Alcohol consumption and impaired work performance. Interventions, and implementation barriers

Mikkel M. Thørrisen

OsloMet Avhandling 2020 nr 7

OSLO METROPOLITAN UNIVERSITY
STORBYUNIVERSITETET

Alcohol consumption and impaired work performance. Interventions, and implementation barriers

Mikkel M. Thørrisen

Thesis submitted for the degree of Philosophiae Doctor (PhD)
Faculty of Health Sciences
OsloMet – Oslo Metropolitan University

Spring 2020

CC-BY-SA versjon 4.0

OsloMet Avhandling 2020 nr 7

ISSN 2535-471X (trykket)
ISSN 2535-5414 (online)

ISBN 978-82-8364-233-9 (trykket)
ISBN 978-83-8364-258-2 (online)

OsloMet – storbyuniversitetet
Universitetsbiblioteket
Skriftserien
St. Olavs plass 4,
0130 Oslo,
Telefon (47) 64 84 90 00

Postadresse:
Postboks 4, St. Olavs plass
0130 Oslo

Trykket hos Byråservice

Trykket på Scandia 2000 white, 80 gram på materiesider/200 gram på coveret

Acknowledgements

Writing this thesis has been an exciting journey and would not have been possible without academic, moral and social support from several people to whom I would like to express my gratitude.

First and foremost, I would like to express my deepest gratitude to my main supervisor and mentor, Professor Randi Wågø Aas. You introduced me to the research project this thesis is based upon, you have supported me on every step on the way, and you have included me in an exciting field and research environment. I would also like to thank my co-supervisor, Professor Ingvild Kjeken. You have provided me with valuable input, discussions and support throughout the process.

I feel very privileged to have been part of the team at the Department of Occupational Therapy, Prosthetics and Orthotics at OsloMet – Oslo Metropolitan University. My wonderful colleagues have provided me with academic as well as moral support. Especially, I would like to express my gratitude to the department head, Mona Dahl. You have been an important support and you have given me the opportunity to become part of the department's excellent teaching staff. I would also like to thank Professor Tore Bonsaksen. You have not only contributed as a co-author, but have also been a great advisor who have given me the opportunity to challenge myself in different fields. I feel privileged to have had the opportunity to work with students at OsloMet. I believe the combination of research and teaching has fostered a great synergy that has benefited me in my work with the thesis.

Importantly, I would like to express my deepest gratitudes to Professors Jens C. Skogen, Hildegunn Sagvaag, Irene Jensen, Willem van Mechelen and researcher Lise Haveraaen for your invaluable contributions as co-authors.

I would like to thank the PhD programme in Health Sciences at OsloMet, and especially Professors Astrid Bergland and Ellen Karine Grov. Also, I would like to express my gratitude to the administrative staff at the university. Research and teaching are not possible without your important work. I am also very grateful to University of Stavanger – and especially to Sindre Mikal Dyrstad, department head for the Department of Public Health – for allowing

me to collaborate on and write my thesis within your research project. Moreover, I want to thank the research groups (Re)habilitation – Individuals, Services and Society, and Interventions in Work and Everyday Life at OsloMet, as well as Participation in School and Work at University of Stavanger.

My life as a PhD student has been enriched by support from and great discussions with fellow PhD students at OsloMet and University of Stavanger. In particular, I would like to express my gratitude to Lisebet Skeie Skarpaas, Neda Hashemi and Aleksandra Sevic. I look forward to continue working with you all. I would also like to thank my great colleagues at KoRus Vest Stavanger, Åsa Sjøgren and Silje L. Rimstad, for all our interesting discussions and your continuous moral support.

I would like to emphasise my deepest gratitude to all those employees and occupational health service professionals who participated in the studies. This thesis would have been impossible without your contributions, and I am thankful for your willingness to prioritise time to participate.

Last, but far from least, I would like to express my warmest gratitude to those people who are most important in my life – my wife, Talieh, and my children, Adrian and Parisa. You make every invested effort worthwhile. Talieh – this thesis would not be possible without your academic input, moral and social support.

Abstract

Background: Alcohol consumption is deeply integrated in social life, and the majority of employees consume alcohol regularly. Alcohol represents a major public health challenge related to both health and participation, on individual as well as on societal levels. Reducing harmful alcohol consumption constitutes a keystone in sustainable development. Although alcohol prevention programmes mostly have demonstrated favourable effects in research, such programmes have proved difficult to implement in practice.

Aims: This thesis aimed to generate a better understanding of employee alcohol consumption and intervention needs, impaired work performance associated with alcohol consumption, and current practices and barriers against implementing alcohol prevention programmes in occupational health services (OHS).

Materials and methods: The thesis utilised data from three sources within the national WIRUS project (Workplace Interventions preventing Risky alcohol Use and Sick leave). Risky drinking and employee intervention needs were explored in a cross-sectional study of 3571 employees in 14 Norwegian companies (Paper I). The relationship between alcohol consumption and impaired work performance (alcohol-related presenteeism) was examined by reviewing the existing research literature (Paper II), as well as empirically in a cross-sectional study of 3278 employees in 14 Norwegian companies (Paper III). Current alcohol prevention activity in OHS' and associations between implementation barriers and prevention activity were explored in a cross-sectional study of 295 OHS professionals in 69 Norwegian OHS units (Paper IV).

Results: First, supporting the notion of alcohol-related presenteeism, employee alcohol consumption seemed to be associated with impaired work performance (Papers II and III). Drinking intensity (binge drinking) was more strongly associated with performance decrements than drinking frequency (Paper III). Second, a considerable proportion of employees (1-3 out of 10) were identified as risky drinkers that would benefit from interventions (Paper I), yet the majority (7 out of 10) of OHS professionals worked with alcohol prevention less than on a monthly basis (Paper IV). Risky drinking was associated with male gender, younger age, low education, being unmarried and not having children

(Paper I). Competence, time and resources constituted the primary barriers against implementation of alcohol prevention programmes in OHS' (Paper IV). Third, the vast majority of risky drinkers (9 out of 10) would, according to international intervention guidelines, benefit from simple secondary prevention interventions (Paper I), yet OHS' alcohol prevention activity was more focused on tertiary than on secondary prevention (Paper IV).

Conclusions: The thesis suggests that alcohol consumption is associated with impaired work performance, and that there seems to be a mismatch between employee intervention needs and OHS' prevention activity. Although further research is warranted, the thesis carries the promising message that OHS' may constitute an abeyant asset for preventing alcohol problems in the workforce, insofar that OHS professionals are ensured adequate training, time and resources.

Key words: *Alcohol drinking; Employees; Health risk behaviours; Implementation; Occupational health services; Presenteeism; Prevention; Risky drinking; Sick leave; Work performance; Workplace interventions; Workforce*

Abstrakt

Bakgrunn: Alkoholbruk er integrert i mange kulturer og sosiale sammenhenger, og et flertall av arbeidstakere drikker alkohol regelmessig. Alkoholbruk er en viktig folkehelseutfordring som har konsekvenser for både helse og deltakelse, på individ- så vel som på samfunnsnivå. Å redusere forekomsten av skadelig alkoholbruk har blitt utpekt som et viktig bærekraftsmål. Forskning har vist at forebyggende tiltak kan redusere risikodrikking, men det har vist seg å være vanskelig å implementere slike tiltak i praksis.

Formål: Avhandlingens formål var å øke kunnskapen om alkoholbruk og intervensjonsbehov blant arbeidstakere, alkoholrelatert arbeidsevnereduksjon, og praksis og implementering av alkoholforebyggende tiltak i regi av bedriftshelsetjenesten (BHT).

Materiale og metoder: Avhandlingen bygger på data fra tre kilder i det nasjonale WIRUS prosjektet. Risikodrikking og intervensjonsbehov blant arbeidstakere ble undersøkt i en tverrsnittstudie blant 3571 ansatte i 14 norske virksomheter (Artikkel I). Forholdet mellom alkoholbruk og redusert arbeidsevne (alkoholrelatert sykenærvær) ble utforsket ved å oppsummere forskningslitteraturen på området (Artikkel II), og empirisk gjennom en tverrsnittstudie av 3278 ansatte i 14 norske virksomheter (Artikkel III). Praksis med alkoholforebygging i bedriftshelsetjenesten og forholdet mellom implementeringsbarrierer og intervensjonsaktivitet ble undersøkt i en tverrsnittstudie av 295 ansatte i 69 norske BHTer (Artikkel IV).

Resultater: For det første: Avhandlingen fant støtte for at arbeidstakeres alkoholbruk var forbundet med redusert arbeidsevne (Artikkel II og III). Drikkeintensitet var sterkere assosiert med kapasitetsreduksjoner enn drikkehyppighet (Artikkel III). For det andre: En betydelig andel arbeidstakere (1-3 av 10) kunne betegnes som risikodrikkere med behov for intervensjoner (Artikkel I), men majoriteten (7 av 10) av ansatte i BHT jobbet med alkoholforebygging sjeldnere enn på en månedlig basis (Artikkel IV). Risikodrikking var forbundet med å være mann, ung, ha lav utdanning, være ugift og ikke ha barn (Artikkel I). Mangel på kunnskap, tid og ressurser var de viktigste barrierene mot alkoholforebyggende arbeid i BHT (Artikkel IV). For det tredje: Majoriteten av risikodrikkere (9 av 10) kunne, i henhold til internasjonale intervensjonsretningslinjer, profitert på enkle

sekundærforebyggende tiltak (Artikkel I), men BHTs alkoholforebyggende arbeid var mer fokusert på tertiærforebygging enn på sekundærforebygging (Artikkel IV).

Konklusjoner: Avhandingen tyder på at alkoholbruk er forbundet med sykenærvær, og at det samtidig synes å være et misforhold mellom arbeidstakeres intervensjonsbehov og BHTs intervensjonsaktivitet. Ytterligere forskning er nødvendig, men avhandlingen antyder at bedriftshelsetjenesten har et uforløst potensiale hva gjelder alkoholforebyggende arbeid overfor arbeidstakere, forutsatt at BHT-ansatte sikres tilfredsstillende opplæring, tid og ressurser.

Nøkkelord: *Alkohol; Arbeidsevne; Arbeidsplasserte intervensjoner; Arbeidstakere; Bedriftshelsetjeneste; Forebyggende arbeid; Helserisikoadferd; Implementering; Risikodrikking; Sykefravær; Sykenærvær*

Contents

List of appendices

List of papers

I. Thørrisen, M. M., Skogen, J. C., & Aas, R. W. (2018). The associations between employees' risky drinking and sociodemographics, and implications for intervention needs. *BMC Public Health, 18*(1).
DOI: **https://dx.doi.org/10.1186/s12889-018-5660-x**

II. Thørrisen, M. M., Bonsaksen, T., Hashemi, N., Kjeken, I., van Mechelen, W., & Aas, R. W. (2019). Association between alcohol consumption and impaired work performance (presenteeism): A systematic review. *BMJ Open, 9*(7).
DOI: **https://dx.doi.org/10.1136/bmjopen-2019-029184**

III. Aas, R. W., Haveraaen, L., Sagvaag, H., & Thørrisen, M. M. (2017). The influence of alcohol consumption on sickness presenteeism and impaired daily activities. The WIRUS screening study. *PLoS ONE, 12*(10).
DOI: **https://dx.doi.org/10.1371/journal.pone.0186503**

IV. Thørrisen, M. M., Skogen, J. C., Kjeken, I., Jensen, I., & Aas, R. W. (2019). Current practices and perceived implementation barriers for working with alcohol prevention in occupational health services. The WIRUS OHS study. *Substance Abuse Treatment, Prevention, and Policy, 14*(1).
DOI: **https://dx.doi.org/10.1186/s13011-019-0217-2**

List of tables

List of figures

List of abbreviations

ANOVA	Analysis of variance
AUD	Alcohol use disorder
AUDIT	Alcohol Use Disorders Identification Test
BAC	Blood alcohol concentration
CDT	Carbohydrate-deficient transferrin
DALYs	Disability-adjusted life years
DNS	Drinking Norms Scale
HSE	Health, safety and environment
ICD	International classification of disorders
KMO	Kaiser-Meyer-Olkin measure of sampling adequacy
NSD	Norwegian Centre for Research Data
OHS	Occupational health service
OR	Odds ratio
PARIHS	Promoting Action of Research Implementation in Health Services
PF	Prevented fraction
PROSPERO	International prospective register of systematic reviews
RD	Risk difference
RDP	The Risk Drinking Project
REK	Regional Committee for Medical and Health Research in Norway
RR	Relative risk
SES	Socioeconomic status
VAS	Visual analogue scale
WHO	World Health Organization
WIRUS	Workplace Interventions preventing Risky alcohol Use and Sick leave
WPAI	Work Productivity and Activity Impairment questionnaire

1. Introduction

1.1 Rationale of the thesis

Alcohol is deeply integrated in many cultures and social situations, the majority of the population in the Western world consume alcohol regularly (1), and alcohol is the most commonly used psychoactive substance in the workforce (2). Alcohol represents a major public health challenge and high levels of alcohol consumption are associated with a variety of adverse outcomes, related to health and functioning (e.g., mortality and disability (3-5), infectious diseases (6-8), noncommunicable diseases (3, 5, 7, 9), mental health problems (10-14), and injuries/violence (15-22)), as well as work performance consequences (e.g., absenteeism (23-29)). Some studies have indicated that a considerable proportion of employees have a drinking pattern that can be characterised as problematic or risky (30-35), i.e., alcohol consumption that increases the risk of social, legal, medical, occupational, domestic and economic problems (36). This thesis focuses on alcohol consumption among employees, how their consumption may be related to work performance consequences (absenteeism and impaired work performance, i.e., presenteeism), and how it may be possible to remedy this major public health issue.

