Harkonmäki et al., 2008) had a large dataset, but the response rate was low and disability retirement was based on self-reports. Two studies from Sweden have also suggested that heavy drinking increases the risk of disability retirement. Månsson et al examined middle-aged men separating moderate and heavy drinkers according to the Malmö modification of the Brief MAST (Michigan Alcohol Screening Test) instead of the amount of drinking (Månsson et al., 1999). Another Swedish study found that heavy drinking was associated with disability retirement among men when measured by usual alcohol consumption and among women when measured by alcohol drinking during the previous week (Upmark et al., 1999). The study also examined problem drinking measured by the CAGE scale and no associations were found between problem drinking and disability retirement.

In contrast to these studies, not all have found associations between a heavy amount of drinking and disability retirement (Krause et al., 1997; Skogen et al., 2012; Samuelsson et al., 2013; Kaila-Kangas et al., 2015). A Swedish study examining twin pairs even found a decreased risk of disability retirement among heavy drinkers. A Norwegian study (Skogen et al., 2012) and a Finnish study (Kaila-Kangas et al., 2015) have suggested that a heavy amount of alcohol drinking is not associated with disability retirement, whereas problem drinking is. The Norwegian study included a large dataset from the general population and examined the associations between both the amount of drinking and problem drinking measured by the CAGE scale with

disability retirement. The study included both men and women who were pooled in the analyses. The Finnish study (Kaila-Kangas et al., 2015), also with a large dataset from the general population, found largely similar associations with Skogen et al., namely that a heavy amount of drinking was not associated with disability retirement, whereas problem drinking, measured by clinical interview, showed strong associations. One factor behind these inconsistent results might be the use of different cut-points in distinguishing heavy drinkers. For example, in the study by Ropponen and Svedberg the cut-points for heavy drinking were rather low (Ropponen & Svedberg, 2013). However, the Norwegian study (Skogen et al., 2012) used quite high cut-points, using the 95th percentile with mean consumption of 42 units for men and 21 for women, yet found no association.

Many studies have found non-drinking to be associated with disability retirement (Månsson et al., 1999; Harkonmäki et al., 2008; Skogen et al., 2012; Samuelsson et al., 2013; Korhonen et al., 2015; Böckerman et al., 2016). Two Finnish studies were able to further analyse the association between non-drinking and disability retirement by distinguishing between constant non-drinkers and former drinkers (Kaila-Kangas et al., 2015; Böckerman et al., 2016). However, one of these studies (Böckerman et al., 2016) found that both constant non-drinking and former drinking increased the risk of disability retirement, whereas the other found no association between non-drinking and all-cause disability retirement, though former drinking was associated with disability retirement due to mental disorders (Kaila-Kangas et al., 2015). A Norwegian study examined whether the increased risk of non-drinkers is due to the ill health of former drinkers by comparing previous consumers and previous excessive consumers to constant non-drinkers and found that previous consumers had an increased risk of disability retirement (Skogen et al., 2012).

In addition to the amount of drinking and problem drinking, some studies have included binge drinking. Korhonen et al. (Korhonen et al., 2015) and Böckerman et al. (Böckerman et al., 2016), examining twin pairs, also found that binge drinking increased the risk of disability retirement. Harkonmäki et al. (Harkonmäki et al., 2008) measured binge drinking as being intoxicated at least once a week, having hangovers at least 2 to 3 times per month and having passed out, these measures were associated with disability retirement. Additionally, different beverage types were analysed separately and only drinking spirits was associated with disability retirement.

Many studies on alcohol drinking and disability retirement have focused on drinking alcohol at a young age by examining men at compulsory military conscription. A Swedish study found that risky use of alcohol at compulsory military conscription combined with drunk driving and criminality were associated with future disability retirement, whereas risky alcohol use per se was not (Upmark et al., 1999). However, other studies have found that alcohol drinking at conscription predicts future disability retirement (Upmark et al., 1997; Sidorchuk et al., 2012). The associations were stronger

for disability retirement due to alcohol-related reasons than for all-cause disability retirement (Upmark et al., 1997) and have been found concerning both early disability retirement before the age of 40 and disability retirement after the age of 40 (Sidorchuk et al., 2012).

Disability retirement requires a medical diagnosis, but they have been studied only seldom. A Finnish study found that problem drinking was associated with all-cause disability retirement and with disability retirement due to mental disorders; the association being stronger for the latter (Kaila-Kangas et al., 2015). A Norwegian study found a non-significant trend of more disability retirement due to mental disorders among problem drinkers (Skogen et al., 2012). In contrast to these, a Swedish study examining middle-aged twins found no association between heavy drinking and disability retirement due to mental disorders (Samuelsson et al., 2013). Another study examining the same twin data found heavy drinking to be associated with a decreased risk of disability retirement due to mental, musculoskeletal and cardiovascular diagnoses (Ropponen & Svedberg, 2013). A study on Swedish military conscripts (Ropponen et al., 2011) separated disability retirement due to musculoskeletal diseases from all-cause disability retirement and found no association, and a Finnish study (Pietikäinen et al., 2011) found no association between alcohol drinking and disability retirement due to low-back pain.

Table 3. Longitudinal studies on alcohol drinking and disability retirement.

Reference and setting	Data on alcohol drinking	Data on disability retirement	Statistical methods, covariates	Main results
Krause 1997 30% random sample of Eastern Finnish men, baseline examination in 1984-89, 968 men aged 42, 48, 54 or 60 years at baseline with complete information were included Follow-up time of 4.2 years	Alcohol consumption during a 4-day period and during the past 12 months -non-drinkers -first quartile (ref.) -second quartile -third quartile -fourth quartile	Self-reported data from baseline and follow-up survey Those retired due to disability at follow-up and not retired at any form at baseline	Logistic regression, ORs and 95% CIs Age	No association between alcohol drinking and disability retirement
Upmark et al. 1997 49,321 Swedish men born in 1949-51 taking part in mandatory conscription for military service in 1969-70 Item non-response to the alcohol questions 2-4%, concerning eye-opener 16% Follow-up of disability retirement 1969/70-1992	Average consumption (g/week) Intoxications Hangovers Eye-openers Arrested for drunkenness Risky use of alcohol	Derived from the Swedish Social Insurance Board -All-cause disability retirement -Disability retirement due to alcohol-related main or secondary diagnosis	Cox regression, relative hazards, 95% CIs Sniffing of solvents, drug misuse, smoking, health status measured by several indicators, childhood adversities measured by several indicators, socioeconomic class, remedial class, unemployment after school	Risky use of alcohol -All-cause disability retirement Univariate model 2.4 (2.1-2.8) Multivariate model 1.2 (1.0-1.4) -Disability retirement due to alcohol-related diagnosis Univariate model 9.3 (6.3-13.6) Multivariate model 2.2 (1.4-3.5) Arrested for drunkenness and eye-opener associated with all-cause disability retirement and disability retirement due to alcohol-related diagnoses in multivariate models
Månsson et al. 1999 Swedish complete birth-year cohorts (1926-30) of men residing in Malmö in the beginning of 1974, invited in 1974-78 N=3751, mean age 48.1 years, participation rate of 77% Follow-up time of 11 years	-Non-drinkers -Low alcohol consumption (score under 2 in Mm-MAST) -High alcohol consumption (score of 2 or more in Mm-MAST)	Derived from the National Social Insurance Board The diagnoses in ICD codes	Cox regression, RRs and 95% CIs Smoking, hypertension, serum cholesterol, BMI	Non-drinkers 1.8 (1.3-2.4) Low Mm-MAST score (ref.) High Mm-MAST score 1.3 (1.1-1.6) Alcohol dependence and alcohol-related diagnoses of injury and poisoning were less common among non-drinkers, no significant differences were found in other diagnoses
Upmark et al. 1999 4 out of 42 primary health care districts in Stockholm County 985 women, 870 men meeting inclusion criteria out of 6217 randomly drawn subjects aged 20 to 52 years at baseline Postal survey 1984 and health examination Follow-up time 1986-1991	Usual alcohol consumption Consumption during the previous week Cut-point for high consumption 35g/day for men and 25g/day for women Problem drinking (GAGE-scale)	Derived from the National Swedish Social Insurance Board	Logistic regression, RRs, 95% CIs Age, smoking, socioeconomic group, self-rated health Reference groups: below 10g/day for men and 7g/day for women, 0-1 positive CAGE answers	Univariate models, those marked with *statistically significant also in multivariate models Usual consumption Men: High consumption 5.6 (1.2-27.0)* Women: NS Alcohol consumption during the past week: Men: NS Women: High consumption 6.4 (1.6-25.5) Problem drinking: Men: NS Women: -

<p>Upmark et al. 1999</p> <p>8122 mandatory conscripts born in 1950-51 from the County of Stockholm</p> <p>Data collection at the time of conscription of military service in 1969 and 70</p> <p>Follow-up time 1969/70-1992</p>	<p>Risky drinking: at least 250g/week and/or one or more of the following indicators: ever having taken an eye-opener, arrested for drunkenness, frequent drunkenness</p> <p>Drunk driving (Statistics Sweden)</p>	<p>Derived from the Social Insurance Board</p>	<p>Mantel-Haenszel's method of bivariate analyses, RRs, 95% CIs</p> <p>Father's social class, psychological and behavioural factors at conscription, criminality</p>	<p>Bivariate model:</p> <p>Risky drinking: 2.6 (2.0-3.5) Drunk driving: 3.1 (2.2-4.2)</p> <p>Multivariate model:</p> <p>Risky drinking: NS Drunk driving: 2.1 (1.7-2.7)</p>
<p>Harkonmäki et al. 2007</p> <p>A population sample representative of the Finnish population, age groups 40-44 and 50-54 included in the study</p> <p>3668 men, 5149 women, postal questionnaire in 1998 and 2003</p>	<p>Drunk once a week -no (ref.) -yes</p>	<p>Self-reported employment status -respondents retired due to disability in 2003 but not in 1998 were included as incident cases</p>	<p>Logistic regression, ORs, 95% CIs</p> <p>Age, gender, socioeconomic status, health behaviour, depression, somatic diseases</p>	<p>Adjusted for age and gender Drunk once a week: 1.94 (1.32-2.85)</p> <p>Fully-adjusted Drunk once a week: NS</p>
<p>Harkonmäki et al. 2008</p> <p>A survey in 1998 among Finns aged 20-24, 30-34, 40-44 and 50-54; follow-up survey in 2003</p> <p>Response rate of 40%</p> <p>N=18,190</p>	<p>Average drinking (g/week)</p> <p>Binge drinking -Drunk at least once/week</p>	<p>Self-reported data on disability retirement derived from follow-up survey in 2003 (those already retired in 1998 excluded)</p>	<p>Logistic regression, ORs, 95% CIs</p> <p>Age, gender</p>	<p>Average drinking (1-249g ref.) 250-499g: 1.70 (1.13-2.56) >=500g: 2.13 (1.05-4.29) Non-drinker: 1.59 (1.22-2.07)</p> <p>Binge drinking 2.07 (1.46-2.93)</p> <p>Binge drinking moderate drinkers (1-249 g/week) had an increased risk of disability retirement (2.29, 1.42-3.68), whereas heavy drinking (>=500 g/week) non-binge drinkers did not (1.85, 0.56-6.11)</p>
<p>Pietikäinen et al. 2011</p> <p>Same-sex twin pairs born in Finland before 1958 not receiving a pension at baseline in 1975</p> <p>N=24,043, 50% women, Mean age 33.2 years, Response rate of 89%</p> <p>Follow-up time 1975-2004</p>	<p>Quantity-frequency questionnaire, (g/day) -abstainers -light drinkers (ref.) -moderate drinkers -heavy drinkers</p>	<p>Derived from the Finnish Centre for Pensions and from the Social Insurance Institution</p> <p>The diagnoses in ICD codes</p> <p>Disability retirement due to low-back disorders</p>	<p>Cox regression, HRs, 95% CIs</p> <p>Age, education, socioeconomic status, BMI, presence of other diseases, pain, frequency of use of analgesics, smoking, gender stratified</p>	<p>Alcohol drinking was not associated with disability retirement due to low-back disorders in either univariate or multivariate models</p>
<p>Ropponen et al. 2011</p> <p>16,713 Swedish same-sex twins born in 1935-58 participating in a mailed questionnaire in 1973 and a telephone interview between 1998-2003, not pensioned at the time of the latest survey, 52% women</p> <p>Follow-up time 1998/03 - 2008</p>	<p>Use of any type of alcohol enquired of in both surveys -stable abstainers -those drinking sometimes or regularly</p>	<p>Derived from the National Social Insurance Agency</p> <p>Disability retirement -musculoskeletal diseases -all-cause disability retirement</p>	<p>Cox regression, HRs, 95% CIs</p> <p>Zygoty, age, employment status, education, marital status, number and severity of diseases; gender stratified</p>	<p>Alcohol drinking was not associated with disability retirement due to musculoskeletal diseases</p> <p>Alcohol drinking was associated with all-cause disability retirement 1.34 (1.02-1.78) but conditional Cox proportional model to control for familial confounding did not support the finding</p>

<p>Skogen et al. 2012</p> <p>The whole county-population aged 20 years or above invited in 1984-86 and in 1995-97 in Nord-Trøndelag, Norway</p> <p>N=34,666 (problem drinking as exposure), N=37,729 (alcohol drinking as exposure)</p> <p>Response rate of 67% among men and 76% among women</p> <p>Follow-up time of maximum 9 years</p>	<p>Typical alcohol consumption during a 2-week period</p> <p>Problem drinking (CAGE scale)</p>	<p>Derived from the Norwegian national insurance database</p> <p>Diagnoses in ICD codes</p>	<p>Cox regression, HRs, 95% CIs</p> <p>Age, gender, anxiety, depression, somatic diagnoses, somatic complaints, socioeconomic status, smoking, organised social activity, number of friends</p>	<p>Alcohol consumption</p> <p>-abstainers: 1.21 (1.07-1.38)</p> <p>-non-consumers (zero consumption not self-identifying as abstainers): NS</p> <p>-0.1-39.9th: ref.</p> <p>-40-79.9th: 0.86 (0.78-0.94)</p> <p>-80.0-94.9th: NS</p> <p>-95.0-100th (mean consumption of 42 units for men and 21 units for women): NS</p> <p>Problem drinking</p> <p>Abstainers: 1.23 (1.08-1.39)</p> <p>CAGE score 0: ref.</p> <p>CAGE score 1: 0.83 (0.72-0.96)</p> <p>CAGE score 2: NS</p> <p>CAGE score 3: NS</p> <p>CAGE score 4: 1.66 (1.23-2.23)</p>
<p>Sidorchuk et al. 2012</p> <p>Swedish men born in 1949-51 conscripted for compulsory military service in 1969-70</p> <p>97.7% of the original cohort included</p> <p>N=49,321, Survey at conscription 1969-70, medical examination</p> <p>Follow-up time of 39 years</p>	<p>Average quantity and frequency of drinking (g/week):</p> <p>-abstainers</p> <p>-light (1-100) (ref)</p> <p>-moderate (101-250)</p> <p>-high (over 250)</p> <p>Risky use of alcohol: at least one of the conditions: arrested for drunkenness, eye-opener, drunk often/quite often, alcohol consumption of more than 250g/week</p>	<p>Derived from the National Social Insurance Board and from a Longitudinal Register of Education and Labor Market Statistics</p> <p>-Disability retirement in total</p> <p>-Early disability retirement if received below age 40</p> <p>-Late disability retirement if received after age 40</p>	<p>Cox regression, HRs, 95% CIs</p> <p>Family's socioeconomic position, childhood adversities measured by several indicators, unemployment, health status assessed by several indicators, psychological status and sociability at conscription, social maturity, cognitive ability, smoking, sniffing of solvents, drug use</p>	<p>Average drinking</p> <p>Early disability retirement</p> <p>Fully-adjusted model</p> <p>Abstainers: 1.95 (1.51-2.52)</p> <p>Moderate: 1.06 (0.88-1.28)</p> <p>High: 1.06 (0.79-1.41)</p> <p>Late disability retirement</p> <p>Fully-adjusted model</p> <p>Abstainers: 1.22 (1.07-1.40)</p> <p>Moderate: 0.98 (0.91-1.06)</p> <p>High: 1.05 (0.91-1.21)</p> <p>Risky use</p> <p>Early disability retirement</p> <p>Unadjusted model: 2.89 (2.47-3.38)</p> <p>Fully-adjusted: 1.32 (1.09-1.59)</p> <p>Late disability retirement</p> <p>Unadjusted model: 1.87 (1.74-2.02)</p> <p>Fully-adjusted: 1.14 (1.05-1.25)</p>
<p>Samuelsson et al. 2013</p> <p>All twins born in Sweden 1925-58 identified in the Swedish Twin Registry</p> <p>Twin register data, data from telephone interviews carried out in 1998-2003 (response rate of 66%)</p> <p>28,613 participants (52% women) aged 41-64 years</p> <p>Follow-up of disability retirement 1998-2008</p>	<p>-Non-drinkers</p> <p>-Light frequent (ref.)</p> <p>-Moderate frequent</p> <p>-Heavy frequent</p> <p>-Light infrequent</p> <p>-Moderate infrequent</p> <p>-Heavy infrequent</p> <p>Cut-point for heavy drinking</p> <p>-infrequent drinkers (g/occasion): 48g men, 36g women</p> <p>-frequent drinkers (g/week): 168g men, 108g women</p>	<p>Derived from Sweden's National Social Insurance Agency</p> <p>Disability due to mental diagnoses (according to ICD)</p>	<p>Conditional Cox regression, HRs, 95% CIs</p> <p>Age, gender, education, marital status, severity of diseases, health behaviours, self-rated health</p>	<p>All participants (age, gender)</p> <p>Non-drinkers: 2.40 (1.90-3.03)*</p> <p>Moderate frequent: NS</p> <p>Heavy frequent: NS</p> <p>Light infrequent: NS</p> <p>Moderate infrequent: NS</p> <p>Heavy infrequent: NS</p> <p>*significant in fully-adjusted model</p>