Figure 1.1 presents a conceptual model of the key elements in the thesis, i.e., the presumed relationships between employee alcohol consumption, health and impairment consequences, work performance consequences, intervention possibilities and implementation barriers.

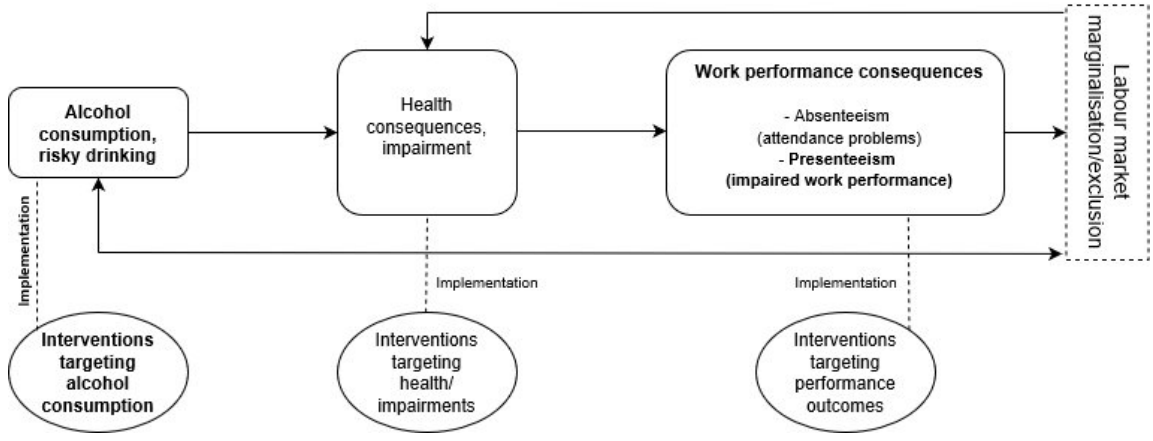


Figure 1.1. Conceptual model of the key elements in the thesis. Elements indicated in bold typeface are empirically studied in the papers

The conceptual model presumes that effects of alcohol consumption on work performance outcomes are partially mediated by health and impairment consequences. Hence, high consumption levels may, over time, lead to adverse health and impairment consequences that could translate into attendance problems (absenteeism) and impaired work performance (presenteeism) (indirect effect). Attendance and performance problems may, in turn, lead to labour market marginalisation or exclusion. Additionally, alcohol consumption, and risky drinking in particular, may generate marginalisation more directly, e.g., by risky drinkers being subjected to social sanctions as a result of their drinking. Moreover, one may argue that work performance consequences and marginalisation processes may affect both health (e.g., being excluded from work is associated with detrimental health outcomes) and risky drinking behaviour (e.g., increased alcohol consumption as a result of social exclusion).

The majority of risky drinkers are employed in the active workforce (37). There is, however, a need for updated knowledge based on employee samples beyond specific subgroups in the workforce utilising internationally validated alcohol screening instruments. Furthermore, research explicitly linking risky drinking estimates to international intervention guidelines is warranted in order to explore to what extent and what types of interventions may be serviceable. These issues are addressed in Paper I.

Work is important in order to meet individuals' basic psychosocial needs (38-41) and that work ability and performance predict participation in the workforce, implying that performance consequences such as absenteeism and presenteeism may carry detrimental effects on labour market inclusion and career opportunities (42-45). Despite its potential importance in understanding alcohol-related performance outcomes, alcohol-related presenteeism stands out as an underresearched topic. In particular, there is a lack of synthesised knowledge on the association between alcohol consumption and impaired work performance. This is addressed in Paper II. Moreover, research is warranted on whether different drinking patterns may have differential associations with work performance, and whether alcohol consumption is dissimilarly related to impaired performance at work and outside the workplace. These issues are addressed in Paper III.

Reducing harmful alcohol consumption has been identified as a keystone in sustainable development (1), and although evidence is somewhat mixed, alcohol prevention programmes have demonstrated favourable effects in research (37, 46-57). Still, implementation of such

interventions in practice has proved to be challenging (58-65). The workplace may be a serviceable arena for alcohol prevention activity targeting employees (37, 66, 67), and several authors have emphasised that the occupational health services (OHS) should obtain a more active role in alcohol prevention (68-70). However, research on OHS intervention activity and implementation barriers related to alcohol prevention programmes is limited. This is addressed in Paper IV.

In this thesis, several existing theoretical frameworks constitute the basis of the thesis' conceptual model, and are applied in order to generate a better understanding of employee alcohol consumption, alcohol-related presenteeism, and implementation of alcohol prevention programmes in occupational health services. Frone's model of employee substance use and productivity (2, 71) (Figure 1.2) underscores the role of drinking and impairment contexts in the occurrence of productivity outcomes related to disrupted work attendance (absenteeism) and impaired performance (presenteeism). Johansson and Lundberg's illness flexibility model (72, 73) (Figure 1.3) provides a more thorough understanding of how perceived work ability impairments, due to ill health or reduced functioning, interacts with motivation in determining participation outcomes, i.e., whether perceived work ability impairments lead to absenteeism or presenteeism. The classical public health distinction between primary, secondary and tertiary prevention (74-76) provides, along with WHOs Ottawa Charter (77), a framework for conceptualising and understanding the nature and characteristics of alcohol prevention activity. The i-PARIHS implementation model (78, 79) (Figure 1.5) is employed in order to better understand how alcohol prevention programmes targeting employees may be successfully implemented in OHS'.

Exploring both relationships between health-risk behaviour and outcomes in a population (Papers I, II and III), as well as the delivery of services (Paper IV), this thesis resides in the intercept between health research and health services research.

1.2 Alcohol use

1.2.1 Alcohol consumption

According to the WHO's most recent global status report on alcohol (1), 43 % of the world's adult population have consumed alcohol in the previous 12 months. However, considerable regional and national variations are reported, with the highest prevalence of drinkers in Europe (59.9 %). In Norway, drinkers constitute 79 % of the adult population, which is markedly higher than in the other Nordic countries (72.8 %) and the USA (71.7 %). The proportion of drinkers has decreased since year 2000, both globally (by 5 %) and in Europe (by 10.2 %).

Despite a somewhat reduced proportion of current drinkers, the WHO reports that the annually total per capita consumption of alcohol has increased worldwide, from 5.7 litres of pure alcohol in 2000 to 6.4 litres in 2016. Current drinkers are estimated to consume an average of 32.8 grams of pure alcohol per day. The highest per capita consumption among drinkers is found in Europe (17.2 litres of pure alcohol annually; 37.4 grams per day). WHOs estimates for drinkers in Norway (9.4 litres annually; 29.3 grams per day) are somewhat lower than for the other Nordic countries (13.5 litres annually; 20.4 grams per day) and the USA (13.7 litres annually; 29.6 grams per day). Binge drinking (heavy episodic drinking; 60 or more grams of pure alcohol on a single occasion on a monthly basis (1)) is particularly prevalent among young drinkers aged 15-19 (world: 45.7 %; USA: 46.7 %; Europe: 46.7 %; Nordic countries: 50.8 %; Norway: 51.1 %).

According to the WHO (1), regional and national variations also exist in the prevalence of alcohol use disorders (AUDs), i.e., diagnoses related to harmful alcohol consumption and alcohol dependence in accordance with the ICD-10 classification of mental and behavioural disorders (80). AUDs are more prevalent in the USA (13.9 %) as compared to Europe (8.8 %), the Nordic countries (8.0 %), Norway (7.2 %) and the world (5.1 %). Key figures for alcohol use in the world, the USA, Europe, the Nordic countries (Norway excluded) and Norway are presented in Table 1.1.

Table 1.1
Key figures for alcohol use (World, USA, Europe, Nordic and Norway)

	World	USA	Europe	Nordic[a]	Norway
Drinkers (%), past 12 months					
	43.0	71.7	59.9	72.8	79.0
Total alcohol per capita (litres of pure alcohol annually), drinkers only					
	15.1	13.7	17.2	13.5	9.4
Average daily intake per capita (grams of pure alcohol), drinkers only					
	32.8	29.6	37.4	29.2	20.4
Prevalence of binge drinking[b] (%), past 30 days					
Population aged 15+	18.2	26.1	26.4	28.5	32.0
Drinkers aged 15+	39.5	36.4	36.4	39.1	40.5
Population aged 15-19	13.6	28.0	28.0	31.4	35.2
Drinkers aged 15-19	45.7	46.7	46.7	50.8	51.1
Prevalence alcohol use disorders and dependence (%)					
Alcohol use disorders[c]	5.1	13.9	8.8	8.0	7.2
Alcohol dependence	2.6	7.7	3.7	3.9	4.0

[a]Mean estimates for Sweden, Denmark, Finland and Iceland; [b]Consumption of 60 grams or more of pure alcohol on at least one occasion in the past 30 days; [c]Including alcohol dependence and harmful alcohol use; Source: World Health Organization (1)

WHO's projections (1) suggest an increase in total alcohol per capita consumption among the adult population in the regions of America, the Western Pacific and South-east Asia. A stable consumption level is projected for the regions of Europe, Africa and the Eastern Mediterranean, resulting in a prediction of a global increase in consumption per capita from 6.4 to 7.0 litres of pure alcohol in 2025.

1.2.2 Consequences of alcohol consumption

In small doses (blood alcohol concentration (BAC) up to 0.1 %) alcohol acts as an agonist, causing euphoric experiences. At higher BAC levels (0.25 – 0.30 %) alcohol will assume more antagonistic effects, leading to confusion and sleepiness, while at even higher BAC levels alcohol may cause coma and even death (81). Prolonged periods of excessive drinking may lead to the development of alcohol dependence.

According to the WHO (1), harmful use of alcohol were involved in three million deaths worldwide in 2016 (5.3 % of global mortality), as well as in 132.6 million disability-adjusted life years (DALYs), representing a total of 5.1 % of global DALYs in 2016. Global mortality

attributable to alcohol was more pronounced than what could be ascribed to for instance digestive diseases (4.5 %), diabetes (2.8 %), road injuries (2.5 %), tuberculosis (2.3 %), HIV/AIDS (1.8 %), hypertension (1.6 %) and violence (0.8 %). The WHO (1) estimate that the highest regional proportions of alcohol-related mortality and DALYs are found in Europe (10.1 % of mortality; 10.8 % of DALYs). Research has documented a dose-response relationship indicating that risk of disease, disability and mortality increase with higher drinking volumes (4). A recent study from the Global Burden of Disease project, based on data from 694 individual/population-level sources and 592 prospective and retrospective studies, concluded that global consequences of alcohol consumption are more severe than previously assumed, and that harmful consequences tend to increase monotonically in accordance with increased consumption (3). For the population aged 15 to 49 years worldwide, alcohol is the leading risk factor for mortality and DALYs (3). A meta-analysis based on data from more than half a million current drinkers showed that adult males could increase their life expectancy with one to two years by reducing their alcohol consumption from 196 grams pure alcohol per week to 100 grams or less per week (5). Alcohol stands out as a unique risk factor involved in more than 200 ICD-10 (80) disease and injury conditions (7).

With regard to major noncommunicable diseases, increased alcohol consumption is found to be associated with a higher risk of strokes, coronary heart disease (excluding myocardial infarction), heart failure, fatal hypertensive disease and fatal aortic aneurysm (5). Moreover, alcohol increases the risk of liver diseases and a variety of cancers, including cancer in the oropharynx, larynx, oesophagus, liver, colon, rectum and the female breast (9). Alcohol has also been associated with the development of infectious diseases, such as HIV/AIDS (7), tuberculosis and lower respiratory infections (8). Increased risk of transmission, as a result of risky sexual behaviour, may explain the association between alcohol and infectious diseases (7), which may also explain the higher prevalence of common sexual transmitted diseases among individuals with AUDs compared with the general population (6).