<p>Ropponen & Svedberg 2013</p> <p>A sample of 31,296 Swedish twin individuals born 1935-58 identified from the Swedish Twin Registry</p> <p>Telephone interview 1998-2003, follow-up of disability retirement until the end of 2008</p>	<p>Daily consumption of alcohol</p> <p>-non-drinkers</p> <p>-light drinkers (ref.)</p> <p>-moderate drinkers</p> <p>-heavy drinkers</p>	<p>Derived from the National Social Insurance Agency</p> <p>-musculoskeletal diagnosis</p> <p>-mental diagnosis</p> <p>-circulatory system diagnosis</p> <p>-other diagnosis</p>	<p>Cox regression, HRs, 95% CIs</p> <p>Age, education, BMI, marital status, number and severity of diseases, physical activity, smoking; stratified for gender</p>	<p>Musculoskeletal diagnosis</p> <p>Moderate: 0.77 (0.67-0.89)</p> <p>Heavy: 0.64 (0.58-0.70)</p> <p>Mental diagnosis</p> <p>Non-drinking: 1.58 (1.29-1.95)</p> <p>Moderate: 0.66 (0.51-0.87)</p> <p>Heavy: 0.78 (0.67-0.91)</p> <p>Circulatory system diagnosis</p> <p>Heavy: 0.69 (0.56-0.85)</p>
<p>Kaila-Kangas et al. 2015</p> <p>3621 30- to 55-year old occupationally-active participants drawn from an original sample of Finnish adults aged 30 years or over</p> <p>Health survey between Aug 2000 and June 2001, clinical examination, home interview and questionnaire</p> <p>Participation rate of 80%</p> <p>Follow-up of disability retirement until the end of 2010</p>	<p>-lifelong abstainers</p> <p>-former drinkers</p> <p>-light drinkers</p> <p>-moderate drinkers</p> <p>-hazardous drinkers: 24 or more units/week for men, 16 units or more for women</p> <p>-alcohol use disorder (Composite International Diagnostic Interview), regardless of the alcohol intake level</p>	<p>Data on disability retirement obtained from the Finnish Centre for Pensions</p> <p>Data included the main diagnoses for disability retirement</p> <p>-all-cause disability retirement</p> <p>-disability retirement due to mental disorders</p>	<p>Cox regression HRs, 95% CIs</p> <p>Gender, age, marital status, common mental disorders, chronic musculoskeletal disorders, other chronic diseases, other health behaviours (smoking, BMI, leisure-time physical exercise), occupational status, physical workload, job demands, job control</p>	<p>All-cause disability retirement</p> <p>Lifelong abstainers: 1.00 (0.70-1.40)</p> <p>Former drinkers: 1.30 (0.90-1.86)</p> <p>Light drinkers: ref.</p> <p>Moderate drinkers: 1.07 (0.81-1.43)</p> <p>Hazardous drinkers: 0.85 (0.52-1.38)</p> <p>Alcohol use disorder: 2.17 (1.49-3.16)</p> <p>Disability retirement due to mental disorder</p> <p>Lifelong abstainers: 1.66 (0.72-3.83)</p> <p>Former drinkers: 2.67 (1.39-5.13)</p> <p>Light drinkers: ref.</p> <p>Moderate drinkers: 1.18 (0.66-2.13)</p> <p>Hazardous drinkers: 1.40 (0.63-3.13)</p> <p>Alcohol use disorder: 4.04 (2.02-8.06)</p>
<p>Korhonen et al. 2015</p> <p>21,719 individuals compiled from the Central Population Registry including all same-sex twins born before 1958, survey in 1975</p> <p>49% men, mean age of 32.6 years, initial response rate of 89%</p> <p>Follow-up time 1975-2004</p>	<p>Daily alcohol consumption</p> <p>-non-drinkers</p> <p>-moderate drinkers (ref.)</p> <p>-heavy drinkers (over 20 g/day)</p> <p>Binge drinking (over 5 drinks per occasion at least 1/month)</p>	<p>Derived from the Social Insurance Institution and the Finnish Centre for Pensions</p>	<p>Cox regression, HRs, 95% CIs</p> <p>Age, smoking</p>	<p>Daily alcohol consumption</p> <p>Men</p> <p>Non-drinkers: 1.41 (1.21-1.65)</p> <p>Heavy drinkers: 1.30 (1.18-1.43)</p> <p>Women</p> <p>Non-drinkers: 1.36 (1.23-1.52)</p> <p>Heavy drinkers: 1.34 (1.04-1.72)</p> <p>Binge drinking</p> <p>Men: 1.33 (1.21-1.45)</p> <p>Women: 1.40 (1.19-1.64)</p>
<p>Böckerman et al. 2016</p> <p>Data compiled from the Central Population Registry of Finland, surveys conducted in 1975, 1981 and 1990</p> <p>5903 twin pairs born before 1958, response rate for the latest survey of 77%</p> <p>Follow-up time 1990-2004</p>	<p>Weekly average consumption</p> <p>-former drinkers</p> <p>-constant non-drinkers</p> <p>-moderate drinkers (ref.)</p> <p>-heavy drinkers (over 280g/week for men, over 190g/week for women)</p> <p>Passing out</p>	<p>Derived from the Finnish Longitudinal Employer-Employee Data based on administrative registers collected by Statistics Finland</p>	<p>Standard logistic regression, conditional logistic regression, ORs, 95% CIs</p> <p>For monozygotic twin pairs, models adjusted for education years, marital status, number of diseases, smoking, leisure-time activity, physically hard work, neuroticism, extraversion, stressful life events index</p>	<p>Bivariate analysis (all twin pairs)</p> <p>Former drinkers: 2.55 (1.69-3.85)</p> <p>Constant non-drinkers: 2.84 (1.89-4.25)</p> <p>Heavy drinkers: 1.37 (1.09-1.72)</p> <p>Passing out</p> <p>1.24 (1.70-3.85)</p> <p>Fully-adjusted model (monozygotic twin pairs only)</p> <p>Former drinkers: 1.99 (0.88-4.51)</p> <p>Constant non-drinkers: 1.51 (0.61-3.75)</p> <p>Heavy drinkers: 1.87 (1.08-3.22)</p>

3.5 SUMMARY OF PREVIOUS RESEARCH

Alcohol drinking markedly increased in Finland from late 1960s, reaching its peak in 2007, and has declined after 2008, but is still relatively high. Women and older people drink more than before. Alcohol drinking is associated with impaired work ability. We lack data, however, about drinking habits among middle-aged employees. Also, data on changes in drinking habits among older employees is scarce, as are studies on the associations between these changes and work disability. Increasing alcohol drinking might deteriorate one's health and health functioning, whereas decreasing drinking might prevent deterioration and help to restore health functioning and work ability.

Longitudinal studies on the association between alcohol drinking and mental and physical functioning are scarce and often focus on elderly people; evidence on employees is also lacking. A longitudinal study on middle-aged people suggested that both non-drinking and heavy drinking are associated with poor health functioning (Powers & Young, 2009). Cross-sectional studies have supported the association between non-drinking and poor functioning, but results concerning heavy drinking have been inconclusive with some studies reporting poor health functioning among heavy drinkers and some suggesting better health functioning among heavy drinkers. Most previous studies have measured the volume of drinking and other drinking habits have been studied only seldom.

There are only few large-scale longitudinal studies on the association between alcohol drinking and sickness absence. They have often focused on the amount of drinking, with other drinking habits having been studied only seldom. Previous studies have suggested that both non-drinkers and heavy drinkers have elevated levels of sickness absence compared to moderate drinkers, although findings have been somewhat inconsistent and associations have often been found among men only. Many of the large-scale longitudinal studies are rather old, involving measures made in 1980s, and the associations may have changed as drinking habits and work life have changed. Self-certified and medically-confirmed sickness absence spells might associate differently with alcohol drinking, but studies have not always distinguished between these measures and have only seldom included both. Working conditions might contribute to the association between alcohol drinking and sickness absence, but they have not been examined.

Studies on the associations between alcohol drinking and disability retirement have been mainly conducted in Finland, Norway and Sweden and are often with a longitudinal approach and register-based data on disability retirement. They have suggested that problem drinking is associated with disability retirement, but the results concerning heavy amounts of drinking have been inconsistent. Many of the previous studies have focused on alcohol drinking at a young age and its association with future disability retirement. The associations between alcohol drinking and disability retirement might be

different among middle-aged employees. Studies focusing on middle-aged employees often involve data collected in the 1970s to 1990s and the associations might have undergone changes as drinking habits and work environments have changed. Disability retirement requires a medical diagnosis and the associations between alcohol drinking and disability retirement may vary depending on the diagnosis. However, studies have only seldom included the diagnosis behind disability retirement, with inconclusive results.

4 AIMS

The general aim of this study was to examine the associations between alcohol drinking and health-related functioning and work disability among ageing municipal female and male employees. The study includes various measures of drinking habits, namely, weekly average drinking, binge drinking and problem drinking. Different covariates such as age, socioeconomic position, working conditions, other health behaviours and health status are taken into account.

The specific aims of the study were

1. To examine the associations between alcohol drinking and subsequent mental and physical health functioning (Sub-study I)
2. To examine the associations between alcohol drinking and self-certified and medically-confirmed sickness absence and to find out whether work-related factors contribute to the associations (Sub-study II)
3. To examine the associations between changes in alcohol drinking and self-certified and medically-confirmed sickness absence (Sub-study III)
4. To examine the associations between alcohol drinking and all-cause disability retirement, disability retirement due to musculoskeletal disease and disability retirement due to mental disorders (Sub-study IV)

These sub-studies are later on referred to with the Roman numeral mentioned above.

5 MATERIAL AND METHODS

5.1 THE HELSINKI HEALTH STUDY DATA

This study is part of the Helsinki Health Study on middle-aged employees of the City of Helsinki (Lahelma et al., 2013). The City of Helsinki is the largest employer in Finland with about 38,000 employees in 31 offices and public utilities (City of Helsinki: Annual Report, 2014). The City of Helsinki takes care of a diversity of fields of activity such as social and health services, education, city planning, art and culture, technical services and emergency services. The jobs include a variety of both manual and non-manual job tasks such as nurses, doctors, teachers, secretaries, garden workers, bus drivers, social workers, fire fighters, lawyers and daycare workers. The majority of the employees are women, as is also the case elsewhere in the municipal sector of Finland.

The baseline data were collected in 2000, 2001 and 2002 by sending postal questionnaires to the employees of the City of Helsinki who turned 40, 45, 50, 55 or 60 during each year (Lahelma et al., 2013). Of the 13,346 employees who were sent the questionnaire, 8960 responded, yielding a response rate of 67%. Women made up 80% of the participants, which reflects the gender distribution of the employees in the Finnish municipal sector. Women, older employees, those in higher socioeconomic positions and those with less sickness absence participated somewhat more than others (Laaksonen et al., 2008; Lahelma et al., 2013). The postal questionnaire included questions regarding, for example, socio-demographic factors, working conditions, health behaviours and health and family situation.

A follow-up survey was conducted among the respondents of the baseline survey in 2007. The questionnaire included essentially the same questions as the baseline survey with 7332 responding (response rate of 83%). Women, older employees, those in higher socioeconomic positions and those with less sickness absence were again somewhat more active in the follow-up participation, but the differences were smaller than in the baseline survey (Lahelma et al., 2013). Consent was given by 78% of the baseline participants (n=6988) to link their questionnaire data to internal records of the City of Helsinki, such as sickness absence records, and 74% (n=6606) consented to external linkages such as disability retirement records. Men, those in higher socioeconomic positions and those with less sickness absence consented to the linkages somewhat more than others, but the differences were small (Lahelma et al., 2013). The non-response analyses have shown that non-participation did not cause major bias, although men performing manual work were somewhat underrepresented (Laaksonen et al., 2008; Lahelma et al., 2013).

The data on sickness absence derive from the employer's personnel register of the City of Helsinki. Consecutive and overlapping sickness absence spells were combined. The absences due to taking care of a sick child or due to work injury were not included as sickness absence spells. The City of Helsinki requires a medical certificate of sickness absence for spells exceeding three days; thus, the sickness absence spells were divided into short, self-certified sickness absence spells (1-3 days) and long, medically-confirmed sickness absence spells (over 3 days). Diagnosis-specific data on sickness absence was not available in registers of the City of Helsinki. In sub-study II, sickness absence was followed from return of the baseline questionnaire until the end of 2005 with a mean follow-up time of 3.9 years. In sub-study III, the follow-up of sickness absence started from the return of the follow-up questionnaire and continued until the end of 2010 and the mean follow-up time was 2.8 years.

The data on disability retirement were obtained from the Finnish Centre of Pensions. The data included the first medical diagnosis required for granting the disability retirement according to ICD-10 (World Health Organization, 2004). Disability retirement was followed from return of the baseline survey until the end of 2010 and the mean follow-up time was 8 years.

5.2 MEASURES OF ALCOHOL DRINKING

The baseline questionnaire and the follow-up questionnaire included identical questions on alcohol drinking. Current consumption of alcohol was asked by three questions, each having seven response alternatives. The first question inquired after the average number of bottles of beer and cider per week, the second one the average number of bottles of wine or other mild beverages per week and the third one the average the number of bottles of spirits per month. From these data, the average consumption of alcohol as units per week was calculated. An alcohol unit was defined as 12g of pure alcohol.

The average alcohol drinking per week was divided into four classes among women and into five classes among men in sub-studies I and II. The first three classes, similarly defined among women and men were non-drinkers (drinking 0 units per week), those drinking less than four units per week, and moderate drinkers who drank four to less than 16 units per week. Among women, the fourth class was heavy drinkers (drinking 16 units or more per week), whereas among men there were two upper categories as cut-point of heavy drinking was set to 24 units per week. The cut-points of 16 and 24 units per week for heavy drinking were defined according to the Finnish recommendations (Seppä et al., 2012). In sub-study IV, the classes were nearly the same as in sub-studies I and II, but the variable included five classes for both genders, and thus the middle class was defined as drinking 4

to 10 units per week and the second highest class was defined as 10 to 16 units per week among women and 10 to 24 units per week for men. Sub-study III examined changes in alcohol drinking between baseline in 2000-02 and 2007. Weekly average drinking was divided into three classes at baseline and follow-up: non-drinkers, moderate drinkers drinking less than 16 units per week and heavy drinkers drinking 16 units or more per week. From these data, a five-class variable for change was formed and those moving from the non-drinking class to moderate or heavy drinking class formed a class named 'more' and those moving from heavy or moderate drinking classes to moderate and non-drinking classes formed a 'less' drinking group. The other three classes were stable non-drinkers, stable moderate drinkers and stable heavy drinkers.

The questionnaires included a question on current frequency of drinking with ten response alternatives. By combining the alternatives, respondents were divided into five classes. The classes were non-drinkers, those drinking a few times per year, those drinking a few times per month, those drinking a few times per week and those drinking more often. The non-drinkers class also included those drinking once a year or less often. This frequency variable was used in sub-study IV.

Binge drinking was defined as drinking six or more units at a time. The questionnaires included a question with six response alternatives inquiring about how often the respondent drank six or more units of alcohol on a single occasion. In sub-study II, respondents were divided into four classes by combining the response alternatives: non-binge drinkers, those binge drinking once a month or less, those binge drinking once a week, and those binge drinking more often than once a week. In sub-studies I and IV, a three-class variable was used. First, non-drinkers were separated from non-binge drinkers using the data from the frequency variable. Then the respondents were divided into non-binge drinkers and binge drinkers. Those binge drinking less than once a month were included in the non-binging group. Thus, the three groups were non-drinkers, non-binge drinkers and binge drinkers.

Problem drinking was measured by the CAGE scale (Schofield, 1988; McCusker et al., 2002). The CAGE consists of four questions: (1) Have you ever thought about cutting down your drinking?, (2) Have you ever been annoyed by criticism about your drinking?, (3) Have you ever felt guilty because of your drinking?, and (4) Have you ever needed an eye-opener? Each positive answer gives one point to a summary score ranging from zero to four points. The usual cut-point of problem drinking is set at two points. For women, the usual cut-point of two was used, but among men we used a higher cut-point of three in order to distinguish those with the most serious drinking problems. Previous Finnish studies have also used this higher cut-point for men (Aalto, 2001). In all four sub-studies, the same classification was used, but sub-study III examined the changes between baseline in 2000-02 and follow-up in 2007, and the respondents were divided into stable non-

problem drinkers, former problem drinkers, new problem drinkers and stable problem drinkers.

5.3 MEASURES OF HEALTH-RELATED FUNCTIONING AND WORK DISABILITY

Mental and physical functioning were measured by the Finnish version of the Short Form 36 survey (SF-36) (Ware et al., 1994). The SF-36 survey is a generic measure of health widely used in both scientific studies and in clinical settings. The SF-36 consists of 36 questions on health and health-related functioning during the preceding four weeks. The SF-36 generates eight subscales and component summaries for mental (MCS=mental component summary) and physical (PCS=physical component summary) functioning. The component summary scales vary between 0 and 100 and have been standardised to the U.S. general population with a mean of 50 and a standard deviation of 10, with higher scores indicating better health functioning. In sub-study I, MCS and PCS scores were calculated at baseline in 2000-02 and at follow-up in 2007. MCS and PCS scores at follow-up were dichotomised the lowest quartile indicating poor health functioning.

The sickness absence data used in sub-studies II and III were derived from the employer's register. Sickness absence spells were divided into one- to three-day lasting self-certified sickness absence and into over three-day lasting medically-confirmed sickness absence spells. The division was made because the employer requires a medical certification by a physician or an occupational health nurse concerning sickness absence spells exceeding three days, whereas the employee is allowed to be absent due to sickness by one's own certification up to three days.

Data on disability retirement came from the Finnish Centre for Pensions national registers which are reliable and practically complete. Among municipal employees in Finland, disability retirement can be granted to 18-62-year-old employees who are not able to continue working in their current position due to ill health and whose work ability cannot be restored by rehabilitation. The work ability must be reduced by at least 60% for a continuous period of at least one year to be eligible for full disability retirement, whereas a 40% reduction in the ability to work justifies a partial disability retirement. Disability retirement requires a medical assessment of the employee's health and must include a diagnosis for work disability. Sub-study IV included three disability retirement variables: all-cause disability retirement, disability retirement due to musculoskeletal diseases (ICD-10 diagnoses M00-M99), and disability retirement due to mental disorders (ICD-10 diagnoses F00-F99).

5.4 COVARIATES

Age was included as a covariate in all analyses, as well as gender when pooled data was analysed in sub-study IV. Data on marital status was derived from the baseline survey, was included in all sub-studies, and was classified as never married, married or co-habiting, and divorced or widowed. Socioeconomic position was measured by occupational class which was derived from the employer's registers and completed from the questionnaires. Socioeconomic position was divided into four categories: managers and professionals, semi-professionals, routine non-manual employees and manual workers (Lahelma et al., 2005).

Sub-studies I, III and IV included single-item questions on mental and physical workload. Sub-study II focused on working conditions and thus included several working condition measures. In addition to the above mentioned single-item question on mental workload, psychosocial working conditions included single-item questions on work satisfaction, work fatigue, workplace bullying and satisfaction with combining paid work and family life. According to Karasek's model of job strain (Karasek, 1979), job demands and job control were measured by nine-item questionnaires. Physical working conditions included single-item question on physical workload and three factors (physical workload, hazardous exposures and computer work) derived from an inventory with 18 questions developed at the Finnish Institute of Occupational Health (Laaksonen et al., 2005). Work arrangements consisted of overwork, shift work and type of work contract.

Sub-studies I, II and IV included health behaviours other than alcohol drinking. Smoking was divided into smokers and non-smokers. Leisure-time physical activity was measured by metabolic equivalent tasks (MET) calculated from four questions. Those with fewer than 14 MET-hours per week were classified as inactive and those with 14 or more as active (Lahti, 2011). Body weight was measured as body mass index (BMI) which was divided into three groups: under 25, between 25 and 30 and above 30 kg/m². Sub-study I included baseline mental and physical functioning as covariates, whereas sub-studies III and IV measured health by limiting long-standing illness (Manderbacka, 1999) and by the General Health Questionnaire (Goldberg et al., 1997) identifying common mental disorders in the general population.

5.5 STATISTICAL METHODS

The analyses were made with the SAS statistical package (SAS Institute Inc., Cary, NC, USA). Women and men were analysed separately in sub-studies I, II and IV and pooled in sub-study IV due to the small amount of events among men. Moderate drinkers, non-binge drinkers and non-problem drinkers served as reference categories.

In sub-study I, the associations between alcohol drinking and mental and physical health functioning were analysed by logistic regression. The results are presented as odds ratios (OR) and their 95% confidence intervals (CI). The models were adjusted first by age and then by baseline mental and physical functioning, respectively. Marital status, socioeconomic position and working conditions were then added to the models and finally other health behaviours were added to models including age and baseline mental or physical functioning.

Sub-study II examined the associations between alcohol drinking and sickness absence. Poisson regression was used in the analyses and the results are presented as rate ratios (RR) and their 95% confidence intervals. The numbers of self-certified and medically-confirmed sickness absence spells served as outcome variables. The base models were adjusted for age and then psychosocial working conditions, physical working conditions and work arrangements were added one by one to the base models. The different sickness absence follow-up times between participants were taken into account by including follow-up time as an offset variable.

In sub-study III, the associations between changes in alcohol drinking and sickness absence were analysed by Poisson regression and the results are presented as rate ratios and their 95% confidence intervals. The base models were adjusted for age and marital status. Next, socioeconomic position and working conditions were added to the base models and then health behaviours and health were added to the base models. Finally, a fully-adjusted model including all covariates was fitted. Follow-up time of sickness absence was included as an offset variable.

Sub-study IV examined the associations between alcohol drinking and all-cause disability retirement, disability retirement due to musculoskeletal diseases and disability retirement due to mental disorders. The analyses were made by Cox regression and the results are presented as hazard ratios (HR) and their 95% confidence intervals. Participants who reached the age of 63, died or retired on the basis of age or due to diagnoses other than those studied during the follow-up were censored. The base models included age, gender and marital status. Next, socioeconomic position and working conditions, and then health behaviours and health, were added to the base models; lastly, a fully-adjusted model with all covariates was fitted.

5.6 ETHICAL APPROVAL

The study protocol was approved by the ethics committees of the Department of Public Health and the University of Helsinki and the health authorities of the City of Helsinki.

6 RESULTS

6.1 ALCOHOL DRINKING AMONG EMPLOYEES OF THE CITY OF HELSINKI

Among women, the vast majority of participants drank under 4 units per week, whereas among men, drinking 4 to 16 units per week was somewhat more prevalent. Among women, the proportion of heavy drinkers slightly increased from 2000-2002 to 2007. The mean consumption was 3.9 units per week at baseline and 4.4 units per week in 2007. Among men, the corresponding figures were 9.2 and 10.3 units per week. At baseline, 18% of women and 44% of men were binge drinkers, and the proportion remained very much the same at follow-up. Among women, the proportion of problem drinkers increased from 17% to 20%, whereas among men, 24% of participants were problem drinkers both at baseline and follow-up.

Table 4. *Drinking habits at baseline in 2000-02 and follow-up 5 to 7 years later.*

	Women				Men			
	Baseline		Follow-up		Baseline		Follow-up	
	n	%	n	%	n	%	n	%
Average drinking (units/week)								
0	554	8	534	9	95	5	92	7
<4	4571	64	3620	61	650	37	451	34
4-<16	1772	25	1476	25	710	40	510	38
16 or over/16-24	215	3	275	5	199	11	161	12
24 or over					125	7	129	10
Binge drinking								
Non-drinker	481	7	473	8	101	6	92	7
No	5255	75	4333	74	887	50	646	48
Yes	1243	18	1040	18	777	44	597	45
Problem drinking								
No	5702	84	4604	80	1331	76	1014	76
Yes	1124	17	1169	20	420	24	320	24

6.2 ALCOHOL DRINKING AND MENTAL AND PHYSICAL FUNCTIONING (I)

Sub-study I examined the associations between alcohol drinking and subsequent mental and physical functioning. Alcohol drinking was measured at baseline in 2000-02 and mental and physical functioning at follow-up in 2007. Covariates were measured at baseline and included baseline mental and physical functioning.

Among women, heavy average drinking was associated with an increased risk of poor mental functioning over a follow-up time of five to seven years (OR 1.54, 95% CI 1.08-2.19) compared to moderate drinkers (OR 1.00) (Table 5). Non-drinking and drinking fewer than four units per week were associated with a decreased risk of poor mental functioning compared to moderate drinkers. However, adjusting for baseline mental health functioning abolished these associations. Binge drinking was associated with poor mental functioning (OR 1.49, 95% CI 1.27-1.74). The association remained, although attenuated, after adjusting for baseline mental functioning. Further adjusting for marital status, socioeconomic position and working conditions had no effect, whereas after adjusting for health behaviours, the association was no longer statistically significant. Problem drinking was associated with a doubled risk of poor mental functioning (OR 2.19, 95% CI 1.87-2.56) and the association remained after all adjustments.

Heavy average drinking was not associated with poor physical functioning among women. Non-drinking (OR 1.61, 95% CI 1.25-2.08) and drinking fewer than four units per week (OR 1.29, 95% CI 1.11-1.51) were associated with an increased risk of poor physical functioning five to seven years later. The association between non-drinking and poor physical functioning remained after adjusting for baseline physical functioning and health behaviours, but after adjusting for marital status, socioeconomic position and working conditions the association was no longer statistically significant. Binge drinking was not associated with poor physical functioning. Non-drinking (OR 1.31, 95% CI 1.02-1.67) was associated with an increased risk compared to non-binge drinkers, but the association was abolished by baseline physical functioning. Problem drinking was associated with poor physical functioning (OR 1.33, 95% CI 1.13-1.58) and the association remained after all adjustments (OR 1.22, 95% CI 1.01-1.48).

Results

Table 5. The associations between baseline drinking habits and poor mental and physical functioning over a follow-up of five to seven years among women. Odds ratios and their 95% confidence intervals.

	Model 1 = age	Model 2 = age + baseline MCS/PCS	Model 2 + marital status + SEP + working conditions	Model 2 + health behaviours
Mental functioning				
Average drinking (units/week)				
0	0.73 (0.56-0.97)	0.83 (0.62-1.11)	0.78 (0.58-1.06)	0.83 (0.62-1.12)
<4	0.83 (0.72-0.96)	0.92 (0.79-1.08)	0.89 (0.76-1.04)	0.93 (0.79-1.08)
4-<16	1.00	1.00	1.00	1.00
16 or more	1.54 (1.08-2.19)	1.29 (0.88-1.89)	1.27 (0.86-1.86)	1.22 (0.83-1.79)
Binge drinking				
Non-drinker	1.02 (0.78-1.32)	1.02 (0.77-1.36)	0.99 (0.74-1.32)	1.02 (0.77-1.36)
No	1.00	1.00	1.00	1.00
Yes	1.49 (1.27-1.74)	1.23 (1.04-1.46)	1.21 (1.02-1.44)	1.15 (0.96-1.37)
Problem drinking				
No	1.00	1.00	1.00	1.00
Yes	2.19 (1.87-2.56)	1.57 (1.32-1.86)	1.57 (1.32-1.86)	1.53 (1.29-1.82)
Physical functioning				
Average drinking (units/week)				
0	1.61 (1.25-2.08)	1.36 (1.03-1.81)	1.24 (0.93-1.66)	1.40 (1.05-1.87)
<4	1.29 (1.11-1.51)	1.16 (0.98-1.37)	1.09 (0.92-1.29)	1.18 (0.93-1.40)
4-<16	1.00	1.00	1.00	1.00
16 or more	1.35 (0.91-1.99)	1.39 (0.90-2.15)	1.41 (0.91-2.18)	1.20 (0.77-1.88)
Binge drinking				
Non-drinker	1.31 (1.02-1.67)	1.25 (0.95-1.64)	1.19 (0.90-1.58)	1.23 (0.93-1.63)
No	1.00	1.00	1.00	1.00
Yes	1.13 (0.96-1.34)	1.21 (1.00-1.46)	1.20 (0.99-1.45)	1.05 (0.86-1.27)
Problem drinking				
No	1.00	1.00	1.00	1.00
Yes	1.33 (1.13-1.58)	1.28 (1.06-1.54)	1.32 (1.09-1.59)	1.22 (1.01-1.48)
MCS=Mental component summary				
PCS=Physical component summary				
SEP=Socioeconomic position				

Among men, there were no associations between weekly average drinking and mental functioning five to seven years later (Table 6). Binge drinking was associated with poor mental functioning (OR 1.48, 95% CI 1.13-1.95), but adjusting for baseline mental functioning abolished the association. Problem drinking was associated with an almost doubled risk of poor mental functioning (OR 1.97, 95% CI 1.47-2.63). Baseline mental functioning attenuated the association though it remained significant. Further adjustments for marital status, socioeconomic position and working conditions, as well as for health behaviours did not affect the association.

Weekly average drinking was not associated with physical functioning among men. Binge drinking was associated with poor physical functioning after adjusting for baseline physical functioning (OR 1.38, 95% CI 1.02-1.86), but the association attenuated to statistical non-significance after further adjustments for marital status, socioeconomic position and working conditions and for health behaviours. Non-drinking was associated with an increased risk compared to non-binge drinking (OR 2.01, 95% CI 1.15-3.51), but the association was no longer statistically significant after adjusting for baseline physical functioning. Problem drinking was associated with poor physical functioning (OR 1.37, 95% CI 1.02-1.84), but attenuated to a statistically non-significant level after adjusting for baseline physical functioning.

Table 6. The associations between baseline drinking habits and poor mental and physical functioning over a follow-up of five to seven years among men. Odds ratios and their 95% confidence intervals

	Model 1 = age	Model 2 = age and baseline MCS/PCS	Model 2 + marital status + SEP + working conditions	Model 2 + health behaviours
Mental functioning				
Average drinking (units/week)				
0	1.44 (0.78-2.65)	1.32 (0.69-2.54)	1.23 (0.63-2.38)	1.34 (0.70-2.57)
<4	0.94 (0.69-1.27)	0.90 (0.65-1.24)	0.87 (0.63-1.21)	0.92 (0.66-1.27)
4-<16	1.00	1.00	1.00	1.00
16-<24	1.42 (0.93-2.17)	1.00 (0.63-1.59)	0.96 (0.60-1.53)	0.97 (0.61-1.54)
24 or more	1.64 (0.98-2.75)	1.27 (0.73-2.21)	1.27 (0.72-2.24)	1.24 (0.71-2.16)
Binge drinking				
Non-drinker	1.76 (0.98-3.14)	1.68 (0.90-3.13)	1.55 (0.82-2.92)	1.69 (0.91-3.16)
No	1.00	1.00	1.00	1.00
Yes	1.48 (1.13-1.95)	1.32 (0.98-1.76)	1.24 (0.92-1.67)	1.29 (0.96-1.73)
Problem drinking				
No	1.00	1.00	1.00	1.00
Yes	1.97 (1.47-2.63)	1.50 (1.10-2.06)	1.45 (1.06-1.99)	1.50 (1.09-2.05)
Physical functioning				
Average drinking (units/week)				
0	1.70 (0.95-3.05)	1.29 (0.66-2.50)	1.25 (0.64-2.44)	1.34 (0.69-2.63)
<4	1.03 (0.77-1.39)	0.92 (0.66-1.28)	0.90 (0.65-1.26)	0.96 (0.69-1.35)
4-<16	1.00	1.00	1.00	1.00
16-<24	1.04 (0.67-1.62)	1.05 (0.64-1.73)	1.01 (0.61-1.68)	0.98 (0.58-1.64)
24 or more	0.77 (0.43-1.38)	0.87 (0.45-1.66)	0.87 (0.45-1.68)	0.82 (0.42-1.60)
Binge drinking				
Non-drinker	2.01 (1.15-3.51)	1.72 (0.91-3.27)	1.59 (0.84-3.03)	1.73 (0.91-3.29)
No	1.00	1.00	1.00	1.00
Yes	1.26 (0.96-1.65)	1.38 (1.02-1.86)	1.30 (0.95-1.77)	1.22 (0.89-1.67)
Problem drinking				
No	1.00	1.00	1.00	1.00
Yes	1.37 (1.02-1.84)	1.21 (0.87-1.69)	1.17 (0.83-1.64)	1.11 (0.79-1.56)

MCS=Mental component summary
PCS=Physical component summary
SEP=Socioeconomic position

6.3 ALCOHOL DRINKING AND SICKNESS ABSENCE (II)

The second sub-study examined the associations between alcohol drinking and sickness absence and the contribution of working conditions to these associations. Alcohol drinking and working conditions were measured at baseline in 2000-02 and sickness absence spells were followed from the day of return of the baseline questionnaire until the end of 2007 or until the employee quit working for the City of Helsinki.