On a psychological level, drinking has been associated with mental health problems, cognitive dysfunctions and comorbidity with other drugs. In a randomised controlled intervention study (14), it was found that risky drinkers, compared to non-risky drinkers, scored lower on psychological functioning and higher on depression at baseline, and follow-up measurements showed that risky drinking had a negative effect on stress perception. Similarly, a study of

primary care patients in 14 countries (10) revealed an association between excessive alcohol consumption and depression. It has been suggested that the risk of developing depression doubles in the presence of an AUD (11). In adolescents, research has found a relationship between drinking and alterations related to visual-spatial processing, memory, attention and verbal learning (13). Such neurocognitive alterations may lead to a diversity of behavioural, psychological and social problems when entering adulthood (12). Quite often, alcohol consumption occurs in the presence of other substances. There is a strong comorbidity between alcohol and tobacco dependence (82), and a national survey in hospital emergency departments in the USA (83) found that alcohol use was often coupled with the use of other drugs, such as cocaine (29 %), cannabis (25 %), benzodiazepines (20 %) and opioids (17 %). Some studies have suggested that the risk of disease, in presence of the use of several substances, cannot be estimated by simply adding the risks together. Rather, they may in combination have a multiplying influence on disease risk. For instance, a longitudinal study from Sweden (84) found that the relative risk for cancer from alcohol use was equal to 4.2, while the relative risk from tobacco was 6.3. However, in combination, the relative risk for cancer from alcohol/tobacco was estimated to 22.1.

Alcohol plays a central role in both intentional injuries (e.g., suicide attempts and interpersonal violence) and unintentional injuries (e.g., traffic accidents). Borges et al. (15) found that the risk for suicide attempts increased seven times after consuming alcohol, and this risk increased as much as 37 times after heavy drinking. Experimental studies have discovered a dose-response relationship between BAC and aggression (17), and a recent review study (22) concluded that evidence of an association between alcohol and violence may be characterised as unequivocal. For instance, meta-analyses have found that as many as 48 percent of both murder victims and perpetrators were alcohol intoxicated at the time of the homicide (19). Pharmacological effects of alcohol, such as reduced fear and anxiety (85), as well as impaired cognitive functioning (86) in combination with increased risk taking and emotional lability (87), may explain the association between alcohol and interpersonal violence. Unintentional alcohol-related injuries are commonly found in road traffic accidents, resulting from drivers and pedestrians being intoxicated. In a study of accidents with fatal injuries in six states in the USA between 1999 and 2010 (16), 39.7 % of drivers tested positive for alcohol. In an Australian study (20), it was found that 24.7 % of injured pedestrians were intoxicated. Similar results have also been revealed in Scotland (18) and South Africa (21).

Negative consequences of alcohol consumption are not restricted to the drinker. Others, in particular members of the drinker's household, may be severely affected (88). Partners and children may suffer from the drinker's behaviour, which may result in health harms such as injuries, mental health problems and transmission of diseases, as well as economic and social difficulties (89). For females, alcohol consumption during pregnancy may result in adverse pregnancy outcomes, such as growth retardation, stillbirth, premature birth and spontaneous abortion (1, 90). On a societal level, the global annual alcohol-related economic burden has been estimated to between 210 and 650 billion U.S. dollars (USD) (health: 40-105 billion USD; premature mortality: 55-210 billion USD; workplace absenteeism: 30-65 billion USD; unemployment 0-80 billion USD; criminal justice systems: 30-85 billion USD; criminal damage: 15-50 billion USD) (91).

Despite a large body of convincing evidence for negative consequences of alcohol consumption across time, study designs and populations, some epidemiological studies have revealed a J-shaped relationship between drinking and health where low to moderate alcohol consumption is associated with better health outcomes than non-drinking (81, 92). Hence, alcohol may have a more complex effect on health outcomes than other behaviours characterised by a quite linear relationship with health (e.g., smoking and physical activity) (81). In particular, some studies have implicated that low to moderate drinkers, compared to abstainers, may have a reduced risk of cardiovascular disease (93, 94). For instance, data from the Global Burden of Disease project revealed a significant J-shaped curve for ischaemic heart disease as well as non-significant J-shaped curves for diabetes and ischaemic stroke (3). Similar relationships have been discovered between alcohol and mental health outcomes. Low to moderate drinking, compared to abstention, has been associated with lower levels of both depression and anxiety (10).

J-shaped relationships between alcohol exposure and health outcomes may reflect either (a) true protective effects of low to moderate drinking (e.g., as a result of low/moderate amounts of alcohol reducing blood clotting activity (95)), or (b) products of confounding (e.g., as a result of poor internal validity). According to Skog (92), it is problematic that studies identifying J-curves seldom control for social factors. Social factors affect health and some of these factors display a J-shaped association with drinking. In the Western world, low/moderate drinking represents normality while both abstention and heavy drinking constitute statistically deviant behaviour, which may be associated with health factors (92)

(abstainers may abstain from alcohol as a result of greater health burden than low/moderate drinkers). In a recent Norwegian twin study (96), it was concluded that a J-curved relationship between alcohol consumption and sick leave were attributable to genetic confounding. By studying a large number of both monozygotic and dizygotic twin pairs, researchers found that low-level consumption was mainly explained by genetic confounding, possibly by genetically inherited diseases or by heritable personality traits known to affect health behaviour (96).

Nevertheless, the general picture painted by decades of evidence suggests that all-cause mortality and DALYs rises in concordance with increased alcohol consumption (3), and that possible health benefits of drinking will be outweighed by negative consequences (1). Hence, at present there seems to exist no convincing evidence for recommending abstainers to drink. As underscored by Grønbæk (81), drinking guidelines should not be perceived of as advice to drink.

1.2.3 The concept of risky drinking

Even though one may, as a general rule, assume that negative consequences of alcohol accumulate in concordance with increased consumption (1, 3, 5), both research and policy guidelines have made attempts to discriminate between risky drinking and non-risk drinking. Risky drinking has been defined by the WHO as a drinking pattern that increases the risk of social, legal, medical, occupational, domestic and economic problems (36). Within a preventive framework, an emphasis on risky drinking (e.g., as opposed to alcohol dependence) seems appealing. It is, however, far from straightforward to establish an appropriate threshold that distinguishes between risky and non-risk drinking, even when assuming a linear relationship between alcohol consumption and harm. First, whether a given drinking pattern is risky will inextricably be linked to individual characteristics, such as general health, physiological factors, other lifestyle factors and sociodemographic variables (97). Second, any level of alcohol consumption may be risky in certain circumstances, e.g., before driving or operating heavy machinery, when taking medications known to interact with alcohol, when suffering from medical conditions that may be aggravated by alcohol, and when being pregnant (98). Third, drinking guidelines vary considerably between countries on how to conceptualise the distinction between risk and non/low risk. Such guidelines are often expressed in terms of a specific number of drinks during a predefined time frame. However,

standard drink sizes are not necessarily comparable across countries. A standard drink in the USA (approximately 14 grams of pure alcohol) is almost twice as large as a standard drink in the United Kingdom (8 grams) (98). Moreover, drinking guidelines differ between countries even when the amount of alcohol is expressed in a common measure. Weekly upper limits for low-risk drinking for males vary from 100 grams in Poland to 252 grams in Denmark (females: from 50 grams in Poland to 168 grams in Denmark) (98). Perhaps not surprisingly, drinkers often lack knowledge on how a standard drink is defined in their country (99).

In research, some definitions of risky drinking are based solely on amount of consumed alcohol within a specified time frame, while other definitions are based on composite instruments assuming a more complex relationship between alcohol and health (100), such as the WHO's Alcohol Use Disorders Identification Test (AUDIT) (36, 101). The AUDIT consists of ten questions relating to alcohol consumption (drinking frequency and intensity), alcohol dependence and problems related to alcohol consumption. Each item is scored between 0 and 4, resulting in a sum score with the potential range of 0 to 40, where 8 scores or higher are generally applied as a threshold for risky drinking (36, 101, 102). The AUDIT is cross-nationally standardised, consistent with ICD-10 (80) definitions of alcohol abuse and dependence (36), validated across languages, cultures, and populations, and has demonstrated reliability, sensitivity and specificity superior to other screening instruments (102). In this thesis, risky drinking is operationalised as an AUDIT sum score of 8 or higher.

1.2.4 Employee alcohol consumption and risky drinking

One may distinguish between workforce overall alcohol consumption and work-related alcohol consumption. The former refers to employees' level of alcohol consumption, regardless of context, including consumption outside the workplace and normal work hours (leisure time, holidays etc.) (2). The latter refers to consumption shortly prior to work or during the workday (2, 103, 104), as well as in contexts directly related to the work environment or the employment relationship (105).

Workforce overall alcohol consumption is prevalent. Based on findings from four national surveys in the USA, Frone (2) reports that three quarters of employees consume alcohol regularly, and that one quarter of employees engage in heavy drinking. Only 24.9 % of

employees abstained from alcohol during the past 12-month period. Moreover, 22.7 % of employees had experienced one or more hangover episodes during the past 12 months, and 9.3 % of employees met the criteria of alcohol abuse and/or dependence. Estimates for the Norwegian workforce, reported by Moan and Halkjelsvik (106), may be considered even higher. Only 9 % of employees abstained from alcohol during the past 12 months, while 38.5 % reported consuming alcohol at least on a weekly basis. Estimates of workforce overall alcohol consumption among employees in the USA and Norway are presented in Table 1.2.

Table 1.2
Alcohol consumption frequency among employees, past 12 months

Drinking frequency	Employees in the USA[a] (%)	Employees in Norway[b] (%)
Never	24.9	9.0
Less than monthly	18.3	20.5
Monthly	19.5	32.0
Weekly or more	37.2	38.5

[a]Combined estimates from four national surveys in the USA (n = 77670), reported by Frone (2, p. 27);
[b]Combined estimates from two national surveys in Norway (n = 3339), reported by Moan and Halkjelsvik (106, p. 18)

Work-related alcohol consumption is somewhat less prevalent, at least with regard to alcohol use shortly prior to or during working hours. Frone (2) reported that 8 % of employees in the USA consumed alcohol during working hours and, according to Moan and Halkjelsvik (107), 13 % of employees in Norway had consumed alcohol during work hours during the past 12 months. Considerable consumption seems to be associated with contexts related to the work environment or the employment relationship. Even though the workplace may be considered an alcohol-free zone (108), a Norwegian study among private sector employees found that 43 % of current drinkers' total consumption was associated with work-related situations (34), while results from two national surveys in Norway (106) revealed that 64.4 % of employees had consumed alcohol in work-related settings during the past 12 months. Studies have found that job travels, networking situations, teambuilding activities and meetings with external business partners constitute the most common arenas for work-related drinking (105, 108). Consuming alcohol in work-related settings is not only conceived as acceptable, but in many instances also somewhat expected (108). In a study of six large companies in Norway, Nordaune et al. (105) found that the employers themselves initiated and organised the majority of situations in which work-related alcohol consumption occurred.

Studies have suggested that employees' drinking may be influenced by workplace culture (68, 109-111). Superordinately, one may distinguish between encouraging and discouraging workplace drinking cultures. This distinction is characterised by the absence or presence of drinking regulations, policies and norms (68, 109, 112, 113). In a study of more than 5000 workers from 16 worksites in the USA, Barrientos-Gutierrez et al. (109) found that belonging to a discouraging workplace drinking culture predicted lower alcohol consumption than belonging to an encouraging culture. More specifically, employees in the most discouraging cultures were substantially less likely than others to drink at work, to be frequent drinkers, and to be heavy drinkers. Interestingly, the identified associations between workplace drinking cultures and employee alcohol consumption were valid for both workforce overall consumption and work-related drinking.

In Norway, the AUDIT has been utilised to explore risky drinking in the general population (17 % risky drinkers (114)), and among students in higher education (46.1 % risky drinkers (115)). Risky drinking among employees have been explored in some studies, e.g., among Australian industrial workers (8.8 % (35)), managers in the USA (7 % (30)), Norwegian restaurant workers (6 % (32)), Norwegian private sector employees (11 % (34)), Canadian employees (8.1 % (33)), and Japanese computer factory workers (males 13 %, females 4 % (31)). Identified proportions of risky drinkers may, however, not be comparable across these studies as a result of application of different measures of alcohol consumption and different thresholds for risky drinking. Despite such heterogeneity, these studies do suggest that risky drinking is a quite prevalent phenomenon among employees and deserves greater attention. Studies have generally suggested that risky drinking is more prevalent among males and younger individuals (33, 114, 116, 117), and that individuals with lower education are less prone to risky drinking than those with higher education (114, 117). Moreover, some studies have found that unmarried individuals and those living alone have an increased probability of risky drinking (33, 116, 118).

Although a considerable body of evidence exists on alcohol consumption and risky drinking, current research on workforce risky drinking suffers from some fundamental shortcomings. First, there is a lack of recent studies. Temporally relevant knowledge is particularly important when exploring a complex phenomenon that is susceptible to changes over time, such as drinking behaviour (119, 120). Second, current research is, to a considerable extent, characterised by not utilising internationally validated alcohol screening instruments (30, 33,

34), by not studying samples beyond specific subgroups in the workforce (e.g., workers vs. managers, specific sectors/industries) (30-35), and by not explicitly studying intervention needs in accordance with international intervention guidelines (30-32, 34, 35).