Among women, heavy average drinking (RR 1.31, 95% CI 1.12-1.54), binge drinking (RR 1.68, 95% CI 1.34-2.10) and problem drinking (RR 1.33, 95% CI 1.23-1.43) were all associated with self-certified sickness absence (Table 7). Non-drinking and drinking fewer than four units per week did not differ from moderate drinkers drinking 4 to 16 units per week. Self-certified sickness absence increased with increasing binge drinking. Binge drinking even once a month or less was associated with an increased risk of self-certified sickness absence (RR 1.14, 95% CI 1.07-1.21). Psychosocial and physical working conditions and work arrangements had only very minor contributions to the associations between drinking habits and self-certified sickness absence among women.

The associations between alcohol drinking and medically-confirmed sickness absence largely resembled the associations between alcohol drinking and self-certified sickness absence among women. Heavy average (RR 1.30, 95% CI 1.06-1.69), binge (RR 1.64, 95% CI 1.24-2.17) and problem drinking (RR 1.20, 95% CI 1.09-1.32) were associated with sickness absence and the RRs were rather similar, although problem drinking increased medically-confirmed sickness absence by only 20% and self-certified sickness absence by 30%. In contrast to self-certified sickness absence, the association between weekly average drinking and medically-confirmed sickness absence was U-shaped. Both non-drinking and heavy drinking were associated with increased medically-confirmed sickness absence by 30%, compared to moderate drinkers. Also, those drinking fewer than four units per week had a slightly elevated rate of medically-confirmed sickness absence (RR 1.13, 95% CI 1.04-1.24) compared to moderate drinkers drinking 4 to 16 units per week. Adjusting for psychosocial working conditions somewhat attenuated the U-shaped association between weekly average drinking and medically-confirmed sickness absence. Psychosocial working conditions also slightly attenuated the associations between binge drinking and problem drinking and medically-confirmed sickness absence. Physical working conditions attenuated the association between non-drinking and medically-confirmed sickness absence and abolished the association among those drinking fewer than 4 units per week. Otherwise, physical working conditions and work arrangements provided no major contributions to the associations.

Table 7. The associations between alcohol drinking and sickness absence among women. Rate ratios and their 95% confidence intervals.

	Age	Age + psychosocial working conditions	Age + physical working conditions	Age + work arrangements
Self-certified sickness absence (1-3 days)				
Average drinking (units/week)				
0	0.97 (0.84-1.11)	0.93 (0.82-1.06)	0.92 (0.81-1.05)	0.95 (0.83-1.08)
<4	0.99 (0.93-1.06)	0.98 (0.92-1.05)	0.96 (0.90-1.03)	0.98 (0.92-1.05)
4-<16	1.00	1.00	1.00	1.00
16 or more	1.31 (1.12-1.54)	1.26 (1.08-1.47)	1.31 (1.13-1.53)	1.32 (1.13-1.54)
Binge drinking				
Never	1.00	1.00	1.00	1.00
Once a month or less	1.14 (1.07-1.21)	1.13 (1.06-1.20)	1.14 (1.07-1.21)	1.14 (1.07-1.22)
Once a week	1.36 (1.21-1.52)	1.31 (1.17-1.47)	1.36 (1.21-1.52)	1.36 (1.21-1.53)
More than once a week	1.68 (1.34-2.10)	1.63 (1.31-2.03)	1.70 (1.37-2.12)	1.70 (1.36-2.13)
Problem drinking				
No	1.00	1.00	1.00	1.00
Yes	1.33 (1.23-1.43)	1.30 (1.20-1.39)	1.34 (1.24-1.44)	1.34 (1.25-1.44)
Medically- confirmed sickness absence (over 3 days)				
Average drinking (units/week)				
0	1.33 (1.14-1.55)	1.25 (1.08-1.45)	1.16 (1.01-1.34)	1.31 (1.12-1.52)
<4	1.13 (1.04-1.24)	1.11 (1.02-1.21)	1.04 (0.96-1.13)	1.12 (1.02-1.22)
4-<16	1.00	1.00	1.00	1.00
16 or more	1.30 (1.06-1.60)	1.22 (1.00-1.49)	1.30 (1.07-1.58)	1.29 (1.05-1.58)
Binge drinking				
Never	1.00	1.00	1.00	1.00
Once a month or less	1.14 (1.05-1.24)	1.13 (1.05-1.22)	1.16 (1.07-1.24)	1.15 (1.06-1.24)
Once a week	1.20 (1.03-1.40)	1.15 (0.99-1.33)	1.23 (1.07-1.42)	1.21 (1.04-1.41)
More than once a week	1.64 (1.24-2.17)	1.48 (1.13-1.94)	1.69 (1.31-2.20)	1.65 (1.24-2.18)
Problem drinking				
No	1.00	1.00	1.00	1.00
Yes	1.20 (1.09-1.32)	1.14 (1.04-1.26)	1.25 (1.14-1.36)	1.21 (1.10-1.33)

Among men, heavy weekly average drinking (RR 1.41, 95% CI 1.07-1.86), binge drinking (RR 1.72, 95% CI 1.27-2.33) and problem drinking (RR 1.34, 95% CI 1.14-1.58) were all associated with an increase in self-certified sickness absence. In contrast to women, only binge drinking more often than once a week was associated with self-certified sickness absence among men. Psychosocial working conditions somewhat attenuated the associations between all drinking habits and self-certified sickness absence among men. Physical working conditions and work arrangements provided only minimal contributions to the associations.

The association between weekly average drinking and medically-confirmed sickness absence was U-shaped, both non-drinkers (RR 1.94, 95% CI 1.36-2.77) and heavy drinkers (RR 1.53, 95% CI 1.08-2.16) having an increased rate of medically-confirmed sickness absence compared to moderate drinkers. Physical working conditions and work arrangements slightly attenuated the risk of non-drinkers. Binge drinking was not associated with medically-confirmed sickness absence. Binge drinking once a month or less was associated with a decreased level of medically-confirmed sickness absence after adjusting for psychosocial working conditions (RR 0.76, 95% CI 0.61-0.95) and physical working conditions (RR 0.77, 95% CI 0.63-0.96). Problem drinking was associated with an increased rate of medically-confirmed sickness absence (RR 1.40, 95% CI 1.15-1.72). Psychosocial working conditions somewhat attenuated the association between heavy average drinking and medically-confirmed sickness absence, as well as the association between problem drinking and medically-confirmed sickness absence. Also, physical working conditions and work arrangements attenuated the association between problem drinking and medically-confirmed sickness absence.

Results

Table 8. The associations between alcohol drinking and sickness absence among men. Rate ratios and their 95% confidence intervals.

	Age	Age + psychosocial working conditions	Age + physical working conditions	Age + work arrangements
Self-certified sickness absence (1-3 days)				
Average drinking (units/week)				
0	1.16 (0.83-1.64)	1.17 (0.85-1.63)	1.09 (0.78-1.53)	1.10 (0.79-1.54)
< 4	0.95 (0.80-1.13)	0.96 (0.81-1.13)	0.94 (0.79-1.11)	0.91 (0.76-1.08)
4-<16	1.00	1.00	1.00	1.00
16-24	1.22 (0.97-1.53)	1.20 (0.96-1.50)	1.25 (0.99-1.56)	1.19 (0.95-1.49)
over 24	1.41 (1.07-1.86)	1.27 (0.97-1.66)	1.44 (1.10-1.89)	1.37 (1.05-1.80)
Binge drinking				
Never	1.00	1.00	1.00	1.00
Once a month or less	1.02 (0.83-1.26)	0.97 (0.79-1.18)	1.01 (0.82-1.23)	1.00 (0.82-1.23)
Once a week	1.15 (0.90-1.46)	1.11 (0.88-1.39)	1.15 (0.91-1.46)	1.13 (0.89-1.43)
More than once a week	1.72 (1.27-2.33)	1.44 (1.07-1.94)	1.71 (1.27-2.31)	1.66 (1.23-2.24)
Problem drinking				
No	1.00	1.00	1.00	1.00
Yes	1.34 (1.14-1.58)	1.20 (1.03-1.41)	1.30 (1.11-1.53)	1.28 (1.09-1.51)
Medically-confirmed sickness absence (over 3 days)				
Average drinking (units/week)				
0	1.94 (1.36-2.77)	1.97 (1.42-2.73)	1.76 (1.29-2.41)	1.76 (1.24-2.49)
<4	1.15 (0.93-1.42)	1.11 (0.91-1.34)	1.10 (0.91-1.33)	1.09 (0.89-1.35)
4-<16	1.00	1.00	1.00	1.00
16-24	1.24 (0.93-1.67)	1.25 (0.96-1.63)	1.37 (1.06-1.78)	1.20 (0.90-1.60)
Over 24	1.53 (1.08-2.16)	1.41 (1.03-1.93)	1.52 (1.12-2.06)	1.47 (1.05-2.05)
Binge drinking				
Never	1.00	1.00	1.00	1.00
Once a month or less	0.81 (0.64-1.04)	0.76 (0.61-0.95)	0.77 (0.63-0.96)	0.80 (0.64-1.02)
Once a week	0.89 (0.67-1.19)	0.86 (0.66-1.12)	0.88 (0.68-1.13)	0.88 (0.66-1.17)
More than once a week	1.33 (0.91-1.93)	1.16 (0.82-1.63)	1.25 (0.90-1.73)	1.25 (0.87-1.80)
Problem drinking				
No	1.00	1.00	1.00	1.00
Yes	1.40 (1.15-1.72)	1.25 (1.03-1.50)	1.23 (1.03-1.47)	1.29 (1.06-1.57)

6.4 CHANGES IN ALCOHOL DRINKING AND SICKNESS ABSENCE (III)

The third sub-study examined changes in alcohol drinking and their contributions to sickness absence. Alcohol drinking was measured at baseline in 2000-02 and at follow-up in 2007. Sickness absence data were followed from the day of return of the follow-up questionnaire until the end of 2010. Covariates were measured at follow-up in 2007.

Among women, both an increase in weekly average drinking (RR 1.38, 95% CI 1.18-1.62) and stable heavy drinking (RR 1.53, 95% CI 1.20-1.94) were associated with an increase in self-certified sickness absence (Table 9). Adjusting for socioeconomic position and working conditions did not affect the associations, whereas adjusting for other health behaviours and health attenuated these associations though they remained significant after all adjustments. Also, a decrease in weekly average drinking (RR 1.21, 95% CI 1.02-1.43) was associated with an increase in self-certified sickness absence. The association attenuated after adjusting for socioeconomic position and working conditions and attenuated even further after adjusting for other health behaviours and health. Stable problem drinking increased the rate of self-certified sickness absence. The association remained after all adjustments, although attenuated somewhat after adjusting for other health behaviours and health.

Increased weekly average drinking (RR 1.37, 95% CI 1.12-1.68) and stable heavy drinking (RR 1.39, 95% CI 1.01-1.92) were associated with medically-confirmed sickness absence among women. Adjusting for socioeconomic position and working conditions strengthened the association between heavy drinking and medically-confirmed sickness absence, whereas adjusting for other health behaviours and health attenuated the associations between increased weekly average drinking and heavy drinking with sickness absence. Non-drinking was not associated with medically-confirmed sickness absence, whereas decreased weekly average drinking (RR 1.47, 95% CI 1.20-1.79) was associated with an increase in sickness absence. The association attenuated somewhat after adjusting for other health behaviours and health, but remained after all adjustments. Stable problem drinking was associated with medically-confirmed sickness absence (RR 1.17, 95% CI 1.02-1.34), however, the association was abolished by other health behaviours and health. Former problem drinking and new problem drinking were not associated with medically-confirmed sickness absence.

Results

Table 9. The associations between changes in alcohol drinking and sickness absence among women, rate ratios and their 95% confidence intervals.

	Base model adjusted for age and marital status	Base model + SEP + working conditions	Base model + health behaviours + health	Fully-adjusted
Self-certified sickness absence (1-3 days)				
Average drinking (units/week)				
Stable non- drinker	1.00 (0.83-1.21)	0.99 (0.82-1.20)	0.97 (0.81-1.17)	0.97 (0.81-1.16)
Decreased	1.21 (1.02-1.43)	1.19 (1.00-1.41)	1.14 (0.97-1.34)	1.13 (0.96-1.33)
Stable moderate	1.00	1.00	1.00	1.00
Increased	1.38 (1.18-1.62)	1.39 (1.19-1.63)	1.24 (1.07-1.44)	1.26 (1.09-1.47)
Stable heavy	1.53 (1.20-1.94)	1.57 (1.23-2.00)	1.36 (1.08-1.71)	1.39 (1.11-1.75)
Problem drinking				
Never	1.00	1.00	1.00	1.00
Former	1.08 (0.90-1.30)	1.09 (0.91-1.31)	1.01 (0.85-1.20)	1.01 (0.85-1.20)
New	1.13 (0.99-1.29)	1.15 (1.01-1.30)	1.09 (0.97-1.24)	1.11 (0.98-1.25)
Stable	1.39 (1.26-1.54)	1.41 (1.27-1.57)	1.27 (1.15-1.40)	1.29 (1.17-1.43)
Medically- confirmed sickness absence (Over 3 days)				
Average drinking (units/week)				
Stable non- drinker	1.16 (0.93-1.45)	1.06 (0.86-1.30)	1.09 (0.89-1.33)	1.01 (0.84-1.23)
Decreased	1.47 (1.20-1.79)	1.32 (1.09-1.58)	1.32 (1.11-1.58)	1.24 (1.05-1.47)
Stable moderate	1.00	1.00	1.00	1.00
Increased	1.37 (1.12-1.68)	1.37 (1.14-1.65)	1.17 (0.97-1.40)	1.22 (1.02-1.45)
Stable heavy	1.39 (1.01-1.92)	1.50 (1.11-2.02)	1.15 (0.86-1.54)	1.24 (0.94-1.64)
Problem drinking				
Never	1.00	1.00	1.00	1.00
Former	1.10 (0.88-1.38)	1.14 (0.93-1.41)	0.99 (0.81-1.21)	1.03 (0.85-1.25)
New	1.00 (0.84-1.19)	1.03 (0.88-1.20)	0.94 (0.80-1.10)	0.96 (0.83-1.12)
Stable	1.17 (1.02-1.34)	1.25 (1.10-1.42)	1.00 (0.88-1.14)	1.09 (0.97-1.23)

SEP= Socioeconomic position

An increase in weekly average drinking was associated with an increased rate of self-certified sickness (RR 1.58, 95% CI 1.18-2.12) absence among men (Table 10). The association attenuated somewhat by adjusting for socioeconomic position and working conditions and other health behaviours and health, but remained after all adjustments. Both stable (RR 1.44, 95% CI 1.10-1.87) and new problem (RR 2.04, 95% CI 1.51-2.77) drinking were associated with self-certified sickness. These associations were slightly attenuated after adjusting for socioeconomic position and working conditions and the association between new problem drinking and self-certified sickness absence was attenuated further after adjusting for other health behaviours and health. The associations remained, however, in the fully-adjusted models. Also, former problem drinking was associated with self-certified sickness absence (RR 1.59, 95% CI 1.14-2.23) and the association remained after all adjustments.