1.3 Alcohol-related impaired work performance

Work performance consequences comprise a variety of phenomena, including attendance disruptions (e.g., absenteeism, tardiness and leaving work early) and performance decrements (e.g., impaired work performance and job injuries/accidents) (2). Work ability and performance can be conceived as central concepts in predicting labour market participation. Studies have demonstrated that absenteeism (absence of productivity) and presenteeism (reduced productivity) due to health problems may have adverse effects on career opportunities (42-45). Work has been emphasised as the best form of welfare, a means for fulfilling a variety of human needs (40), including access to adequate economic and psychosocial resources, such as income, individual identity, social roles and status (38, 39). Conversely, worklessness has been associated with decrements in both physical and mental health (41).

Psychopharmacological and experimental workplace simulation studies suggest that alcohol intoxication has a detrimental effect on cognitive and psychomotor performance, and thereby may impair work performance, particularly at high BAC levels (≥0.09 %) (121-124). For both males (age: 40, body weight: 80 kg) and females (age: 40, body weight: 60 kg), three standard UK drinks would produce a BAC surpassing ≥0.09 % (in a six-hour time window: male = nine drinks; female = six drinks) (125). Some studies have suggested that long-term use of alcohol may result in more permanent brain impairments (126, 127), although such research has been criticised for being tainted by methodological problems (2). Studies investigating effects of hangover episodes (an adverse mental and physical state experienced after heavy drinking when the BAC level returns to zero; (2, p. 86) have demonstrated mixed results, even though hangover episodes include symptoms believed to be related to performance decrements, such as headaches, nausea, drowsiness and sensitivity to light/sound (122, 128, 129).

Frone (2, 71) developed an integrative conceptual model of employee substance use and productivity, emphasising a correspondence between the context of consumption, the context of impairment, and type of performance outcome (Figure 1.2).

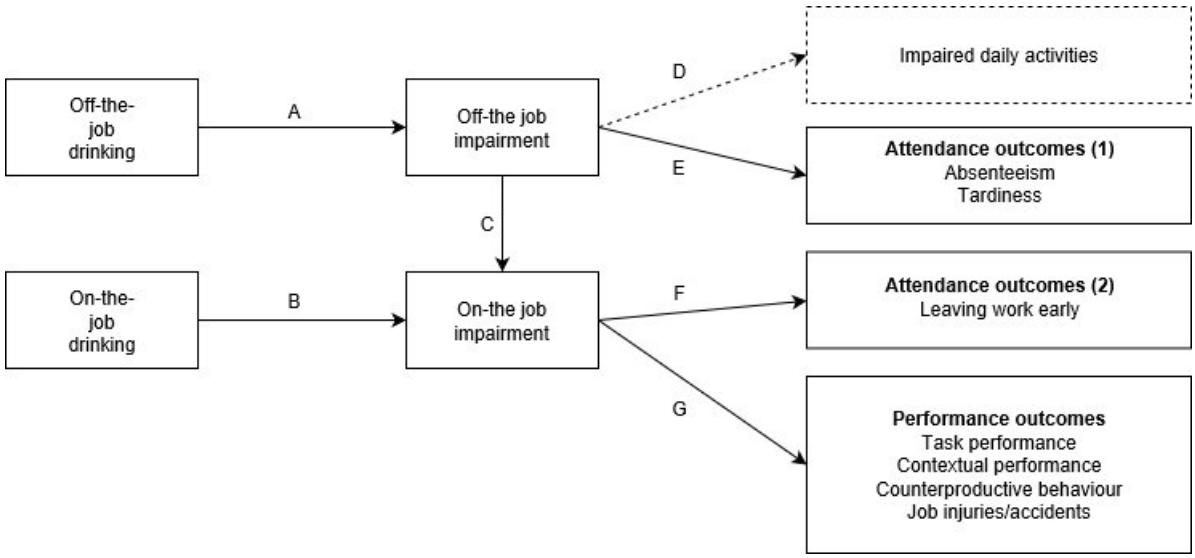


Figure 1.2. Model of employee substance use and productivity[1]

According to the conceptual model, performance outcomes such as not arriving at work (absenteeism) and arriving late at work (tardiness) are primarily affected by off-the-job drinking and off-the-job impairment (pathway AE). Leaving work early and on-the-job performance decrements are mainly due to on-the-job drinking and impairment (pathways BF and BG). The model does, however, allow the possibility of cross-over effects between contexts. For instance, off-the-job drinking "may indirectly affect performance outcomes to the extent that it causes off-the-job substance impairment, which when carried into the workplace becomes workplace impairment" (2, p. 134) (pathway ACG).

Employees' alcohol consumption may, as well, be associated with performance outcomes outside the workplace, i.e., impaired daily activities, which is not explicitly included in Frone's original model of employee substance use and productivity. Research has demonstrated that difficulties in carrying out daily routines (130) and mobility problems (131), as well as difficulties in economic self-sufficiency, restriction of participation in meaningful activities and impaired social relationships (132) are all associated with alcohol

[1] From "Alcohol, drugs, and workplace safety outcomes: A view from a general model of employee substance use and productivity," by M. R. Frone, 2004, in J. Barling and M. R. Frone (Eds.), *The psychology of workplace safety* (p. 135), Washington, DC: American Psychological Association. Copyright 2003 by American Psychological Association. Reused and adapted with permission.

consumption. In an extension of Frone's original model (2, 71) (Figure 1.2), one may assume that employee productivity impairments outside the workplace mainly are produced by off-the-job drinking (pathway AD).

Relationships between drinking contexts, impairment contexts and productivity outcomes are affected by a variety of moderating individual and environmental variables (2). Different drinking patterns, for example, may affect performance outcomes dissimilarly. It is reasonable to assume that a high drinking intensity (binge/heavy drinking episodes) may produce short-term impairment (hangover symptoms) more directly associated with workplace productivity outcomes, compared to a high drinking frequency, which is more likely to generate long-term ill-health consequences (133, 134). For instance, studies have proposed that the occurrence of occupational injuries are quite consistently associated with binge drinking episodes rather than chronic alcohol use (135, 136).

1.3.1 Absenteeism

Research on the association between alcohol consumption and sickness absence has demonstrated quite consistent results. Alcohol-related sickness absence is particularly prevalent among males and employees with low socioeconomic status (24, 29), for current drinkers there seems to be a dose-response relationship between alcohol intake and absence (24-26), while some studies suggest a J-curved relationship where sickness absence is more prevalent among abstainers than among light-moderate drinkers (137, 138). Time series studies from Sweden and Norway (27, 139), based on register data on alcohol sales and sickness absences, have suggested that an annual increase of one liter pure alcohol per inhabitant is associated with a 13 % increase in sickness absence among males. In absolute numbers, estimates from Sweden (23) suggest that an increased annual total per capita consumption of pure alcohol by 0.35 liters is associated with an additional 1.6 million annual sick leave days in the Swedish population.

In a recent systematic review, Schou and Moan (28) identified 27 papers (reporting results from 28 studies) that tested a total of 48 associations between alcohol consumption and sickness absence. The vast majority (83.3 %) of these associations reached statistical significance, and results indicated that the association between alcohol consumption and

absenteeism did not systematically vary across gender, socioeconomic status or type of measurement (28).

The global cost of alcohol-related sickness absence has been estimated to 30-65 billion USD annually, constituting 10-14 % of the total global costs related to alcohol (91). In Norway, costs associated with alcohol-related absenteeism has been conservatively estimated to 511 million NOK (62.3 million USD) per year (140).

1.3.2 Presenteeism

In addition to not attending work (absenteeism), employee alcohol consumption may be associated with impaired performance while at work (Figure 1.2, pathways BG and ACG), often termed presenteeism. In general, it has been argued that presenteeism may carry more substantial costs than absenteeism. Hemp (141, p. 2) stated that "the illnesses people take with them to work (…) usually account for a greater loss in productivity because they are so prevalent, so often go untreated, and typically occur during peak working years. Those indirect costs have long been largely invisible to employers". This important topic has been explored in different traditions and defined in a variety of ways, resulting in what Johns (142, p. 521) refers to as a "definitional creep".

Chapman (143) stated that the concept presenteeism is believed to have emerged in the early 1990s as a response to employees spending increasing amounts of time at work as a result of job insecurity. In more recent research, two distinct health-related approaches to presenteeism have been identified (142, 144). The first perspective, traditionally dominated by European researchers (145, 146), emphasises the study of determinants of presenteeism, combined with exploration of presenteeism as a personal choice (chosen behaviour). In this perspective, presenteeism is typically defined as the act of "showing up for work even when one is ill" (142, p. 519), or "the phenomenon of people who, despite complaints and ill health that should prompt rest and absence from work, are still turning up at their jobs" (145, p. 503). As such, presenteeism is conceptualised as a possible alternative to absenteeism, as well as a quite neutral construct that may entail both positive and negative consequences related to health and performance. Regarding health, presenteeism may then be conceived of as a health-promoting measure within a return to work framework (147), or oppositely as a behaviour resulting in health decrements as a result of the strains of attending work while ill

(148). Regarding performance, presenteeism may entail positive productivity outcomes if conceived as an alternative to absenteeism. However, negative productivity outcomes may be stated if presenteeism is conceptualised as an alternative to optimal work performance, i.e., as work impairments.

The second perspective on presenteeism, traditionally adopted by North American researchers (149, 150), emphasises specific productivity consequences of the behaviour of attending work while ill. Hence, presenteeism is defined as "decreased on-the-job performance due to the presence of health problems" (151, p. 548), "the health-related productivity loss while at paid work" (152, p. 35), or "the measurable extent to which health symptoms, conditions and diseases adversely affect the work productivity of individuals who choose to remain at work" (143p. 2). Even though this approach would maintain that adverse performance outcomes are inherent in the conceptualisation of presenteeism, it has in common with the perspective dominated by European researchers that attending work despite health decrements may be perceived as a chosen behaviour. In this case, a chosen behaviour that does indeed result in impaired work performance.

Conceptualising presenteeism as a chosen behaviour raises the issue of the relationship between absenteeism and presenteeism. Absenteeism and presenteeism have been found to correlate moderately, and presenteeism has been identified as a predictor of future absenteeism (148). However, the relationship between absenteeism and presenteeism is likely quite complex, and affected by both individual and contextual factors. The illness flexibility model (Figure 1.3), developed by Johansson and Lundberg (72, 73), aims to describe and predict whether people attend work while ill, and thus highlight the relationship between being absent or present in the presence of impairments or health problems.

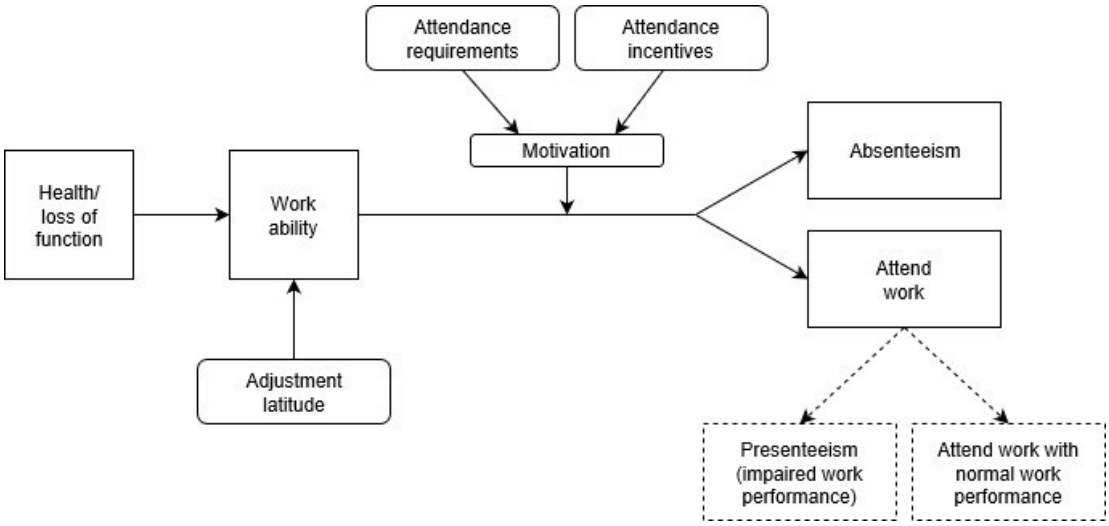


Figure 1.3. The illness flexibility model[2]

In the illness flexibility model, perceived work ability is affected by the health condition and loss of function, as well as adjustment latitude, i.e., "the opportunities people have to reduce or in other ways change their work-effort when ill" (72, p. 1857), e.g., by working at a lower pace. Attendance requirements (negative consequences of being absent from work) and attendance incentives (perceptions of rewards associated with attending work, e.g., social belonging, self-esteem and self-actualisation) are proposed to influence personal motivation that acts as a moderator between self-perceived work ability and the decision of attending work or not (being absent or present) (72, 73, 153).