Weekly average drinking was not associated with medically-confirmed sickness absence. Stable problem drinking was associated with an increase in the rate of medically-confirmed sickness absence (RR 1.41, 95% CI 1.03-1.93). The association became non-significant after adjusting for socioeconomic position and working conditions and other health behaviours and health. Also, former problem drinking was associated with medically-confirmed sickness absence (RR 1.63, 95% CI 1.09-2.43). The association attenuated, however, after adjusting for socioeconomic position and working conditions, as well as other health behaviours and health.

The associations between changes in binge drinking and sickness absence were also analysed (Data not shown). New binge drinking and stable binge drinking were associated with an increase in self-certified sickness absence among both women and men. Regarding medically-confirmed sickness absence, stable binge drinking was associated with sickness absence among women, whereas among men an association was found between former binge drinking and sickness absence.

Results

Table 10. Changes in alcohol drinking and sickness absence among men, rate ratios and their 95% confidence intervals.

	Base model adjusted for age and marital status	Base model + SEP + working conditions	Base model + health behaviours + health	Fully-adjusted
Self-certified sickness absence (1-3 days)				
Average drinking (units/week)				
Stable non- drinker	1.59 (0.99-2.55)	1.52 (0.96-2.42)	1.51 (0.97-2.35)	1.46 (0.94-2.27)
Decreased	1.35 (0.94-1.94)	1.32 (0.93-1.87)	1.33 (0.95-1.87)	1.31 (0.93-1.83)
Stable moderate	1.00	1.00	1.00	1.00
Increased	1.58 (1.18-2.12)	1.45 (1.08-1.94)	1.47 (1.12-1.93)	1.43 (1.09-1.88)
Stable heavy	1.26 (0.94-1.69)	1.17 (0.87-1.57)	1.06 (0.80-1.40)	1.04 (0.78-1.38)
Problem drinking				
Never	1.00	1.00	1.00	1.00
Former	1.59 (1.14-2.23)	1.49 (1.06-2.08)	1.51 (1.10-2.07)	1.47 (1.07-2.03)
New	2.04 (1.51-2.77)	1.86 (1.37-2.54)	1.69 (1.26-2.27)	1.62 (1.20-2.19)
Stable	1.44 (1.10-1.87)	1.32 (1.02-1.72)	1.29 (1.01-1.65)	1.26 (0.98-1.62)
Medically- confirmed sickness absence (over 3 days)				
Average drinking (units/week)				
Stable non- drinker	1.59 (0.93-2.73)	1.44 (0.88-2.36)	1.55 (0.98-2.42)	1.47 (0.95-2.27)
Decreased	1.34 (0.89-2.02)	1.37 (0.94-1.99)	1.40 (0.99-1.99)	1.37 (0.98-1.91)
Stable moderate	1.00	1.00	1.00	1.00
Increased	1.21 (0.83-1.78)	1.15 (0.81-1.64)	1.11 (0.80-1.53)	1.11 (0.81-1.51)
Stable heavy	1.22 (0.86-1.73)	1.25 (0.91-1.73)	1.03 (0.77-1.39)	1.13 (0.85-1.51)
Problem drinking				
Never	1.00	1.00	1.00	1.00
Former	1.63 (1.09-2.43)	1.40 (0.97-2.01)	1.52 (1.09-2.12)	1.38 (1.00-1.91)
New	1.31 (0.85-2.02)	1.27 (0.86-1.88)	1.07 (0.75-1.53)	1.08 (0.76-1.53)
Stable	1.41 (1.03-1.93)	1.24 (0.94-1.65)	1.20 (0.92-1.56)	1.14 (0.89-1.47)

SEP= Socioeconomic position

6.5 ALCOHOL DRINKING AND DISABILITY RETIREMENT (IV)

In the fourth sub-study, the associations between alcohol drinking and disability retirement were examined. Alcohol drinking and covariates were measured at baseline with disability retirement measured until the end of 2010 or until the onset of retirement, the age of 63 or death.

Non-drinking was associated with all-cause disability retirement measured by both amount (HR 1.94, 95% CI 1.42-2.65) and frequency (HR 1.64, 95% CI 1.29-2.08) of drinking after adjustments for gender, age and marital status (Table 11). These associations remained after fully adjusting (e.g. adjusting for socioeconomic position, working conditions, health and health behaviours). Heavy average drinking was not associated with all-cause disability retirement measured either by quantity or frequency of drinking. An only association was only found (HR 1.60, 95% CI 1.04-2.44) for the amount of drinking adjusted for socioeconomic position and working conditions, and this association was abolished after further adjustments for health and health behaviours. (Sub-study IV) The association between binge drinking and all-cause disability retirement was U-shaped, both non-drinkers (HR 1.80, 95% CI 1.37-2.37) and binge drinkers (HR 1.36, 95% CI 1.11-1.66) having increased risk compared to non-binge drinkers. The U-shaped association was attenuated by adjustments for socioeconomic position, working conditions and health and health behaviours; the risk for binge drinkers did not remain after the adjustments. Problem drinking was associated with all-cause disability retirement even after all adjustments (HR 1.30, 95% CI 1.05-1.59).

Heavy drinking measured either by amount or frequency of drinking did not increase the risk of disability retirement due to musculoskeletal disorders. Drinking a few times per week even tended to be associated with a decreased risk (HR 0.44, 95% CI 0.27-0.71). Non-drinking (HR 2.09, 95% CI 1.34-3.27) was associated with a more than doubled risk of disability retirement due to musculoskeletal disorders compared to those drinking 4 to 10 units per week, but the association was explained by further adjustments. Binge drinking and problem drinking were not associated with disability retirement due to musculoskeletal disorders, whereas non-drinkers had an elevated risk compared to non-binge drinkers even after full adjustment (HR 1.64, 95% CI 1.12-2.41).

The association between average drinking and disability retirement due to mental diseases was U-shaped. Both non-drinking and heavy drinking were associated with a doubled risk compared to moderate drinkers, measured either by amount or frequency of drinking and after fully adjusting for socioeconomic position, working conditions, health and health behaviours. Binge drinking was not associated with disability retirement due to mental disorders, whereas non-drinkers had an increased risk compared to non-binge drinkers even in the fully-adjusted model (HR 1.73, 95% CI 1.01-2.96).

Also, problem drinking was associated with a doubled risk of disability retirement due to mental disorders (HR 2.17, 95% CI 1.53-3.08) even after all adjustments.

Table 11. The associations between alcohol drinking and all-cause disability retirement, disability retirement due to musculoskeletal diseases and disability retirement due to mental disorders (hazard ratios and their 95% confidence intervals).

	All-cause disability retirement		Disability retirement due to musculoskeletal diseases		Disability retirement due to mental disorders	
	Base model	Fully-adjusted	Base model	Fully-adjusted	Base model	Fully-adjusted
Quantity of drinking (units/week)						
0	1.94 (1.42-2.65)	1.57 (1.14-2.16)	2.09 (1.34-3.27)	1.40 (0.88-2.21)	2.45 (1.31-4.58)	2.24 (1.19-4.22)
<4	1.03 (0.82-1.30)	0.92 (0.73-1.16)	0.94 (0.67-1.33)	0.74 (0.52-1.05)	1.18 (0.73-1.92)	1.15 (0.70-1.87)
4-10	1.00	1.00	1.00	1.00	1.00	1.00
>10-16 (women)/>10-24 (men)	1.13 (0.83-1.54)	1.17 (0.86-1.59)	1.01 (0.63-1.63)	1.18 (0.73-1.90)	1.54 (0.85-2.80)	1.43 (0.79-2.61)
>16 (women)/>24 (men)	1.43 (0.94-2.19)	1.34 (0.87-2.05)	0.59 (0.23-1.49)	0.59 (0.23-1.49)	2.81 (1.40-5.62)	2.54 (1.26-5.12)
Frequency of drinking						
Non-drinkers	1.64 (1.29-2.08)	1.41 (1.10-1.79)	1.54 (1.09-2.18)	1.14 (0.80-1.62)	2.42 (1.51-3.89)	2.42 (1.5-3.91)
A few times/year	1.16 (0.94-1.43)	1.02 (0.82-1.26)	1.02 (0.75-1.40)	0.80 (0.58-1.11)	1.65 (1.08-2.53)	1.62 (1.05-2.48)
A few times/month	1.00	1.00	1.00	1.00	1.00	1.00
A few times/week	0.70 (0.53-0.92)	0.90 (0.69-1.19)	0.44 (0.27-0.71)	0.67 (0.42-1.08)	1.20 (0.73-2.00)	1.36 (0.82-2.27)
More often	1.02 (0.74-1.41)	1.30 (0.94-1.79)	0.53 (0.29-0.99)	0.87 (0.47-1.64)	2.17 (1.27-3.71)	2.10 (1.23-3.61)
Binge drinking						
Non-drinkers	1.80 (1.37-2.37)	1.49 (1.13-1.97)	2.24 (1.53-3.27)	1.64 (1.12-2.41)	1.91 (1.12-3.25)	1.73 (1.01-2.96)
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.36 (1.11-1.66)	1.16 (0.94-1.44)	1.29 (0.93-1.77)	1.13 (0.81-1.59)	1.46 (1.00-2.12)	1.27 (0.86-1.88)
Problem drinking						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.44 (1.18-1.76)	1.30 (1.05-1.59)	1.03 (0.73-1.45)	1.03 (0.72-1.46)	2.61 (1.86-3.65)	2.17 (1.53-3.08)

Fully adjusted models included age, gender, marital status, socioeconomic position, working conditions, health behaviours and health status.

7 DISCUSSION

7.1 MAIN RESULTS OF THE STUDY

This study examined the associations between alcohol drinking, health-related functioning and work disability among middle-aged municipal employees. The study found that alcohol drinking was associated with all studied measures of health functioning and work disability, namely poor health functioning, self-certified and medically-confirmed sickness absence and disability retirement. The main findings of this study are summarized in more detail below.

First, the associations between alcohol drinking and mental and physical functioning were different: Heavy average, binge and problem drinking were all associated with poor mental functioning except for heavy average drinking among men, whereas only problem drinking and non-drinking increased the risk for poor physical functioning.

Second, heavy weekly average drinking, binge drinking and problem drinking were all associated with self-certified sickness absence among both women and men and, with the exception of binge drinking among men, also with medically-confirmed sickness absence. The contributions of working conditions were small, but psychosocial working conditions slightly explained the associations between drinking habits and sickness absence, especially among men.

Third, increased alcohol drinking between 2000-2002 and 2007 was associated with self-certified and medically-confirmed sickness absence. Associations were found more often for self-certified sickness absence while associations for medically-confirmed sickness absence were often explained by health and health behaviours.

Fourth, heavy weekly average drinking and frequent drinking were not associated with all-cause disability retirement, whereas binge and problem drinking were. All drinking habits predicted disability retirement due to mental disorders, whereas alcohol drinking was not associated with the risk of disability retirement due to musculoskeletal diseases.

Fifth, alcohol drinking was associated with poor mental health in particular. Relatively strong associations and associations with several drinking habits were found concerning poor mental functioning and disability retirement due to mental disorders.

Sixth, problem drinking was the drinking habit with the strongest and most widespread contributions to health functioning and work disability. The associations between weekly average drinking and health functioning were often U-shaped, with moderate drinkers having the lowest risks and both non-drinkers and heavy drinkers having increased risks. Binge drinking was associated with health functioning and work disability especially among

women, but among men associations were less frequent and quite often attenuated by covariates.

7.2 INTERPRETATION OF THE MAIN FINDINGS

The studied employees drank relatively little in terms of overall amount of alcohol consumed. The majority of women drank under 4 units per week while among men it was most common to drink 4 to 16 units per week. Among men, 7% were heavy drinkers while among women, only 3%. The results are in line with other Finnish studies (Kaila-Kangas et al., 2015; Vahtera et al., 2002), but among women the proportion of non-drinkers was lower than in the latest Finnish drinking habit survey conducted in 2008 (Mäkelä et al., 2010) and in previous Finnish studies on work-aged people (Kaila-Kangas et al., 2015) and municipal employees (Vahtera et al., 2002). In contrast to previous studies, the current study included people working in the Helsinki metropolitan area, which might contribute to the women's drinking habits. Alcohol drinking slightly increased during the follow-up. Not many Finnish cohort studies with recent data have examined changes in alcohol consumption, but a study among older men suggested that alcohol drinking somewhat increased as they got older (Ilomäki et al., 2010). Although the overall amount of drinking was relatively small, binge drinking and problem drinking were common among both women and men. Another Finnish study found a much lower proportion (6%) of problem drinkers, but the assessment was based on a computerised interview carried out by healthcare workers (Kaila-Kangas et al., 2015) instead of questionnaire data. Binge drinking was also common in a previous study with 9% of 40- to 44-year-old participants and 6% of 50- to 54-year-old participants drinking until they felt drunk at least once a week (Harkonmäki et al., 2007).

Alcohol drinking was associated with all studied measures of health functioning and work disability. The associations between alcohol drinking and mental and physical functioning were different: Heavy average drinking, binge drinking and problem drinking were all associated with poor mental functioning with the exception of heavy average drinking among men. Concerning physical functioning, only problem drinking was associated with poor physical functioning and non-drinking was also associated with poor physical functioning compared to moderate drinkers. Only two previous studies have focused on employees, both of them cross-sectional and involving several subscales of the SF-36 survey. In a Japanese study (Saito et al., 2005), no association between heavy drinking and poor health functioning was found, whereas in a Swedish study (Bendtsen et al., 2003), self-perceived excessive alcohol drinking was associated with poor health functioning. Previous longitudinal studies on these issues are scarce and have not always found associations between heavy alcohol drinking and health functioning (Strandberg et al., 2004; Byles et al., 2006; Ortola et al., 2016). A

Danish study found no associations between change in alcohol drinking and improved health functioning although, in line with the present study, in cross-sectional analyses non-drinkers had poorer physical functioning compared to moderate drinkers and that heavy drinking was associated with poor mental functioning (Pisinger et al., 2009). In that study, however, non-drinkers also had poorer mental functioning compared to moderate drinkers (Pisinger et al., 2009). An Australian study examining elderly women found no association between heavy drinking and poor health functioning, but non-drinkers and rare drinkers had poorer health functioning compared to moderate drinkers (Byles et al., 2006). Another Australian study on middle-aged women examined the general health subscale of the SF-36 survey and found that both non-drinkers and heavy drinkers had poorer health functioning compared to moderate drinkers (Powers & Young, 2009). A Spanish study on elderly people found no associations between amount of drinking and health functioning (Ortola et al., 2016). Lack of associations between heavy drinking and poor health functioning in some previous studies might be due to only examining the amount of drinking instead of also including other measures of alcohol drinking. In the present study, problem drinking was the drinking habit showing strongest associations with poor health functioning. The association between problem drinking and mental functioning remained even after adjusting for baseline mental health functioning, marital status, socioeconomic position, working conditions and other health behaviours.

Heavy average, binge and problem drinking were all associated with both self-certified and medically-confirmed sickness absence among women and men, except for binge drinking and medically-confirmed sickness absence among men. Alcohol drinking might be associated with self-certified and medically-confirmed sickness absence via different mechanisms. Medically-confirmed sickness absence is considered a valid measure of health (Laaksonen et al., 2011), whereas acute effects of heavy drinking might play a role in short sickness absence spells (Hensing et al., 2010). A previous cross-sectional Australian study found that alcohol drinking was associated with both alcohol-related and illness-related sickness absence (Roche et al., 2008). In the present study, alcohol-related sickness absence was not inquired but the associations were largely similar between self-certified and medically-confirmed sickness absence suggesting that both acute adverse effects of drinking and more long-term ill health due to alcohol drinking play a role. However, there was one difference between self-certified and medically-confirmed sickness absence; the association between weekly average drinking and medically-confirmed sickness absence was U-shaped, both non-drinkers and heavy drinkers had increased risk compared to moderate drinkers. Two British longitudinal studies have included both self-certified and medically-confirmed sickness absence and one of them found associations for self-certified sickness absence only (Marmot et al., 1993), whereas the other found associations concerning them both (Jenkins, 1986).