The model predicts (i) that low adjustment latitude is associated with higher absenteeism and lower presenteeism, and (ii) that high attendance requirements are associated with lower absenteeism and higher presenteeism (72, 153). The model is supported by some empirical evidence. In a Swedish study, low adjustment latitude has been found to be associated with higher absenteeism among women, and high attendance requirements has been found to be related to higher presenteeism in both genders (72). Furthermore, Aronsson, Gustavsson and Dallner (145) found an increased risk of presenteeism among occupational groups characterised by being teachers, care and welfare providers, i.e., employees with presumable high attendance requirements as a result of working directly with clients/students.

[2] From "Adjustment latitude and attendance requirements as determinants of sickness absence or attendance. Empirical tests of the illness flexibility model," by G. Johansson and I. Lundberg, 2004, *Social Science & Medicine, 58*(10), p. 1858. Copyright 2004 by Elsevier. Reused and adapted with permission.

It is entirely plausible to assume that a variety of diseases and health conditions do not result in work impairments. For instance, a Finnish study of 723 illness-related visits to occupational physicians – for a wide range of diseases, including musculoskeletal, respiratory, mental and cardiovascular diseases – found that 63 % of patients reported no work impairments despite their illnesses (154). Hence, it is quite conceivable that it is possible to attend work while sick, yet without the health condition resulting in productivity impairments. In an organisational perspective, however, one may argue that attending work while sick becomes of interest primarily when performance decrements are involved. In this thesis, presenteeism is conceptualised as reduced on-the-job performance due to health problems (in line with the definition by Schultz and Edington (151)), thus constituting a link between on-the-job productivity and employee health, addressing the grey area between optimal work performance and the absence of productivity (i.e., absenteeism) (142).

1.3.2.1 Alcohol-related presenteeism

In this thesis, alcohol-related presenteeism is conceptualised as impaired work performance associated with alcohol consumption, in line with how presenteeism has been defined as "decreased on-the-job performance due to the presence of health problems" (151, p. 548). Alcohol-related presenteeism is then operationalised as the product of a relationship between two variables (exposure: alcohol consumption; outcome: (impaired) work performance) rather than a single variable (attending work while sick), rendering it possible to retain the notion of work performance as inherent in the phenomenon of presenteeism without conflating cause and effect.

A systematic review (144) found that known predictors of presenteeism include health conditions (musculoskeletal problems, depression and anxiety), individual characteristics (gender, age, job satisfaction, stress and family status), and factors related to the work environment (employment security, work schedules, workload, managerial support, corporate culture and leadership style). Knowledge of associations between health risks, such as alcohol consumption, and impaired work performance is more limited, even though one may assume that alcohol consumption has the potential of influencing activity performance in a variety of domains, including the occupational sphere. For instance, a study of 832 American manufacturing plant employees (103) found that drinking and hangovers at work were significantly related to experiencing episodes of sleeping on the job, and that hangovers at

work were also associated with having problems with tasks as well as with co-workers. Furthermore, a study of more than 17000 computer manufacturer employees in the USA (155) revealed that at-risk alcohol consumption was associated with impaired overall work performance. A mixed-methods study from Norway (156) utilised both quantitative data from 1940 employees as well as qualitative interview data from 24 managers, heavy-drinking employees and co-workers of heavy-drinking employees. Survey data showed that 11 % of employees had experienced alcohol-related presenteeism during the past year, with an average productivity loss of 20 %, and that alcohol-related presenteeism was more prevalent than alcohol-related absenteeism. Interview data indicated that alcohol-related presenteeism was perceived to be a major concern relating to both performance decrements and safety issues. Recent estimates suggest that alcohol-related presenteeism in Norway is associated with annual costs approximating 545 million NOK (66.5 million USD) (140).

Current research has established that employees' alcohol consumption may play a role in work performance outcomes, particularly by demonstrating a quite consistent association between alcohol use and absenteeism. Presenteeism stands out as a phenomenon that may be important in understanding alcohol-related work performance outcomes, yet research on this topic is quite sparse. Even though some studies have explored the relationship between alcohol consumption and work performance, there is a general lack of recent and synthesised evidence. One systematic review (157) did find a weak negative association between alcohol consumption and work performance (population correlation corrected for unreliability = -.06) when studying relationships between psychological, physical and behavioural health and work performance, implying that higher consumption levels were associated with impaired performance. However, this review was based solely on 12 studies identified in two scientific databases in 2011, and did not focus explicitly on alcohol-related presenteeism. Moreover, current research is limited when it comes to shed light on whether different drinking patterns may have differential associations with impaired work performance, and on whether employees' alcohol consumption may have differential associations with performance decrements at work (presenteeism) and outside the workplace (impaired daily activities).

1.4 Implementation perspectives

Reducing harmful use of alcohol has been identified as a keystone in sustainable development by the WHO (1). Several studies have demonstrated support for the aphorism “an ounce of prevention is worth a pound of cure”, yet treatment continues to be on the receiving end of public spending to a much greater extent than prevention (158). One may argue that risky drinking constitutes a greater societal challenge than alcohol misuse and dependence. For instance, the prevalence of risky drinking in Norway has been estimated to 17 % of the population (114), while the proportion of the Norwegian population diagnosed with AUDs and alcohol dependence are 7 % and 4 %, respectively (1). Early identification and intervention may be beneficial in preventing the development of alcohol-related problems. As stated in an editorial article in Addiction: “What will it take (…) to offer evidence-based treatments for problem drinkers, the underserved majority. Until this happens, providers and the field will continue to force problem drinkers to keep their pursuit of low-risk drinking a private struggle” (159, p. 1717).

1.4.1 Prevention and health promotion

The WHOs Ottawa charter (77), an influential framework for worldwide health promotion, defined the following five action areas: (i) building healthy public policy, (ii) creating supportive environments, (iii) developing personal skills, (iv) strengthening community action, and (v) reorienting health services in the direction of health promotion. The charter adopted a socioecological approach to health by emphasising the inextricable interactions between individuals and their environments, and health promotion was not conceptualised solely as a health sector responsibility. Rather, it was underscored that successful health promotional action hinges on a broad and collaborative effort, including governments, industries, local authorities and non-governmental organisations.

In classical public health literature, authors have emphasised a triad of prevention approaches (primary, secondary and tertiary prevention) rather than health promotion per se (74, 75). Prevention and promotion are often considered as distinct, yet overlapping, concepts. Whereas prevention is oriented towards avoiding disease by identifying and removing risk factors, promotion focuses on improving health by identifying and strengthening protective factors that increase everyday coping and functioning (160). The end-state (i.e., the ultimate

goal of the effort; avoiding or achieving a specified outcome) distinguishes the two constructs. In a content analysis of different definitions of prevention, Coohey and Marsh (76, p. 528) stated that "the term prevention is always used when an undesirable end-state is specified, and the term promotion is always used when a desirable end-state is specified". Public health literature has traditionally distinguished between primary, secondary and tertiary prevention. Discriminations between these three levels of prevention may be done on the basis of timing (primary: before the occurrence of an undesirable or desirable end-state, or during a desirable state, i.e., to maintain the desirable state; secondary: during the early phases of or shortly prior to the occurrence of an undesirable end-state; tertiary: after the occurrence of an undesirable state), and targets (primary: environments and asymptomatic individuals; secondary: individuals at risk for an undesirable end-state; tertiary: individuals who have already experienced an undesirable end-state) (76).

A fundamental distinction between promotion and prevention may be conceived as differences in framing (i.e., of specifications of desirable versus undesirable end-states), and therefore as somewhat futile. For instance, an alcohol-oriented programme may be framed in terms of maintaining a low-risk drinking level (promotion) or avoiding a risky drinking level (prevention), yet consisting of the same content. As stated by Coohey and Marsh (76, p. 534), "regardless of specification, undesirable versus desirable, the study of one end-state is necessarily the study of both protective and risk factors. Consequently, no distinction can be made between 'prevention research' and 'health promotion research'".

In this thesis, primary prevention (including health promotion) is conceptualised as efforts prior to the occurrence of an undesirable end-state (alcohol-related problems) or during a desirable state (maintaining low-risk drinking), targeting environments and/or asymptomatic individuals. Secondary prevention is considered to comprise efforts during the early phases of an undesirable end-state (alcohol-related problems), targeting individuals at risk for experiencing that state (risky drinkers). Finally, tertiary prevention is perceived as efforts after the occurrence of an undesirable end-state (alcohol problems, misuse and/or dependence), targeting individuals already experiencing this state (alcohol misusers/dependents).

1.4.2 Alcohol prevention

An intervention may be defined as "any action taken by health care workers (including the people working in social care and public health situations) with the aim of improving the well-being of people with health and/or social care needs" (161, p. 2). With this definition, the term intervention comprises a broad spectrum of activities directed at health promotion and disease prevention at primary, secondary and tertiary levels.

Based on overall scores on the AUDIT alcohol screening instrument (36, 101), the WHO recommends different intervention approaches corresponding to different risk levels (36, 162). Individuals with overall scores between 0 and 7 (low-risk, primary prevention) should receive general alcohol education with the aim of maintaining a low-risk drinking level. Secondary prevention approaches are recommended for those characterised by moderate risk (scores 8-15; simple advice on how to reduce risky drinking) and high risk (scores 16-19; brief counselling and consecutive monitoring). Tertiary prevention is recommended primarily for those with likely alcohol dependence (scores 20-40; referral to further diagnostic evaluation). A conceptual model for the relationships between alcohol consumption, drinking categories, prevention levels, risk levels and intervention recommendations is presented in Figure 1.4.

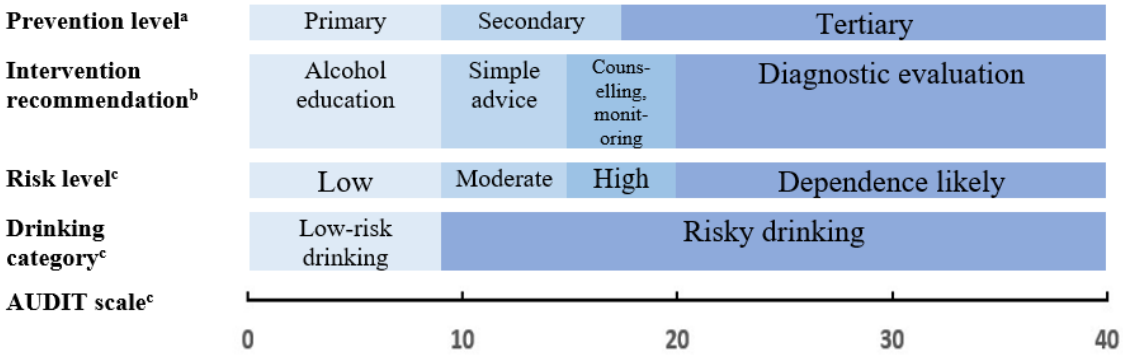


Figure 1.4. Conceptual model for the relationships between alcohol consumption, drinking categories, risk levels, intervention recommendations and prevention levels. [a]Based on Coohey and Marsh (76); [b]Based on Babor et al. (36, 162); [c]Based on Babor et al. (36)

A large body of evidence has demonstrated favourable effects of secondary prevention programmes on reduced alcohol consumption in a variety of populations, with regard to face-to-face consultations with a health care professional (49, 51, 52) as well as web-based formats where the individual receives the intervention on a digital platform (56, 57). Similar results

have been identified in employee samples (37, 46-48, 50, 53-55). Research on primary prevention programmes, such as alcohol education, has generally demonstrated more inconsistent results. Still, such interventions have been found to improve motivation for reducing alcohol consumption (163), somewhat reduce heavy drinking (164, 165), and improve knowledge of alcohol-related risks (166).

1.4.3 Implementation barriers

The majority of adults are employed and spend considerable time at work (66), the majority of employees consume alcohol regularly (2, 106), and the majority of risky drinkers are part of the active workforce (37). Hence, the workplace setting may constitute a serviceable arena for alcohol prevention activities, and has by the WHO (67) been established as a priority setting for health promotion and prevention.

Alcohol prevention programmes, both in primary care and workplace settings, have demonstrated favourable effects in research (37, 46-57, 163-166). Implementing such efforts in practice, however, has proved to be challenging (58-65). Several authors have argued that implementation of alcohol prevention programmes, rather than research on their effectiveness, constitutes the main challenge for future research (167-171). Simply providing health care professionals with research-based evidence or guidelines is not sufficient. Rather, dissemination of effective efforts seems to hinge on the development and application of tailored implementation strategies (63). As stated by Durlak and DuPre (172, p. 327), "developing effective interventions is only the first step towards improving the health and well-being of populations. Transferring effective programs into real world settings and maintaining them is a complicated long-term process".

1.4.3.1 The (i-)PARIHS implementation framework

PARIHS (Promoting Action on Research Implementation in Health Services) was first published in 1998 as a framework for guiding implementation of evidence-based practice in health care (173). Within the original framework, successful implementation (SI) was represented as a function (f) of the nature and type of evidence (E), the qualities of the context in which evidence is introduced (C), and the way the implementation process is facilitated (F),

i.e., SI = f (E, C, F) (173, 174). PARIHS has, since its original publication, been widely utilised and also criticised, which led to a revision of the conceptual framework, resulting in an integrated model known as i-PARIHS (78, 79). In particular, the original model was criticised for failing to address certain key dimensions, such as implementation target groups and wider external (macro) implementation contexts (175-177), and for not taking into account individuals' role in the implementation processes (178).

In the i-PARIHS framework, depicted in Figure 1.5, successful implementation is defined as "achievement of agreed implementation/project goals", or as "the uptake and embedding of the innovation in practice" (79, p. 4).

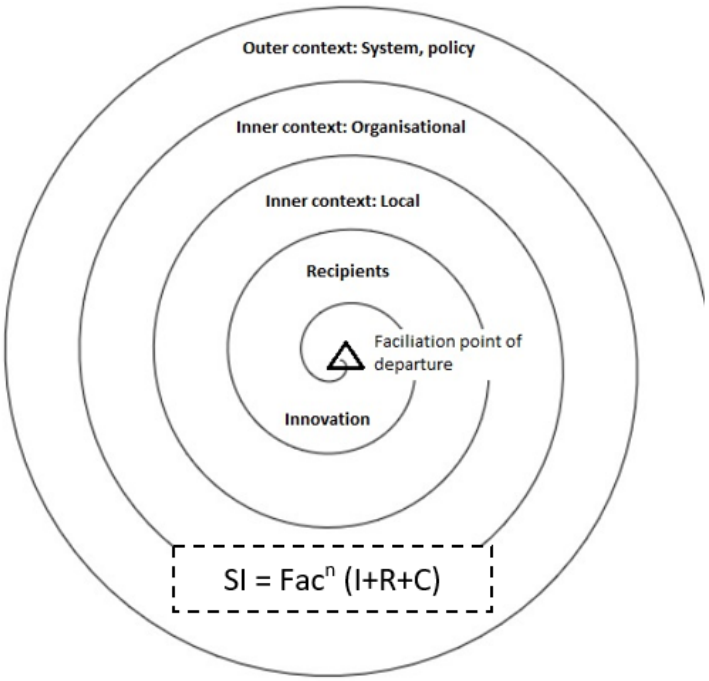


Figure 1.5. The i-PARIHS implementation framework[3]

The model contains four core constructs (78, 79): (i) innovation (a revised conceptualisation of evidence, including "raw" research evidence as well as evidence that has been adapted by means of knowledge translation processes), (ii) recipients (individuals involved in the implementation process), (iii) context (includes both inner, local (organisational level) context, and outer (system level) implementation context), and (iv) facilitation (the active

[3] From "PARIHS revisited: From heuristic to integrated framework for the successful implementation of knowledge into practice," by G. Harvey and A. Kitson, 2016, *Implementation Science*, *8*(1), p. 8. Reused and adapted under the terms of the Creative Commons Attribution 4.0 International Licence (http://creativecommons.org/licences/by/4.0/).

implementation component, includes both the facilitator role and facilitation process). In order to achieve successful implementation, active facilitation involves assessing the nature and quality of the knowledge/evidence (innovation), then exploring key aspects and potential barriers related to the implementation recipients (e.g., health care professionals), and the organisation (inner context; e.g., health care unit) and system (outer context; e.g., system policies) in which the recipients are embedded. Therefore, the implementation process may be described in terms of the formula SI = Fac^n (I+R+C), where SI = successful implementation, Fac^n = facilitation, I = innovation, R = recipients, and C = context. Facilitation and, ultimately successful implementation, may hinge on knowledge about potential implementation barriers located at different levels (e.g., on recipient and organisation levels).

The majority of research on barriers to implementing alcohol prevention programmes has been conducted in primary care contexts. Implementation barriers have been identified on recipient levels (e.g., lack of alcohol-related knowledge and skills among health care professionals, health care professionals' concerns about negative patient reactions (169)), organisational context levels (e.g., lack of time, workload, competing priorities, inadequate managerial support, staff turnover (61, 169, 179, 180)), and system context levels (e.g., lack of training opportunities for health care professionals, inadequate financial resources (169)).

1.4.3.2 The occupational health services as implementation context

The aims of the OHS are to protect and promote safety and health among employees, improve working conditions and the work environment, and prevent productivity loss (181). The OHS have been identified by the WHO (182, 183) as an important ingredient in improving employee health, and the OHS do possess a unique expertise with regard to the relationship between work and health (184). Although far from every employee has access to an OHS, estimations of OHS coverage do imply that such services have the potential to reach a large number of employees (e.g. France: 90 %, Finland: 85 %, Italy: 80 %, Norway: 60 %, USA: 35 %) (181). Hence, the OHS may be uniquely positioned when it comes to identify and reach risky drinkers in the workforce (185).

In Norway, OHS units are accredited by the Norwegian Labour Inspection Authority (186), and regulated by the Working Environment Act (187). OHS' activities are characterised by interdisciplinary systematic health, safety and environmental (HSE) work (186). Nursing,

medicine and physical therapy constitute the most common educational backgrounds among OHS professionals in Norway (188). In the Norwegian context, an organisation called Akan plays an important role in handling alcohol, drug, gambling and gaming issues among employees. Akan offers primary intervention activities in the form of education and counselling, as well as tertiary activities targeting individual employees who have developed dependency-related problems (189). Evaluations of Akan have demonstrated that the organisation is less involved in secondary prevention activities, that Akan-involvement is organised quite differently across companies, and that the organisation and its efforts are not well known in certain industries (189-191). Akan does not consist of certified health care professionals but does, in many instances, collaborate with OHS units, particularly with regard to tertiary activities (189). It is beyond the scope of this thesis to explore the role of Akan. In a Norwegian context, however, it is important to emphasise that Akan and OHS units may be serviceable collaborators as well as supplementing each other.

Even though some studies suggest that OHS professionals do thematise alcohol consumption with their patients (192, 193), several authors have advocated that the OHS should obtain a more active role in alcohol prevention (68-70). It is quite common for OHS to routinely perform health examinations aimed at early identification of illness and adverse lifestyle outcomes. A Swedish study (184) found that such examinations are initiated by employers, and that employees expressed positive attitudes toward this practice. Similarly, in a study of employees in the United Kingdom, it was revealed that 95 % of employees supported online health checks administered by the OHS (185). Some studies have indicated that alcohol prevention activities may be appropriately integrated in OHS' regular health examinations (194, 195). A Swedish study among OHS professionals (192) revealed positive attitudes towards gaining further training and knowledge about alcohol prevention programmes, and a Finnish study (193) found that early identification and intervention targeting heavy drinking employees were considered by health care professionals to be just as appropriate in occupational health settings as in primary care settings, and more appropriate in occupational settings than within specialised health care. In a Swedish general population sample, the OHS were considered to be more appropriate for alcohol treatment/prevention than primary health care settings (196).

Compared to other health care delivery settings, research on OHS practice and on OHS as an implementation setting is limited, both in general and with regard to alcohol prevention

activity in particular (192, 193, 197-199). Enabling the OHS to be more actively involved in alcohol prevention seems to warrant further research on OHS practice as well as on prevailing implementation barriers.

In accordance with the i-PARISH model of implementation (78, 79) (see Figure 1.5), one may argue that barriers against (increased) implementation of alcohol prevention programmes in the OHS may reside within different domains and on different levels, i.e., related to both the recipients (OHS professionals) and to the contextual setting (OHS units, workplaces/employers and/or system policies/regulations). Development of strategies for successful implementation may thus hinge on increased knowledge of current barrier domains, whether and how these domains are associated with actual intervention activity, and whether different barrier domains are dissimilarly related to preventive efforts on different levels (i.e., primary, secondary and tertiary prevention).

2. Aims of the thesis

The aims of this thesis were to generate a better understanding of employee alcohol consumption and intervention needs, impaired work performance associated with alcohol consumption, and current practices and implementation of alcohol prevention programmes in OHS'. The purpose of this work was to enable increased alcohol prevention activity in occupational health settings as a contribution to remedying a major public health issue.

Paper I: The objectives of Paper I were to generate new knowledge on risky drinking and intervention needs in the workforce by (i) exploring the proportions of risky drinkers in a heterogeneous sample of Norwegian employees by utilising an internationally validated alcohol screening instrument, (ii) investigating sociodemographic associations with risky drinking, and (iii) examining implications for intervention needs, in accordance with international intervention guidelines.

Paper II: Paper II aimed to synthesise existing knowledge on alcohol-related presenteeism by exploring whether evidence in the literature supports an association between alcohol consumption and impaired work performance.

Paper III: The objectives of Paper III were to generate new knowledge on alcohol-related performance outcomes by exploring whether different aspects of alcohol consumption (drinking frequency and drinking intensity) demonstrated differential associations with performance decrements at work (presenteeism) and outside the workplace (impaired daily activities).

Paper IV: Paper IV aimed to generate new knowledge on key implementation perspectives related to OHS' role in alcohol prevention by (i) exploring current intervention activity in a sample of Norwegian OHS professionals, (ii) investigating whether and how alcohol prevention activity was associated with perceived implementation barriers, and (iii) examining whether implementation barriers were dissimilarly associated with alcohol prevention activity on different prevention levels (primary, secondary and tertiary prevention).

3. Materials and methods

This thesis utilised data from three sources within the national WIRUS project. Materials and methods applied in this thesis are summarised in Table 3.1.

Table 3.1
Overview of papers' objectives, materials and methods

	Paper I	Paper II	Paper III	Paper IV
Objectives	Explore proportions of risky drinkers, sociodemographic associations with risky drinking, and implications for intervention needs	Synthesise existing knowledge on alcohol-related presenteeism. Explore whether evidence supports an association between alcohol consumption and impaired work performance	Explore whether different aspects of alcohol consumption (frequency and intensity) demonstrate differential associations with performance decrements at work (presenteeism) and outside the workplace (impaired daily activities)	Explore current alcohol prevention activity in the OHS, associations between prevention activity and implementation barriers, and whether barriers are dissimilarly associated with prevention activity on different levels (primary, secondary and tertiary prevention)
Design	Quantitative, cross-sectional study	Systematic review	Quantitative, cross-sectional study	Quantitative, cross-sectional study
Study sample	Employees in Norway, from 14 companies (N = 3571)	Published studies in scientific journals (N = 26 studies)	Employees in Norway, from 14 companies, abstainers excluded (N = 3278)	OHS professionals in Norway, from 69 OHS units (N = 295)
Data	Survey data from the WIRUS Screening study (sociodemographics, AUDIT sum score)	132 tested associations from 26 studies deemed eligible for inclusion after searches in seven scientific databases	Survey data from the WIRUS Screening study (sociodemographics, items from AUDIT, items from WPAI)	Survey data from the WIRUS implementation study (current practices, perceived implementation barriers)

WIRUS = Workplace Interventions preventing Risky alcohol Use and Sick leave; AUDIT = the Alcohol Use Disorders Identification Test (36, 101); WPAI = Work Productivity and Activity Impairment questionnaire (200)

An overview of statistical procedures utilised in the thesis is presented in Table 3.2.

Table 3.2
Overview of analyses/statistical procedures utilised in the thesis

Analysis/statistical procedures	Paper I	Paper II	Paper III	Paper IV
Descriptive statistics	X	X	X	X
Cross-tabulation with OR/RR	X	X	X	
Chi square test of independence	X	X		X
Multiple logistic regression	X			
Correlation			X	
Multiple linear regression			X	X
Analysis of variance (ANOVA)				X
Factor analysis				X
Analysis of internal consistency (Cronbach's α)	X			X
Mann-Whitney U test				X
Paired-samples t-test				X
Fisher's exact test				X

OR = odds ratio; RR = relative risk

3.1 Ontological and epistemological perspectives

Assumptions of reality (ontology) affect the perceived nature of knowledge and how it can be produced (epistemology), which in turn affect which methods are applied (methodology), ultimately affecting how that knowledge may be translated back to and implemented in reality (knowledge translation). According to Malterud (201), one may executively distinguish between positivist and interpretative research paradigms, with the latter subsuming hermeneutics, phenomenology, social constructivism and postmodernism. (Post)positivism is characterised by the belief in an objective world and a relatively value-free research and researcher within a scientific paradigm emphasising the importance of reductionism, measurement, validity and reliability (202). In contrast, interpretative research relies on participants' views, experiences or perceptions of situations or phenomena in a subjective world wherein meaning is constructed through a diversity of subject positions (201, 202).

Although building on data from individual participants, this thesis is not primarily interested in producing knowledge on how employees or OHS professionals construct meaning around the phenomena of alcohol consumption, presenteeism and intervention implementation.

Rather than interpreting how participants view or perceive these phenomena, the thesis is oriented towards answering predefined research questions regarding relationships between these variables. It is assumed that reality does exist independently from the researcher's perceptions, and that true (real) relationships between variables exist independently from how participants may interpret them. Consequently, data from participants are not treated as experiences that should be subjected to interpretation, but rather as information sources about variables that may be more or less valid and reliable. Therefore, a quantitative approach is utilised.