The study finding no association for medically-confirmed sickness absence, however, required a medical certificate for sickness absence spells exceeding 7 days, which might explain the difference. A previous Finnish study examined medically-confirmed sickness absence and found, in line with the present study, a U-shaped association (Vahtera et al., 2002). The study also found associations among both women and men whereas many previous studies have found associations more often among men (Norström, 2006; Norström & Moan, 2009; Marmot et al., 1993; Upmark et al., 1999). In our study, all studied drinking habits were associated with sickness absence except for binge drinking among men. Other longitudinal studies have only seldom included measures of alcohol drinking other than overall amount of drinking. A study among urban transit workers included heavy episodic drinking which was associated with sickness absence even after adjusting for modal alcohol consumption (Bacharach et al., 2010), and a Swedish study found that problem drinking was associated with sickness absence among men but not among women (Upmark et al., 1999).

The study also aimed to examine if working conditions contribute to the association between alcohol drinking and sickness absence. Previous studies have not focused on these issues, although some have included working conditions among other covariates. Studies on the associations between alcohol drinking and working conditions have produced inconclusive results and have not always supported the association. A Canadian longitudinal study suggested that working conditions make a limited contribution to heavy drinking, whereas non-work factors such as education, family situation and health behaviours have a greater contribution (Marchand et al., 2011). A meta-analysis examining the association between job strain and alcohol use found no clear evidence between job strain and alcohol drinking (Heikkilä et al., 2012). Another meta-analysis focused on long working hours and concluded that working more than standard recommendations was likely to increase alcohol use (Virtanen et al., 2015). There are also some studies on the associations between alcohol drinking and physical working conditions suggesting that physically demanding work increases alcohol drinking (Crum et al., 1995; Zins et al., 1999). The present study included psychosocial and physical working conditions and work arrangements including working overtime, shift work and type of work contract as a measure of job security. Working conditions did not play a major role and the association between alcohol drinking and sickness absence mainly remained after adjusting for them. Psychosocial working conditions somewhat explained the associations, especially among men, suggesting that employees might try to cope with the psychosocial burden of work by drinking alcohol. It might also be that heavy drinkers perceived their work to be psychosocially strenuous more often than others. No straightforward conclusions can be drawn as alcohol drinking and working conditions were measured simultaneously.

To deepen the understanding about alcohol drinking and sickness absence, the associations between changes in alcohol drinking and

subsequent sickness absence were examined. In contrast to the study on alcohol drinking and sickness absence, the associations somewhat differed between self-certified and medically-confirmed sickness absence: Associations were found more often for self-certified sickness absence as associations for medically-confirmed sickness absence were often explained by other health behaviours and health. The study suggests that alcohol drinking is more strongly associated with self-certified than medically-confirmed sickness absence. However, it instead might be that selection by health status was stronger for medically-confirmed sickness absence since medically-confirmed sickness absence has been shown to be associated with health status (Marmot et al., 1995; Kivimäki et al., 2003). A reduction in alcohol drinking among women and former problem drinking among men were associated with self-certified and medically-confirmed sickness absence. It might be that reducing one's alcohol drinking is associated with a decline in health and thus maybe this was the actual reason for these associations. No previous study has examined changes in alcohol drinking and their association with sickness absence. Some studies have suggested that increased drinking does not affect health status measured by mortality (Wellman et al., 2004) or self-rated health (Eigenbrodt et al., 2006). The present study does not support these findings, but suggests that increased alcohol drinking increases poor health functioning and work disability. The group of increased alcohol drinking included both previous non-drinkers who had become moderate drinkers and moderate drinkers who had increased their drinking to heavy drinking. The majority of the group (third of women and over 90% of men) had increased their drinking to heavy drinking, thus, the results suggest a true contribution of increased alcohol drinking to poor health functioning instead of only selection.

Previous studies on the association between a heavy amount of alcohol drinking and disability retirement have been inconsistent. Two studies have suggested that the overall amount of drinking is not associated with all-cause disability retirement (Skogen et al., 2012; Kaila-Kangas et al., 2015) and disability retirement due to mental disorders (Kaila-Kangas et al., 2015), whereas problem drinking is. Concerning all-cause disability retirement, the findings of the present study somewhat supported these results. Heavy drinking measured either by quantity or frequency of drinking had only small contributions to all-cause disability retirement, whereas binge drinking and problem drinking increased the risk, problem drinking even after all adjustments. However, when separately examining disability retirement due to mental disorders and musculoskeletal diseases, the above mentioned was not true. A heavy amount of drinking and problem drinking more than doubled the risk of disability retirement due to mental disorders, and the associations remained strong even after all adjustments. Also, Kaila-Kangas et al. (Kaila-Kangas et al., 2015) found that the associations between problem drinking and disability retirement were stronger for disability retirement due to mental disorders than for all-cause disability retirement. Concerning

disability retirement due to musculoskeletal diseases, neither a heavy amount of drinking nor binge or problem drinking were associated with disability retirement due to musculoskeletal disorders. Frequent drinking was associated with a decreased risk and non-drinking with an increased risk of disability retirement due to musculoskeletal disorders. Some previous studies have also examined the associations between alcohol drinking and musculoskeletal disorders, and in line with the present study found no associations (Pietikäinen et al., 2011) or even a decreased risk among heavy drinkers (Samuelsson et al., 2013). The findings suggest that alcohol drinking is unlikely hidden behind the more socially acceptable musculoskeletal diagnoses. However, alcohol drinking as the reason behind work disability due to mental disorders and other causes might not always be recognised. According to a small Finnish survey, alcohol problem was often missing from diagnoses for disability retirement, although heavy drinking was apparent in medical records (Gockel 2008 in Gockel et al., 2013).

Throughout the study, alcohol drinking showed the strongest and most widespread associations with poor mental health. Problem drinking doubled the risk for poor mental functioning among women and nearly doubled the risk among men. The risk of disability retirement due to mental disorders more than doubled due to heavy weekly average drinking, frequent drinking and problem drinking. These associations remained after all adjustments. It is well-known that alcohol drinking and poor mental health often co-occur. Alcohol drinking has been associated with mental distress (Mäkelä et al., 2015), anxiety disorders (Kushner et al., 2000) and depression (Fergusson et al., 2009) for example. A question regarding the temporal order of alcohol drinking and mental health is often raised. It has been suggested that they have common exposures or that one predicts the other. It has been suggested that people might try to self-medicate their mental problems by drinking alcohol. Additionally, it may be that alcohol drinking causes or worsens mental health problems. In the present study, adverse alcohol drinking predicted the outcomes, and the associations remained after adjusting for baseline mental functioning when examining mental health functioning and after adjusting for common mental disorders when examining disability retirement due to mental disorders. The results thus suggest that alcohol drinking may predict poor mental health.

Previous studies have often found that non-drinkers have poorer health compared to moderate drinkers using various health outcomes, such as poor health functioning (Byles et al., 2006; Powers & Young, 2008; Pisinger et al., 2009), sickness absence (Marmot et al., 1993; Upmark et al., 1999; Kivimäki et al., 2001; Vahtera et al., 2002), disability retirement (Månsson et al., 1999; Harkonmäki et al., 2008; Skogen et al., 2012; Sidorchuk et al., 2012; Samuelsson et al., 2013; Ropponen & Svedberg, 2013; Korhonen et al., 2015; Böckerman et al., 2016), cardiovascular diseases (Wellman et al., 2004; Mäkelä et al., 2005; Rehm et al., 2010) and mortality (Wellman et al., 2004). In line with previous studies, non-drinkers had an increased risk of poor

physical functioning, medically-confirmed sickness absence and disability retirement due to mental disorders and musculoskeletal disorders, compared to moderate drinkers. It has been suggested that the increased risk of non-drinkers is explained by the presence of previously heavy drinkers or people not drinking due to health reasons among the non-drinker group, as well as other methodological biases (Mäkelä et al., 2005; Liang & Chikritzhs, 2013; Stockwell et al., 2016). In the present study, non-drinking when measured both at baseline and five to seven years later was not associated with sickness absence when examining changes in alcohol drinking, although point estimates were elevated for men. This suggests that a selection by health status might play a role. Moderate drinkers might share other features beneficial for health compared to non-drinkers, and instead of alcohol per se, these features might better explain health and health functioning compared to non-drinkers. The present study supports this possibility since non-drinking was associated with disability retirement due to musculoskeletal diseases, and alcohol itself hardly protects from musculoskeletal diseases.

The study included different measures of alcohol drinking (e.g. weekly average drinking, binge drinking and problem drinking). Of the studied drinking habits, problem drinking showed the most widespread associations with poor health-related functioning and work disability. It was associated with poor mental and physical functioning among both women and men, with self-certified and medically-confirmed among women and men and with all-cause disability retirement and with disability retirement due to mental disorders. The only outcome with which problem drinking was not associated was disability retirement due to musculoskeletal disorders. Previous studies have rarely included several drinking habits together. Some studies have suggested binge drinking to be harmful for health, irrespective of the amount of drinking (Laatikainen et al., 2003; Sundell et al., 2008; Paljärvi et al., 2009). In the present study, binge drinking showed associations with poor health-related functioning and work disability, but the associations were not as extensive as those of problem drinking. It might be that the measure of binge drinking, set to 6 units at a time, was not able to differentiate the most serious binge drinkers, especially among men. The results highlight the importance of also inquiring about problem drinking instead of only overall amount of alcohol drinking in future studies and in health services when trying to identify and prevent alcohol-related ill health.

7.3 METHODOLOGICAL CONSIDERATIONS

The study examined the associations between alcohol drinking, health-related functioning and work disability among middle-aged employees. The data consisted of two mailed questionnaires and register data on sickness absence and disability retirement. The data included 8960 participants with a response rate of 67% at baseline and 7332 participants with a response rate

of 83% at follow-up. Data linkage to employer's registers was consented to by 78% of participants and 74% consented to linkage to other registers such as register data on disability retirement.

The study had certain strengths such as a large dataset and prospective design. However, the study population of employees was a selected group and the healthy worker effect might play a role. Those with poor health may have selected out before the beginning of the study and further selection may have occurred during the study. Those invited to the study were employed and fit for work at the age of 40 to 60 at baseline. In addition, the participants were selected by consenting to answer the questionnaire at baseline and at follow-up and consenting to data linkages. According to the non-response analyses, young employees, men, those with medically-confirmed sickness absence and those in lower socioeconomic positions were somewhat less likely to participate. The same factors were associated with non-consenting to data linkages (Laaksonen et al., 2008; Lahelma et al., 2013). Concerning the follow-up survey conducted in 2007, the response rate tended to be lower for younger employees, those in lower socioeconomic positions and those with poorer health, but differences were smaller compared to baseline. According to the non-response analyses, non-response is unlikely to cause serious bias, although the results concerning manually-working men especially should be interpreted with care (Laaksonen et al., 2008; Lahelma et al., 2013).

In addition, selection by alcohol drinking may have occurred. The distributions of drinking habits at baseline were, to a great extent, similar among all participants, those consenting to internal data linkages (linking the questionnaire data with employer's register), those consenting to external linkages (linking the questionnaire data with other than employer's register) and those participating at follow-up. Chi-square tests were calculated for consenting to internal and external linkages and for participating at follow-up. Among women, the participants differed according to both internal and external linkage consenting regarding weekly average drinking ($p < 0.001$ for internal and external linkages) and binge drinking ($p = 0.019$ for internal linkages, $p = 0.013$ for external linkages), whereas among men the only difference was found for participating at follow-up regarding binge drinking ($p = 0.012$). There were no differences concerning problem drinking. Among women, non-consenters were somewhat more likely to be non-drinkers, heavy drinkers or binge drinkers. Among men, those not participating at follow-up were more often non-drinkers or binge drinkers compared to participants. Selection due to consenting to data linkages and participation at follow-up was rather small and is not likely to cause major bias. However, it might be that the biggest selection due to drinking habits took place at baseline participation. If heavy drinkers were less likely to participate, the results might underestimate the contributions of alcohol drinking to health-related functioning and work disability.

Alcohol drinking was assessed by four variables. Alcohol drinking is a complex behaviour and measuring it is challenging. In the present study, the measures of alcohol drinking were self-reported. Self-reports tend to underestimate alcohol drinking (Rehm et al., 2007; Livingston & Callinan, 2015). For example, the Finnish drinking habit surveys conducted in 2000 and 2008 both covered 38% of documented alcohol consumption (Mäkelä et al., 2010). This under-coverage is partly because respondents of the surveys may not represent the general population, as alcohol drinking is highly skewed. Among non-respondents, both non-drinkers and heavy drinkers have been found to be overrepresented (Lahaut et al., 2002). Another source of under-coverage is that respondents might not report their actual alcohol consumption. Standard alcohol units might be poorly understood (Kerr & Stockwell, 2012) and the time frame of the survey may produce bias due to seasonal variation in alcohol drinking (Knudsen & Skogen, 2015). The more detailed the questions the bigger the volumes reported (Dawson, 1998; Livingston & Callinan, 2015). Based on these findings, it is likely that the weekly amount of alcohol consumed among the participants of the present study was under-estimated. However, the under-reporting of alcohol drinking does not have to interfere with comparing between drinking groups since the sequence of the groups remains the same even though the amounts consumed may not be exact. Binge drinking was measured by a single-item question and was common, especially among men. The same cut-point of 6 or more alcohol units per occasion was used for both women and men, thus, it is likely that most serious binge drinkers, especially among men, were not recognised. Associations for binge drinking among men might have emerged more often with a higher cut-point or if a question inquiring about experiences of a real drunken state was used instead. Problem drinking was measured by the CAGE scale. CAGE is a short, easy-to-use, validated tool in detecting alcohol abuse (Mayfield et al., 1974; Dhalla & Kopec, 2007), although its performance has varied and it is not regarded as an appropriate test for less severe forms of problem drinking (Dhalla & Kopec, 2007). The use of structured questionnaires to assess problem drinking has also been criticised. Cultural concepts might affect answers to questions such as feeling guilty because of alcohol drinking and the questionnaires might produce different proportions of problem drinkers between countries and drinking cultures (Rehm et al., 2015). In the present study, the proportion of problem drinkers was quite large, but was measured from a lifetime perspective. The usual cut-point on the CAGE scale of 2 would have classified nearly half of the men into problem drinkers, thus, a higher cut-point of 3 was used instead, among men. In sub-study III, changes in alcohol drinking were examined between baseline in 2000-02 and follow-up in 2007. Regression to the mean (i.e. a variable, extreme upon first measurement, will be closer to the average at the next measurement) might have diluted the results if the groups of increased drinkers and decreased drinkers included others than those who really changed their drinking habits.

Health-related functioning and work disability were measured by both a self-reported variable (i.e. the SF-36 survey) and register-based variables, namely self-certified and medically-confirmed sickness absence and disability retirement. This enabled examining a continuum of general health-related functioning and work disability from temporary to more permanent work disability. The SF-36 survey is a widely used, reliable and validated measure of health functioning (Ware et al., 1994). Sickness absence and disability retirement were measured by objective and complete register data. Disability retirement data included the main diagnosis for disability retirement, but not the secondary diagnosis. The surveys include a wide array of measures on socio-demographic factors, working conditions and health and health behaviours, allowing for adjusting the associations for them.

7.4 TOWARDS AN OVERALL PICTURE OF ALCOHOL DRINKING, HEALTH-RELATED FUNCTIONING AND WORK DISABILITY

This study examined drinking habits and their contribution to health-related functioning and work ability among middle-aged municipal employees. In Finland, alcohol drinking has increased considerably over the last few decades, reaching its peak in 2007. Now, older cohorts drink more than previous ones. Employees taking part in the study were born between 1940 and 1962. Alcohol consumption has increased markedly in Finland during their adulthood. Alcohol drinking has become a more everyday custom instead of concentrating only on special occasions. Another major phenomenon in Finnish drinking habits is that women have increased their drinking and non-drinking women are becoming more rare. The study population was female-dominated and aged 40 to 60 years at baseline and thus were suitable for examining the consequences of these phenomena. The study was, however, performed among middle-aged employees and thus those with the most serious alcohol drinking problems are likely not included in the study. In line with general trends in Finland, alcohol drinking among the study population was common and non-drinking rather rare. Although the majority drank relatively little in terms of weekly average weekly drinking, binge and problem drinking were frequent.

The study indicates that alcohol drinking threatens health-related functioning and work ability among middle-aged employees. Previous studies on these issues have been inconsistent, sometimes not finding any associations and sometimes even suggesting that alcohol drinking is associated with improved health-related functioning. In the present study, alcohol drinking was associated with poor mental and physical functioning, self-certified and medically-confirmed sickness absence and with all-cause disability retirement and disability retirement due to mental disorders. Like many other studies, the present study found that non-drinking was

associated with poorer health functioning and work ability than moderate drinking. However, the association was not found when examining changes in alcohol drinking, which might signify health selection behind better health functioning among non-drinkers. Alcohol drinking compromised health-related functioning and work ability among both women and men. Previous studies have found associations more often among men, but this study indicates that among Finnish middle-aged employees the associations are quite similar between genders.