The thesis aims at enabling increased implementation of alcohol prevention activity in occupational health services. As such, one may argue that the thesis has certain political underpinnings insofar that the aim is closely associated with an intention of change in current practices. The thesis may carry elements of what Creswell (202) described as a transformative research paradigm. The thesis is not, however, intertwined with an explicit *political* change agenda. Rather than a transformative agenda, the thesis may be characterised by emphasising research questions more explicitly than committing to a specific research philosophy. Hence, it can be argued that the thesis rests on a (post)positivistic worldview with a pragmatic approach.

3.2 Research design

The four papers in this thesis are part of the ongoing Norwegian national WIRUS project (203-205). The WIRUS project aims to synthesise relevant research in the field (the WIRUS review study), generate knowledge on drinking culture in occupational settings (the WIRUS culture study), produce knowledge on alcohol consumption and risky drinking in the workforce (the WIRUS screening study), test the effects of workplace interventions (the WIRUS RCT study), explore cost-benefit and cost-effectiveness of workplace interventions (the WIRUS cost-benefit study), and produce knowledge on implementation of such interventions in occupational settings (the WIRUS implementation study).

Papers I and III were based on data from the WIRUS screening study, a cross-sectional alcohol screening study among employees in private and public companies in Norway. Paper II was designed as a systematic review of the literature, and part of the WIRUS review study.

The protocol for Paper II was registered in the International prospective register of systematic reviews (PROSPERO, ID: CRD: 42017059620). Paper IV was based on data from the WIRUS implementation study, which included a cross-sectional study among professionals (health care/service providers) in OHS units in Norway accredited by the Norwegian Labour Inspection Authority.

3.3 Papers I and III

3.3.1 Data collection and participants

Papers I and III were based on the same data collection (the WIRUS screening study). A total of 14 companies were recruited by three occupational health service units. These private (n = 5) and public sector (n = 9) companies employed approximately 14500 individuals within the following work divisions, as categorised by the European Classification of Economic Activities (206): Accommodation and food service activities (n = 1), human health and social work activities (n = 3), public administration (n = 7), manufacturing (n = 2), and transportation and storage (n = 1).

Individual-level criteria for being included were the following: (i) aged 16-72, (ii) status as employee (blue, white or pink collar worker, or manager, i.e., salaried person), (iii) employed in a company served by one of the participating OHS units, regardless of work division or geographical region, (iv) basic understanding of the Norwegian language, (v) provided written informed consent to participate, and (vi) responded on all relevant study variables. For inclusion in Paper III, respondents had to meet the additional criteria of being a regular drinker (employees who had not consumed alcohol during the past 12 months were excluded).

Data were collected between October 2014 and February 2017. Employees were recruited through their employers. Included companies provided email addresses for all their employees, and the employees (n = 14353) were invited to participate by receiving a web-based questionnaire (Appendix A, section A1).

For Paper I, 4432 provided informed consent (30.9 %), while 3571 (24.9 %) responded on all relevant items and constituted the final study sample. For Paper III, 4275 (29.8 %) consented

to participate and provided at least one response to the questionnaire. As a result of not responding on all relevant items, 726 employees were excluded, and an additional 271 employees were excluded as a result of reporting abstention the past 12 months, leaving a final study sample of 3278 (22.8 %) employees. Recruitment for Papers I and III is depicted in Figure 3.1, Panel A[4].

[4] The discrepancy between number of participants providing informed consent between Paper I and Paper III, is due to different data extraction dates from the ongoing data collection (the WIRUS screening study).

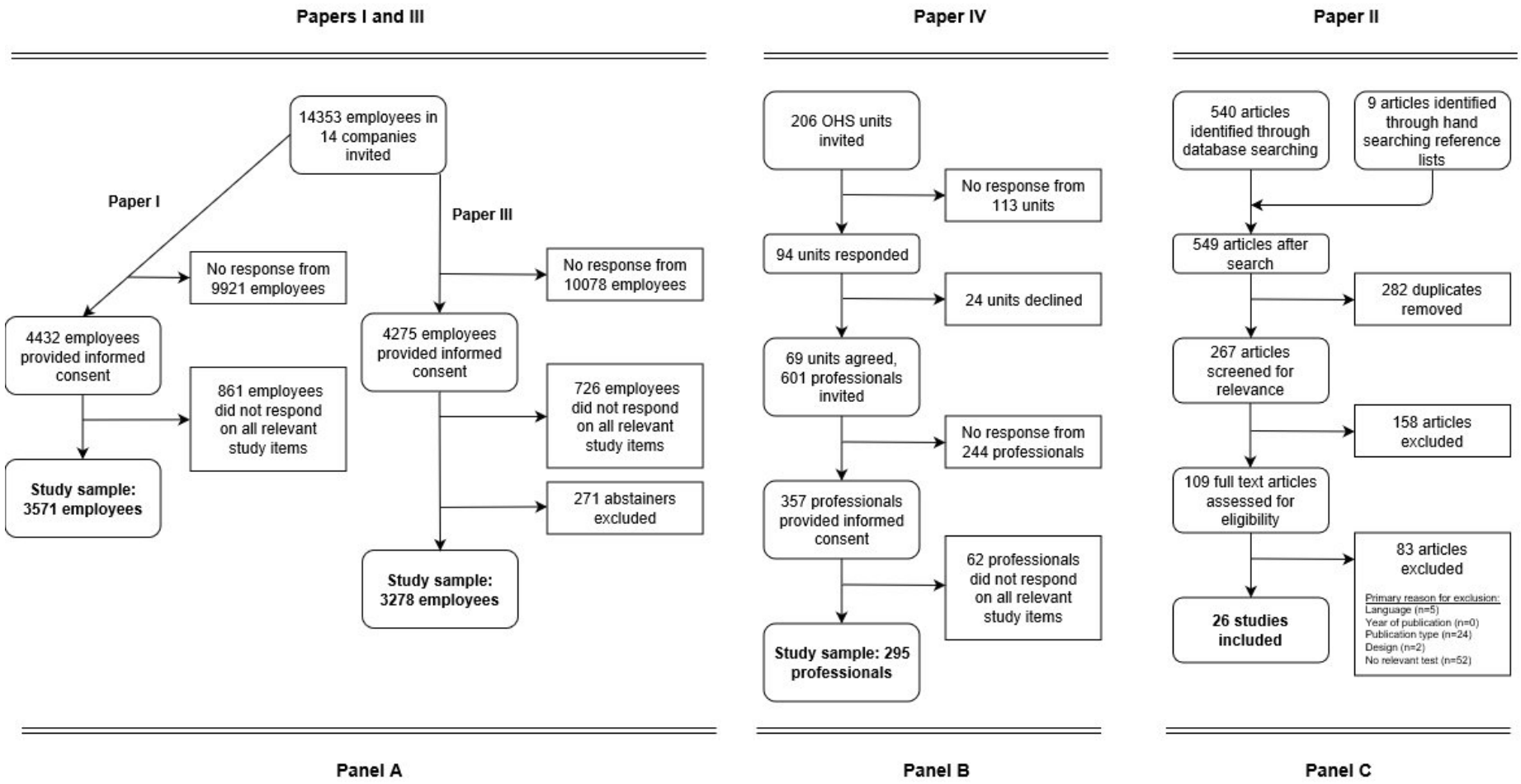


Figure 3.1. Flow charts depicting the processes of participant recruitment (Papers I, III and IV) and study selection (Paper II)

The study samples were characterised by containing quite large proportions of females (67.4 %), employees aged ≥40 (Paper I: 68.7 %; Paper III: 68.5 %), and employees with university/college education (Paper I: 75.3 %; Paper III: 75.0 %). More thorough descriptions of study sample characteristics are presented in Paper I (Table 1) and Paper III (Table 1).

3.3.1.1 Study selection analyses

Comparisons between the study samples, the invited sample in the WIRUS screening study and the Norwegian workforce were performed in order to explore the issue of representativity with regard to Papers I and III. Information on gender and age distributions among all employees in the invited sample (n = 14353) was obtained from included companies' personnel records, while information on distributions of gender, age and educational attainment in the Norwegian national workforce and public sector was collected from Statistics Norway.

The gender distributions in the study samples were not significantly different from that in the invited sample (1.6 percentage points, $p = .071$ (Paper I); $p = .081$ (Paper III)). There were small but significant differences with regard to age (Paper I: 4.2 percentage points, $p < .001$; Paper III: 4.0 percentage points, $p < .001$). However, the study samples were quite different from the national workforce, regarding gender (20.1 percentage points, $p < .001$), age (Paper I: 13.7 percentage points, $p < .001$; Paper III: 13.5 percentage points, $p < .001$) and educational attainment (university/college: Paper I: 33.9 percentage points, $p < .001$; Paper III: 33.6 percentage points, $p < .001$). However, the study samples were more similar to the population of public sector employees, with quite small yet significant differences regarding gender (2.4 percentage points, $p < .01$) and educational attainment (Paper I: 2.6 percentage points, $p < .001$; Paper III: 2.3 percentage points, $p < .01$). Study sample, invited sample, national workforce and public sector distributions of age, gender and educational attainment are presented in Table 3.3.

Table 3.3

Distributions of gender, age and educational attainment in Papers I and III: Study samples, invited sample, national workforce and public sector

Variable	Study sample Paper I[a]	Study sample Paper III[b]	Invited sample[c]	National workforce[d]	Public sector[e]
Part A: Distributions of gender, age and education					
Gender					
Male	32.6	32.6	34.2	52.7	30.2
Female	67.4	67.4	65.8	47.3	69.8
Age					
≤39	31.3	31.5	35.5	45.0	-
≥40	68.7	68.5	64.5	55.0	-
Education					
Level 1[g]	2.5	2.4	-	16.3	-
Level 2[h]	22.2	22.7	-	42.3	-
Level 3[i]	75.3	75.0	-	41.4	72.7[f]

Variable and paper	Invited sample	National workforce	Public sector
Part B: Differences in percentage points and *p* values[j] (age, gender and education)			
Gender (% males)			
Paper I, study sample	1.6 (.071)[ns]	20.1 (<.001)*	2.4 (<.01)*
Paper III, study sample	1.6 (.081)[ns]	20.1 (<.001)*	2.4 (<.01)*
Age (% ≤39)			
Paper I, study sample	4.2 (<.001)*	13.7 (<.001)*	-
Paper III, study sample	4.0 (<.001)*	13.5 (<.001)*	-
Education (% university/college)			
Paper I, study sample	-	33.9 (<.001)*	2.6 (<.001)*
Paper III, study sample	-	33.8 (<.001)*	2.3 (<.01)*

[ns]Non-significant; *Significant (*p* <.05); [a]n=3571; [b]n=3278; [c]n=14353, data obtained from included companies' personell records; [d]n=2800000, data obtained from Statistics Norway; [e]n=849620, data obtained from Statistics Norway (https://www.ssb.no/regsys); [f]only state sector employees, n=159389, data obtained from Statistics Norway (https://www.ssb.no/statbank/table/12626); [g]Primary/lower secondary; [h]Upper secondary; [i]University/college; [j]Differences tested with chi-square tests

In order to explore whether those who responded on the AUDIT items (responders) were significantly different from those who did not (non-responders), comparisons were made on the basis of gender, age and educational attainment. Non-responders, compared to responders, were characterised by a significant overrepresentation of females, younger age and lower education (see Table 3.4).

Table 3.4
Characteristics of responders compared to non-responders in Papers I and III

Variable	Responders[a]	Non-responders[b]	*p* value
Gender, % females	67.7	75.7	<.001[c]
Age, mean	45.4	43.9	<.01[d]
Education, % university/college	74.9	63.6	<.001[c]

[a]Employees who responded on sociodemographic items but not on the alcohol items (AUDIT) (n = 646); [b]Employees who responded on sociodemographic and alcohol items (n = 3410); [c]Difference tested with chi square test; [d]Difference tested with independent samples t-test

3.3.2 Measures and variables

3.3.2.1 Paper I

The main study variables in Paper I were risky drinking (outcome) and sociodemographics (predictors). Variables, measures and applications are thoroughly described in Paper I, and an overview is presented in Table 3.5.