Alcohol drinking was rather similarly associated with different outcomes of health-related functioning and work disability which enhances the credibility of the results. Alcohol drinking compromised both short-term work disability, characterised as self-certified sickness absence, as well as permanent work ability measured by disability retirement. Work disability due to alcohol drinking is likely to include work disability due to acute effects of alcohol drinking, as well as chronic poor health status because of alcohol drinking. The study highlights the importance of alcohol drinking on poor mental health outcomes. The association between alcohol drinking and mental disorders is well-known, but the study suggests that alcohol drinking might not always be recognised as a reason for poor mental health. Since alcohol drinking was measured before the assessment of poor mental functioning and disability retirement due to mental disorders and the associations remained after adjusting for baseline mental functioning and common mental disorders respectively, it is likely that alcohol drinking was the likely reason for poor mental health and not vice versa.

Work environment and occupational status might contribute to alcohol drinking. Occupational status was not able to explain the associations between alcohol drinking and health-related functioning and work disability. It has been suggested that work-related stress might enhance alcohol drinking as an attempt to cope with work-related stress. Previous studies on the association between adverse working conditions and alcohol drinking have been inconsistent and the present study does not provide much support to the role of working conditions, although psychosocial working conditions somewhat explained the association between alcohol drinking and sickness absence, particularly among men. Other health behaviours and health status had more pronounced contributions to the associations between alcohol drinking and health-related functioning and work ability. This is understandable since at least smoking among other health behaviours often co-exists with heavy drinking, and poor health status is likely to mediate the association between alcohol drinking and poor health functioning.

Different drinking habits were all associated with poor health-related functioning and work disability. However, problem drinking showed the strongest and most widespread associations. Our study highlights the importance of problem drinking to poor health-related functioning and work ability. Problem drinking measured by the CAGE scale was able to predict poor mental and physical functioning, self-certified and medically-confirmed

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sickness absence, as well as disability retirement. In future studies, it is important to include problem drinking in addition to the overall amount of alcohol drinking when examining adverse effects of alcohol in order to capture the true contribution of alcohol drinking.

8 CONCLUSIONS

Overall, this study suggests that alcohol drinking contributes to health-related functioning and work ability among middle-aged municipal employees. The study indicates that alcohol drinking is also a problem in working populations with relatively moderate alcohol consumption in terms of weekly average alcohol drinking. Currently, older cohorts drink more than previous ones and when trying to improve work ability among ageing employees and their health functioning after retirement, it is essential to promote moderate drinking habits. The study indicates that alcohol drinking also causes problems among employees with relatively moderate alcohol consumption, in terms of weekly average alcohol drinking. The findings call for prevention of increasing alcohol drinking at the population level as well as among employees. Drinking habits are potentially modifiable and the workplace offers a means to reach the majority of middle-aged people for promoting healthier behaviours. In addition to the overall amount of drinking, binge drinking and problem drinking should be assessed in order to capture the consequences of alcohol drinking in both future research and in clinical settings. Alcohol drinking should be taken into account in occupational health care and in other health services. Alcohol drinking that leads to mental health problems might not always be recognised and should be routinely inquired about when treating employees and other patients with mental health problems.

ACKNOWLEDGEMENTS

This study was carried out at the Department of Public Health, University of Helsinki. I am grateful to the Department for providing the excellent research facilities. I wish to thank the Juho Vainio Foundation, the Yrjö Jahnsson Foundation and the Finnish Foundation for Alcohol Studies for financial support to the study.

I have been fortunate to have excellent supervisors Professor Eero Lahelma, Docent Mikko Laaksonen and Professor Ossi Rahkonen since, I first came as a green med student to the department to do my licentiate thesis. You were very supportive from the very beginning and have always been prompt to answer my questions and share your expertise and insights with me. I thank you for giving me this opportunity and the effort you have put into the study. I also want to thank you for understanding my wish to do clinical work and allowing me to take the time I needed for this work. I am grateful to Eero for his enthusiasm and advice as well as his experience as a researcher and a supervisor. I thank Mikko for sharing his knowledge in statistical methods and for his thoughtful comments that have significantly contributed to the study. I am grateful to Ossi for persuading me to continue with research and finally registering as a doctoral student.

I acknowledge the reviewers of this study, Docent Pia Mäkelä and Docent Annina Ropponen, for their thorough evaluation and constructive comments for improving the thesis.

I want to thank all my current and former colleagues in the Helsinki Health Study. It has been a joy to work with you in a friendly and supportive work environment. Thank you, Jouni Lahti, Peppi Haario and Tina Loman for your help and support during this process, for discussions during lunch and coffee breaks and for your friendship. Friendly thanks to Anna Svärd and Eira Roos for sharing the room and discussions about combining research with clinical work. Warm thanks to Taina Leinonen for your friendship over the years and your valuable support.

I want to thank the entire staff of Porvoo Hospital for your great support and hilarious moments during my first years of clinical work. Special thanks to Karri Helin for providing me the opportunity to work-part time which allowed me to carry out this study. Thanks also to my co-workers and bosses in Malmi Hospital, Myyrmäki Health Care Centre, Meilahti Hospital and Jorvi Hospital.

Above all, I want to thank my friends and family for believing in me, for always encouraging me and taking my mind off work. I am grateful to have you in my life.

Helsinki, November 2016
Aino Salonsalmi

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APPENDICES

Appendix 1. Cross-sectional studies on the associations between alcohol drinking and mental and physical functioning.

Reference and setting	Data on alcohol drinking	Data on health functioning	Statistical methods, covariates	Main results
<p>Volk et al. 1997</p> <p>1333 primary care patients presenting to the Family Practice Center of the University of Texas Medical Branch in the U.S.</p> <p>Minorities and females oversampled</p> <p>Mean age of 43 years</p>	<p>Quantity and frequency</p> <ul style="list-style-type: none"> -non-drinkers (ref.) -infrequent drinkers -less frequent, low-quantity drinkers -less frequent, high-quantity drinkers -frequent low-quantity drinkers -frequent heavy drinkers <p>Alcohol use disorder in the past year (DSM-IV, according to a structured diagnostic interview)</p> <ul style="list-style-type: none"> -no disorder (ref.) -alcohol abuse -alcohol dependence 	<p>SF-36 survey</p> <ul style="list-style-type: none"> -PCS and MCS scores -8 subscales 	<p>Analysis of variance, multiple linear regression, hierarchical linear regression</p> <p>Age, gender, race, smoking, mood/anxiety disorders, physical comorbidity</p>	<p>PCS was not different across alcohol use disorder groups</p> <p>No disorder and alcohol abuse groups scored higher on MCS than alcohol dependence group</p> <p>Alcohol dependence was associated with lower MCS scores compared to those with no disorder. The association remained after all adjustments</p> <p>A modest decrease in the 8 subscales for those meeting criteria for alcohol dependence compared to those with no disorder or with alcohol abuse</p> <p>Frequent low-quantity drinkers had higher scores in PCS compared to non-drinkers</p> <p>Infrequent drinkers and less-frequent, high-quantity drinkers had lower MCS scores compared to non-drinkers</p>
<p>Bendtsen et al. 2003</p> <p>1075 women aged 18-64 years and employed as metalworkers, nurses, assistant nurses or medical secretaries in the county of Östergötland, Sweden</p> <p>Data collected in 1995 by postal questionnaire</p> <p>Response rate of 76%</p>	<p>Frequency of alcohol intake</p> <p>Increase in intake in the last year</p> <p>Self-perceived excessive consumption</p>	<p>SF-36 survey</p> <ul style="list-style-type: none"> -8 subscales 	<p>Means, 95% CIs</p>	<p>Women with excessive alcohol consumption had lower mean scores in vitality, social role function, emotional role function and mental health compared to women without excessive consumption</p>
<p>Green et al. 2004</p> <p>3069 men and 2600 women responding to one of 3 mailed surveys in 1990-92, aged 25 years or over</p> <p>Data drawn from a large health maintenance organization (375,000 members) in the metropolitan areas comprising Oregon and Southwestern Washington in the U.S.</p> <p>Response rate of 60%, mean age of 58 years</p>	<p>Frequency (never, 1/month or less, 2-4/month, 2-3 /week, 4+/week)</p> <p>Quantity per occasion (none, 1-2, 3 or more)</p> <p>Average drinks/month (0, 1-14, 15-29, 30-59, 60 or more)</p> <p>Drinking pattern (non-drinkers, very infrequent light, infrequent light, regular light to moderate, occasional heavy, regular heavier)</p>	<p>SF-36 survey</p> <ul style="list-style-type: none"> -general health, physical functioning, emotional wellbeing subscales 	<p>Analysis of covariance</p> <p>Age, ethnicity, marital status, body water index, current smoking</p>	<p>Alcohol drinking was associated with better general health and physical functioning and to a lesser extent with better mental health until reaching 2-3 times per week, 1-2 drinks per occasion, 15-29 drinks per month and a regular light to moderate drinking pattern</p> <p>Associations were stronger for women</p>

Appendices

<p>Van Dijk et al. 2004</p> <p>Health surveys conducted by the Municipal Health Centres in Rotterdam and Utrecht in 1999 in the Netherlands</p> <p>Random samples of the general population aged 16 to 69 years</p> <p>N=4472, 56% women, mean age of 38.5 years</p> <p>Response rate of 55%</p>	<p>-Usual alcohol consumption past year (glasses/week)</p> <p>-Consumption during the previous week</p> <p>-non-drinkers (ref.)</p> <p>-former drinkers (no alcohol past year)</p> <p>-light drinkers 1-14 (women)/1-21 (men)</p> <p>-heavy drinkers 14-28 (women)/21-42 (men)</p> <p>-excessive drinkers over 28 (women) over 42 (men)</p>	<p>Dichotomised SF-36 subscales as outcomes</p> <p>Cut-points at the lowest quartile points</p>	<p>Logistic regression, ORs, 95% CIs</p> <p>Gender, age, marital status, household, working situation, education, financial situation, city, use of sleep-inducing drugs or tranquilizers, smoking, ethnic group</p>	<p>Light and heavy drinkers had better health compared to non-drinkers in most of the 8 subscales (precise CIs not shown)</p> <p>Excessive drinkers had better health compared to non-drinkers in general health and in bodily pain (usual consumption only)</p> <p>Former drinkers had better health compared to non-drinkers in mental health</p>
<p>Saito et al. 2005</p> <p>4521 male employees aged 25 years or over working in one of 12 companies in Japan</p> <p>Response rate of 92%</p> <p>Questionnaire in 1999-2000</p>	<p>Alcohol intake per day</p> <p>-non-drinkers (ref.)</p> <p>-ex-drinkers</p> <p>-1-22.9 g/day</p> <p>-23-45.9 g/day</p> <p>-46-68.9 g/day</p> <p>-69 or over g/day</p> <p>Frequency of drinking</p> <p>-non-drinkers (ref.)</p> <p>-1-2 /week</p> <p>-3-4/week</p> <p>-5-6/week</p> <p>-daily</p>	<p>Japanese version of the SF-36 survey</p> <p>5 subscales</p> <p>- role-physical</p> <p>- general health</p> <p>- role-emotional</p> <p>- mental health</p> <p>- vitality</p> <p>Sub-optimal health defined as less than median on each scale</p>	<p>Logistic regression</p> <p>Age, marital status, working hours, physical activity at work, self-reported job stress, smoking status, regular exercise, factors indicating obesity, hypertension, hyperlipidemia and diabetes</p>	<p>Daily intake:</p> <p>-Ex-drinkers had increased risk of sub-optimal score in general health OR 1.68 (1.27-2.22)</p> <p>-Those drinking 1-22.9 g/day had decreased risk 0.85 (0.73-0.997) of sub-optimal score in role-physical subscale</p> <p>-Those drinking 23 g/day or over had decreased risk of sub-optimal score in vitality subscale</p> <p>Frequency of alcohol drinking:</p> <p>-Ex-drinkers had increased risk of sub-optimal score in general health 1.68 (1.26-2.22)</p> <p>-Those drinking 1-2 times/week had decreased risk of sub-optimal scores in vitality 0.76 (0.61-0.96) and in mental health 0.76 (0.60-0.95)</p> <p>-Those drinking 5-6 times/week had decreased risk of sub-optimal scores in role physical 0.82 (0.68-0.99) and in vitality 0.69 (0.57-0.85)</p>
<p>Chen & Storr 2006</p> <p>2235 adolescents aged 12-18 years collected as part of the 2001 National Health Interview Survey in Taiwan</p> <p>Response rate of 94%, 48% women</p> <p>Face-to-face interviews</p>	<p>Use of alcohol 30 days before the interview</p> <p>-no (ref.)</p> <p>-yes</p>	<p>Taiwanese version of the SF-36 survey</p> <p>-8 subscales</p>	<p>Linear regression, regression coefficients, 95% CIs</p> <p>Age, gender, aboriginal ethnicity, family income, household size</p>	<p>Alcohol drinking was associated with reduced scores in:</p> <p>bodily pain -3.34 (-5.88 -0.79)</p> <p>general health -4.10 (-7.44 -0.76)</p> <p>vitality -2.99 (-5.78 -0.21)</p> <p>social functioning -3.05 (-5.84 -0.26)</p> <p>role-emotional -10.5 (-16.9 -4.12)</p> <p>mental health -3.60 (-6.56 -0.58)</p>
<p>Stranges et al. 2006</p> <p>3586 35-79-year-old participants derived from the Department of Motor Vehicles of New York State and from Health Care Financing Administration list, in the U.S.</p> <p>Interview and health examination between 1995 and 2001</p>	<p>Drinking status</p> <p>-lifetime non-drinker</p> <p>-non-current drinker</p> <p>-current drinker</p> <p>Drinks per day</p> <p>Drinks per drinking day</p> <p>Pattern in relation to frequency</p> <p>Pattern in relation to intoxication</p>	<p>SF-36 survey</p> <p>-PCS</p> <p>-MCS</p>	<p>Analysis of covariance, general linear model procedure</p> <p>Age, education, BMI, race, marital status, annual household income, smoking, self-reported history of coronary heart disease, hypertension, hypercholesterolemia</p>	<p>Among women, current drinkers had better physical health across all drinking variables compared to life-time non-drinkers and non-current drinkers</p> <p>Among women, non-current drinkers had poorest mental health across all drinking variables. Daily drinkers had better mental health compared to lifetime non-drinkers, less than weekly drinkers and weekly but not daily drinkers.</p>

Response rate 59.5%	Pattern in relation to food Beverage type		a, diabetes	Intoxication was associated with worse mental health. A preference for beer was associated with better mental health. Among men, non-current drinkers had poorest physical health across all drinking variables. Drinking 2-2.9 units/day was associated with better physical health compared to lifetime non-drinkers and those drinking 3+ units/day. Intoxication was associated with worse physical health. A preference for spirits was associated with poor physical health. Among men, non-current drinkers had poorest mental health across all drinking variables
Chan et al. 2009 633 men and 961 women aged 50-97 years attending a follow-up evaluation of an original sample in 1972-74, including 82% of all adult residents in the southern California community of Rancho Bernado in the U.S. Survey between 1992 and 1996	Quantity (units in the previous 2 weeks) and frequency -continuous variable g/week -categorical variable -non-drinker -occasional drinker -light regular drinker -moderate regular drinker Problem drinking CAGE scale	SF-36 survey -Global health status score -MCS -PCS	Analysis of covariance, multivariate linear regression Age, BMI, exercise, smoking, estrogen use	SF-36 score increased with increasing alcohol intake category among men and women Among men, alcohol drinking (g/week) was positively associated with global health score, PCS and MCS; for women, no associations
Livingston 2009 6220 Australian men and women aged 15 or over (3110 couples) representative of all Australian households Survey in 2005	Weekly average drinking -non-drinkers -ex-drinkers -low-risk drinkers (<24 units for men/<12 units for women) -low-risk drinkers (ref.) -risky drinkers (24-41 units for men/12-23 units for women) -high-risk drinkers (42 or more units for men/24 or more units for women)	SF-36 survey -general health -social functioning -mental health	Multiple linear regression analysis	Non-drinkers had lower scores in general health Ex-drinkers had lower scores in general health, social functioning and mental health Risky drinkers had lower scores in mental health High-risk drinkers had lower scores in general health, social functioning and mental health
Valencia-Martin et al. 2013 11,782 persons of non-industrialised Spanish population aged 18 years or over	Average alcohol intake (consumption of a typical week in the last 12 months) -non-drinkers (ref.) -ex-drinkers -moderate drinkers -heavy drinkers Binge drinking (80g or more: men and 60g or more: women) Preference of beverage type, no preference (ref.)	SF-12 survey -PCS -MCS	Linear regression, beta-coefficients, 95% CIs Age, gender, educational level, social class, tobacco consumption, physical activity, BMI, diagnoses of chronic diseases, alcohol intake, number of binge drinking episodes Average alcohol intake modeled as categorical variable, binge drinking as continuous variable	Average alcohol intake PCS Ex-drinker: NS Moderate drinker: 1.42, 1.03-1.81 Heavy drinker: 1.86, 1.07-2.64 MCS NS Binge drinking NS Preferring spirits was associated with poor physical functioning) ; wine and spirits preference associated with good mental functioning

Appendix 2. Retrospective and cross-sectional studies on the associations between alcohol drinking and sickness absence.

Individual-level retrospective studies				
Reference and setting	Data on alcohol drinking	Data on sickness absence	Statistical methods, covariates	Main results
<p>Spak et al. 1998</p> <p>A questionnaire mailed to 3130 Swedish women who were born in 1925, 1935, 1945, 1955 or 1965 and registered in District West of Gothenburg at the end of 1985, response rate of 78%</p> <p>A stratified sample based on alcohol problem screening interviewed in 1989-1990, 292 included in the analysis</p>	<p>A psychiatric evaluation of alcohol dependence and abuse based on DSM-III-R on lifetime basis</p> <p>11 women had a diagnosis of alcohol dependence or abuse only, 26 women had another additional psychiatric disorder</p>	<p>Derived from the sickness insurance records at the Local Social Insurance Office, from Jan 1981 to Dec 1990</p> <p>The number of sick-leave spells over 7 days (from June 1988, over 14 days) on an annual basis</p>	<p>Mean annual number of sick leave spells/days, 95% CIs</p> <p>Annual mean duration of sick-leaves spells per woman, 95% CIs</p> <p>Multiple regression</p> <p>Age, socio-economic group, the Global Assessment of Functioning score, education, psychiatric disorder</p>	<p>Women with alcohol dependence or abuse had more sickness absence spells but the duration of the spells were similar compared to those without the diagnosis; women with additional psychiatric diagnoses had higher incidence and duration of sickness absence</p> <p>For those with alcohol dependence or abuse and additional psychiatric diagnoses, there was higher sick-leave levels with lower socioeconomic standing</p>
<p>Hermansson et al. 2002</p> <p>989 employees at a large Swedish transport sector workplace coming to a regular health examination between Feb 1997 and Jan 2000</p> <p>Mean age 43.2 years</p>	<p>AUDIT questionnaire, 8 points as cut-off</p> <p>Blood tests -carbohydrate-deficient transferring -gamma-glutamyltransferase</p> <p>Weekly alcohol consumption: cut-off of over 110 g/week for men and over 80 g/week for women</p>	<p>Derived from the company payroll system from 12 months before the screening</p> <p>Number of sick-days</p>	<p>A three-ordinal level cumulative logistic model, ORs and 95% CIs</p> <p>Occupation, age, gender</p>	<p>AUDIT 1.5 (1.0-2.3), p=0.047</p> <p>CDT 1.0 (0.7-1.5), p=0.85</p> <p>GGT 1.3 (0.8-2.2), p=0.15</p> <p>Sickness absence exceeding 4 weeks, 6 or more sickness absence spells during a year and sickness absence on Monday or Friday did not differentiate those screening positive in alcohol tests</p> <p>Weekly alcohol consumption 1.5 (1.0-2.2), p=.047</p>
Individual-level cross-sectional studies				
<p>Vasse et al. 1998</p> <p>471 Dutch employees in 2 municipal garbage collecting departments and in a large pharmaceutical company, surveys in 1992 and 1994</p> <p>Response rates of 48%, 40% and 54%</p>	<p>Average alcohol drinking (units/week): -abstainers -moderate drinkers (under 21 for men and under 14 for women) -excessive drinkers (21 or more for men and 14 or more for women)</p>	<p>Did you stay home from work one or more times during the last 6 months because of an illness or an accident?</p>	<p>Multiple logistic regression</p> <p>Age, gender, education, marital status, type of work-site, smoking</p>	<p>No association between excessive drinking and sickness absence</p> <p>In the presence of work stressors, abstinence increased the risk of sickness absence compared to moderate drinking</p>
<p>McFarlin & Fals-Stewart 2002</p> <p>Random sample of 280 U.S. employees from 3 large companies</p>	<p>Retrospective self-certified daily drinking over a 4-week period, interview 2 weeks after signing a consent to participate and again 2 weeks after first interview</p> <p>A collateral informant interviewed to evaluate the accuracy of the data</p>	<p>Derived from the human resources departments of the companies during the same period</p> <p>Sickness absence after 0-day lag, 1-day lag and 2-day lag after drinking</p>	<p>Logistic regression</p> <p>Participation code to control for sociodemographic and background variables, 1-day lag absent</p>	<p>Alcohol use was not associated with sickness absence on the day of drinking or 2 days after drinking</p> <p>Alcohol use was associated with sickness absence 1 day after drinking, relative risk 2.01</p>

DSM-III-R=Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised

AUDIT= Alcohol Use Disorders Identification Test

<p>Bendtsen et al. 2003</p> <p>1075 Swedish 18 to 64-year-old women employed as metalworkers, nurses, assistant nurses or medical secretaries</p> <p>A mailed questionnaire in 1995</p> <p>Response rate of 76%</p>	<p>Frequency of alcohol intake -never -1 to 4 times a month -2 to 3 times a week</p> <p>Increase in the intake in the last year</p> <p>Self-perceived alcohol problem</p>	<p>Derived from the Social Insurance Offices in 1996</p> <p>Sickness absence over 14 days</p>	<p>Mean number of sick leave spells per woman and year, mean 95%</p> <p>Mean number of sick-leave days per sick-listed women and year, mean 95% CIs</p> <p>Age</p>	<p>No statistically significant associations</p>
<p>Cunradi et al. 2005</p> <p>1446 U.S. transit operators employed by San Francisco Municipal Railway who underwent medical examination for driver's license renewal Aug 1993 to Sept 1995</p> <p>Participation rate of 73%</p>	<p>Heavy drinking -15 or more units/week</p> <p>Binge drinking -5+ units on most occasions</p> <p>Risk for alcohol dependence (CAGE scale)</p> <p>Consequences of alcohol consumption in the past 12 months</p> <p>Increased drinking since becoming a transit operator</p> <p>Any problem drinking indicator (above-mentioned measures)</p>	<p>Self-report on the number of "miss-outs" in the past 12 months</p> <p>Dichotomised -none -1 or more</p>	<p>Linear and non-linear regression for mean consumption</p> <p>Logistic regression for other measures, ORs, 95% CIs</p> <p>Age, gender, ethnicity, marital status, income, education, seniority</p>	<p>Fully-adjusted models</p> <p>-Heavy drinking 1.87 (1.11-3.14)</p> <p>-Binge drinking 1.32 (0.56-3.15)</p> <p>-Risk for alcohol dependence 2.46 (1.28-4.73)</p> <p>-Consequences due to drinking 2.17 (1.26-3.75)</p> <p>-Increased drinking since becoming transit operator 1.74 (1.09-2.80)</p> <p>-Any problem drinking indicator 1.72 (1.17-2.52)</p> <p>When additionally adjusted for work stressors: Any problem drinking indicator Men 1.82 (1.20-2.77) Women 1.16 (0.35-3.91)</p>
<p>Johansson et al. 2009</p> <p>Repeated cross-sectional data</p> <p>Randomly selected sample of 5000 15- to 64-year-old permanently resident citizens from 18 Finnish regions each year from 1993 to 2005</p> <p>Response rate on average 73%, those not working during the year excluded</p>	<p>Number of alcohol drinks/week</p>	<p>Self-reported data on sickness absence</p> <p>Number of sickness absence days during 1 year</p>	<p>Poisson regression</p> <p>Gender-specific regional unemployment, age, marital status, education, regional indicators, year indicators</p>	<p>A larger number of alcohol drinks consumed per week is associated with a higher number of sickness absence for men, for women and for pooled sample</p> <p>When analysing individuals with low education, the relationship is stronger than in full sample but statistically significant among men only</p>
<p>Roche et al. 2008</p> <p>13,582 Australians aged 14 years or over, stratified sampling to be representative of the Australian population aged 14 years old over</p> <p>Drop and collect, face-to-face and computer-assisted telephone interview with response-rates of 51%, 39% and 49%</p> <p>Data collection July-Dec 2001</p>	<p>Frequency and quantity of alcohol units consumed over the past 12 months</p> <p>-Abstainers -Short-term risk drinkers -Long-term risk drinkers</p>	<p>Self-reported number of days missed from work, school or technical and further education due to: -personal use of alcohol in the 3 months prior to the survey -any illness or injury in the 3 months prior to the survey</p> <p>Categorised as no days missed or 1 or more days missed</p>	<p>Logistic regression, ORs and their 95% CIs</p> <p>Age, gender, marital status and concerning illness/injury absenteeism; also, industry of employment, country of birth and regional location</p>	<p>Alcohol-related absenteeism</p> <p>Short-term risk: Low risk (ref) At least yearly risky 2.73 (1.40-5.32) At least yearly high risk 3.12 (1.74-5.60) At least monthly risky 5.14 (3.16-8.37) At least monthly high risk 8.68 (5.34-14.11) At least weekly risky 12.44 (7.41-20.89) At least weekly high risk 21.87 (12.90-37.06) Long-term risk: Low (ref) Risky 4.26 (3.04-5.98) High risk 7.34 (4.46-12.08)</p>

				<p>Illness/Injury absenteeism</p> <p>Short-term risk: Abstainers 0.87 (0.71-1.07) Low risk (ref) At least yearly risky 1.17 (1.00-1.36) At least yearly high risk 1.27 (1.04-1.54) At least monthly risk 1.17 (0.99-1.38) At least monthly high risk 1.40 (1.12-1.75) At least weekly risky 1.31 (1.03-1.66) At least weekly high risk 1.53 (1.13-2.07)</p> <p>Long-term risk: Abstainers 0.80 (0.66-0.98) Low (ref) Risky 1.10 (0.92-1.32) High risk 1.11 (0.82-1.51)</p>
<p>Hensing et al. 2011</p> <p>19- to 64-year-old Swedish individuals, 2888 on sick leave and 3567 others from a random population sample</p> <p>Those on sick leave (14 days or over) identified by the Swedish Social Insurance agency Feb-Apr 2008, controls randomly selected</p> <p>Response rates of 54% and 50%</p>	<p>The AUDIT questionnaire: -not at risk (0-7 for men and 0-5 for women) -harmful alcohol habits (8 or over for men, 6 or over for women)</p> <p>Those not having used alcohol in the last 12 months excluded</p>	<p>Sickness absence data from the Swedish Social Insurance Agency (14 days or over)</p>	<p>Logistic regression, ORs and 95% CIs</p> <p>Age, income, self-reported health, perceived symptoms</p> <p>Education, country of birth, civil status, occupational class, health, pregnancy, children at home, job strain, physical and mental challenges at work, employment status, current sick leave</p>	<p>No differences in harmful alcohol habits between newly sick-listed men and other men OR 0.96 (0.79-1.17) in a univariate model</p> <p>Women in random population sample more often had harmful alcohol habits than newly sick-listed women OR 1.54 (1.23-1.89) in a univariate model and 1.44 (1.16-1.81) after adjustments</p>
<p>Schou et al. 2014</p> <p>1762 employees aged 25 to 37 years in 2005</p> <p>Original sample obtained by selecting schools from a national register of schools in 1992</p> <p>Follow-up survey in 2005, those working were included</p> <p>Cumulative response rate of 66.9%</p>	<p>Frequency of drinking in past year -up to once a month (ref) -2-3 times a month -about once a week -2+ times per week</p> <p>Frequency of 5+ units past year -up to 5 times (ref) -6-10 times -11-50 times -55+ times</p> <p>Frequency of intoxication in past year -up to 5 times (ref) -6-10 times -11-50 times -55+ times</p> <p>Abstainers excluded</p>	<p>Self-reported data on alcohol-related sickness absence</p> <p>Having been absent from work due to alcohol in the last 12 months: once or more, never</p>	<p>Logistic regression, odds ratios, 95% CIs</p>	<p>Women</p> <p>Frequency of drinking: 2-3 times a month 5.02 (1.88-13.43) About once a week 8.30 (3.29-20.30) 2+ times per week 9.87 (3.40-28.69)</p> <p>Frequency of 5+ units: 6-10 times 3.11 (0.94-10.33) 11-50 times 14.84 (5.71-38.61) 55+ times 15.74 (4.29-57.71)</p> <p>Frequency of intoxication: 6-10 times 3.91 (1.47-10.45) 11-50 times 9.78 (4.15-23.05) 55+ times 19.65 (6.36-60.74)</p> <p>Men</p> <p>Frequency of drinking: 2-3 times a month 2.02 (0.93-4.97) About once a week 3.13 (1.54-6.32) 2+ times per week 5.87 (2.8-12.28)</p> <p>Frequency of 5+ units: 6-10 times 2.41 (1.03-5.65) 11-50 times 3.45 (1.66-7.18) 55+ times 7.72 (3.30-18.09)</p> <p>Frequency of intoxication: 6-10 times 2.87 (1.38-6.00) 11-50 times 3.30 (1.69-6.42) 55+ times 6.89 (3.05-15.24)</p>

Appendix 3. Cross-sectional studies on the associations between alcohol drinking and disability retirement

Individual-level cross-sectional studies				
Reference and setting	Data on alcohol drinking	Data on disability retirement	Statistical methods, covariates	Main results
<p>Upmark & Thundal 2002</p> <p>A questionnaire mailed to 3130 Swedish women who were born in 1925, 1935, 1945, 1955 or 1965 and registered in District West of Gothenburg at the end of 1985, response rate of 78%</p> <p>A stratified sample based on alcohol problem screening interviewed in 1989-1990, 284 included in the analysis</p>	<p>Alcohol dependence or abuse based on DSM-III-R</p> <p>Alcohol intoxication <15 years of age</p>	<p>Derived from the local Social Insurance Office</p> <p>Those who were registered as disability pensioners on 07 Apr 1998 were classified as disability pensioners</p> <p>Half of the women were granted a disability retirement during the interview year or before</p>	<p>ORs, 95% CIs</p> <p>Other psychiatric diagnoses</p> <p>Age</p>	<p>Alcohol dependence or abuse Crude 4.4 (1.9-10.1)</p> <p>Adjusted for other psychiatric diagnoses 4.1 (1.7-9.7)</p> <p>Alcohol intoxication <15 years Crude NS Adjusted for age NS</p>
<p>Spak et al. 2008</p> <p>A questionnaire mailed to 3130 Swedish women who were born in 1925, 1935, 1945, 1955 or 1965 and registered in District West of Gothenburg at the end of 1985, response rate of 78%</p> <p>A stratified sample based on alcohol problem screening interviewed in 1989-1990, 399 included in the analysis</p>	<p>A psychiatric evaluation of alcohol dependence and abuse based on DSM-III-R on lifetime basis</p>	<p>Self-certified information on disability retirement (granted full-time or part-time disability retirement or on long-term sick leave=over 90 days)</p>	<p>Logistic regression, ORs, 95% CIs</p>	<p>Those with alcohol dependence or abuse 2.95 (1.25-6.95)</p>
<p>Nurmela et a. 2015</p> <p>Documentary information on 505 long-term unemployed (over 12 months) subjects with health problems impairing employability sent to the development project "Eligibility for a Pension" in 2001-2007 in Finland</p>	<p>Alcohol abuse -not identified -identified in employment services (examinee's own description/ employment counsellor's assessment/ medical statement)</p> <p>-identified in health care (diagnosis of alcohol use disorder in medical records)</p> <p>-identified in both places</p>	<p>Derived from employment pension insurance companies</p>	<p>Binary logistic regression analysis, odds ratios, 95% CIs</p> <p>Gender, age, marital status, occupation, learning difficulties at school, duration of unemployment, criminality, alcohol problems in childhood family</p>	<p>Not identified (ref.)</p> <p>Identified in health care only: 2.9 (1.5-5.6)</p> <p>Identified in employment services only: NS</p> <p>Identified in both places: NS</p>