Table 3.5
Overview of variables, measures and applications in Paper I

	Item	**Response scale/ categories**	**Application(s)**
Outcome (dependent variable)			
Risky drinking (AUDIT)*	Composite measure (10 items)**	Risky drinking = sum score 8-40; low-risk drinking = sum score 0-7	*In regression analysis:* Categorical dichotomous (0=risky drinking, 1=low-risk drinking); *In estimations of intervention needs:* Categorical ordinal (low-risk=0-7; moderate risk=8-15; high risk=16-19; dependence likely risk=20-40***)
Predictors (independent variables)			
Age		Number of years	*In chi-square test:* Categorical dichotomous (≤39; ≥40); *In regression analysis:* Continuous (higher score = older age)
Educational attainment	Highest level of completed education	Four-point Likert scale (0=primary/lower secondary; 1=upper secondary; 2=university college <4 years;	*In chi-square test:* Categorical dichotomous (university college education; no university/college education); *In regression analysis:* Categorical ordinal

		3=university/college ≥4 years)	(higher score = higher educational attainment)
Gender		0=male; 1=female	*In chi-square test and regression analysis:* Categorical dichotomous
Living status	Living alone or with others	0=alone; 1=with others	*In chi-square test and regression analysis:* Categorical dichotomous
Marital status	Married or unmarried	0=unmarried; 1=married	*In chi-square test and regression analysis:* Categorical dichotomous
Children	Having children or not	0=no children; 1=children	*In chi-square test and regression analysis:* Categorical dichotomous
Children in household	Having children in the current household	0=no children in household; 1=children in household	*In chi-square test and regression analysis:* Categorical dichotomous
Work position	Worker or manager	0=worker; 1=manager	*In chi-square test and regression analysis:* Categorical dichotomous

*Alcohol Use Disorders Identification Test (AUDIT) (36, 101); **Wording of the ten items is presented in Appendix B (section B1); ***Risk categories based on WHO guidelines (36)

The outcome in Paper I (risky drinking) was measured with AUDIT (36, 101). The AUDIT has been implemented and validated in a variety of settings and populations, often demonstrating psychometric qualities superior to other alcohol screening instruments (102). The instrument is most often applied as a unidimensional measure, reflecting levels of alcohol-related problems (36, 102). Studies exploring the underlying factor structure of the AUDIT have supported models of one factor (all ten items), two factors (drinking habits, items 1-3; consequences, items 4-10), and three factors (drinking habits, items 1-3; alcohol dependence, items 4-6; harmful use, items 7-10) (207-213). However, two-factor solutions seem to enjoy most empirical support (211). Estimates of internal consistency (Cronbach's α) for the ten items have typically ranged between 0.59 and 0.97 (214), with a mean α of 0.80 (102).

For Paper I, psychometric qualities of the AUDIT items were explored by means of factor analysis (maximum likelihood extraction with oblique rotation) and analyses of internal

consistency (Cronbach's α and estimations of mean inter-item correlations). An exploratory factor analysis identified three factors with Eigenvalues (λ) ≥1.0, yet without a clear and simple structure. A parallel analysis (215) was performed to aid in determining how many factors to extract. The parallel analysis indicated extraction of two factors (for the third factor, the randomly generated λ exceeded the corresponding λ in the data; $\lambda 3_{random} = 1.04$, $\lambda 3_{data} = 1.01$). Consequently, a confirmatory factor analysis (with two fixed factors) was conducted. The two-factor model (F_1: Drinking habits, items 1-3; F_2: Consequences, items 4-10) explained 44.7 % of the variance (F_1 = 34.2 %; F_2 = 10.5 %), and both factors demonstrated mean inter-item correlations of >0.20 (F_1 = 0.36; F_2 = 0.26). Moreover, the overall AUDIT scale (ten items) displayed satisfactory internal consistency (α = 0.72; mean inter-item correlation = 0.26), indicating that it was appropriate to construct an AUDIT sum score. Results from factor analysis and analyses of internal consistency are presented in Table 3.6.

Table 3.6
Factor structure and internal consistency for the ten AUDIT items

	Pattern matrix		Structure matrix		
Item	F_1	F_2	F_1	F_2	Communality
AUDIT-3	**1.07**	-0.12	**1.00**	0.55	1.00
AUDIT-2	**0.48**	0.15	**0.57**	0.45	0.34
AUDIT-1	**0.41**	0.06	**0.45**	0.31	0.20
AUDIT-4	-0.05	**0.71**	0.40	**0.68**	0.46
AUDIT-8	0.09	**0.59**	0.46	**0.64**	0.42
AUDIT-7	0.06	**0.58**	0.43	**0.62**	0.39
AUDIT-5	0.05	**0.53**	0.39	**0.57**	0.32
AUDIT-10	-0.03	**0.43**	0.24	**0.41**	0.17
AUDIT-6	-0.03	**0.40**	0.22	**0.38**	0.14
AUDIT-9	0.04	**0.26**	0.20	**0.29**	0.08

	F_1	F_2	Both
Eigenvalue λ (% explained variance)	3.42 (34.17)	1.06 (10.57)	(44.74)
Cronbach's α	0.59	0.68	0.72
Mean inter-item correlation	0.36	0.26	0.26

Parallel analysis	λ dataset	λ randomly generated
Factor 1	3.42	1.09
Factor 2	1.06	1.06
Factor 3	1.01	1.04

Factor structure generated with confirmatory maximum likelihood extraction with oblique rotation; Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) = 0.81; Bartlett's test of sphericity p <.001

Questionnaire items used in Paper I is presented in Appendix B (section B1).

3.3.2.2 Paper III

The main study variables in Paper III were presenteeism and impaired daily activities (outcomes), and drinking frequency and intensity (predictors). Variables, measures and applications are thoroughly described in Paper III. An overview is presented in Table 3.7.

Table 3.7
Overview of variables, measures and applications in Paper III

	Item	Response scale/ categories	Application(s)
Outcomes (dependent variables):			
Presenteeism (WPAI)*	"During the past seven days, how much did alcohol consumption affect your productivity while you were working?"	VAS, 0 (no influence on productivity) to 10 (obstructed productivity completely)	*In cross-tabulations:* Categorical dichotomous (no impairment = 0, impairment = 1-10); *In correlation and regression analyses:* Continuous (higher score = higher impairment)
Impaired daily activities (WPAI)*	"During the past seven days, how much did alcohol consumption affect your ability to do regular daily activities, other than work at a job?"	VAS, 0 (no influence on productivity) to 10 (obstructed productivity completely)	*In cross-tabulations:* Categorical dichotomous (no impairment = 0, impairment = 1-10); *In correlation and regression analyses:* Continuous (higher score = higher impairment)
Predictors (independent variables)			
Drinking frequency (AUDIT-1)**	"How often, during the past year, did you have a drink containing alcohol?"	Four-point Likert scale (1=monthly or less; 2=2-4 times a month; 3=2-3 times a week; 4=4 or more times a week)	*In cross-tabulations:* Categorical dichotomous (frequent drinking = 3 and 4; infrequent drinking = 1 and 2); *In correlation and regression analyses:* Categorical ordinal (higher score = higher frequency)
Drinking intensity (binge episodes) (AUDIT-3)**	"How often, during the past year, did you have six or more drinks on one occasion?"	Five-point Likert scale (0=never; 1=less than monthly; 2=monthly; 3=weekly; 4=almost daily)	*In cross-tabulations:* Categorical dichotomous (recurrent binge = 2-4; never/rarely binge = 0 and 1); *In correlation and regression analyses:* Categorical ordinal (higher score = more binge episodes)
Covariates (control variables)			

Gender (male; female); *Age* (years); *Educational attainment* (primary/lower secondary; upper secondary; university/college <4 years; university/college ≥4 years); *Living status* (living alone; living with others); *Employment sector* (private; public)

VAS = visual analogue scale; *Single item from the Work Productivity and Activity Impairment questionnaire (WPAI) (200); **Single item from the Alcohol Use Disorders Identification Test (AUDIT) (36, 101)

Questionnaire items used in Paper III is presented in Appendix B (section B2).

3.3.3 Data analysis

For Paper I, data were analysed by means of descriptive statistics, analysis of internal consistency, cross-tabulations, chi square tests of independence and multiple logistic regression. For Paper III, data were analysed with descriptive statistics, cross-tabulations with odds ratios (ORs) and relative risks (RRs), correlation analyses and multiple linear regression analyses. For both papers, choice of statistical procedures were based on sample size and whether specific tests' assumptions were appropriately met. For instance, the normality of data were explored by inspecting histograms, normal and detrended normal q-q plots, and standardised residual plots. Significant results were defined as $p < .05$, and all analyses were performed with IBM SPSS version 24. More detailed descriptions of data analytical procedures are presented in Papers I and III.

3.4 Paper II

The methodological procedure for Paper II was based on the Cochrane approach for conducting systematic reviews (216). As a result of the Cochrane approach being designed primarily for reviews of the effects of interventions (not for reviewing observational studies exploring associations between exposures and outcomes), some adjustments were necessary. An important adjustment was to choose associations, rather than studies, as the unit of analysis and quality assessment. A considerable proportion of included studies were characterised by having broader aims than the review aim in Paper II, and a considerable proportion of included studies tested several associations between alcohol consumption and work performance within the same study, often based on different measures and different sub-

samples. Analysing and quality assessing studies were therefore deemed inexpedient. The applied procedure is described in detail in Paper II. An overview is presented in Figure 3.2.

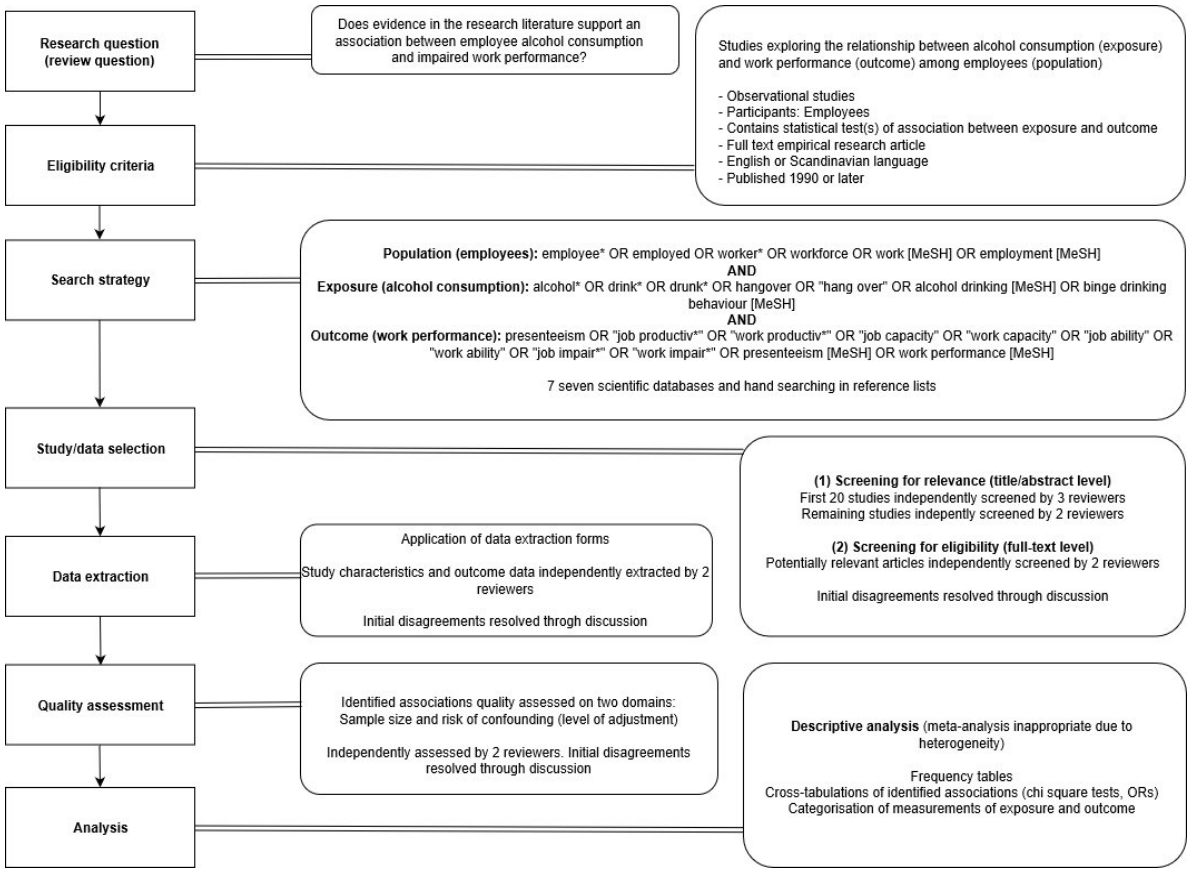


Figure 3.2. Overview of the methodological procedure for Paper II

3.5 Paper IV

3.5.1 Data collection and participants

Contact information for accredited OHS units were collected from the Norwegian Labour Inspection Authority. Two-hundred-and-six accredited units were invited to participate in the study and asked to provide email addresses for their employees (OHS professionals) (see Appendix A, section A2). Ninety-three units (45.2 %) responded to the invitation, of which 69 units (74.2 % of responding units) agreed to participate. A total of 601 OHS professionals (in 69 units) were invited to participate by receiving a web-based questionnaire (Appendix B, section B3), and 357 (59.4 %) provided written informed consent to participate.

Individual-level inclusion criteria were: (i) employed in an OHS unit accredited by the Norwegian Labour Inspection Authority, (ii) actively involved in systematic HSE work (i.e., not only administration), (iii) basic understanding of the Norwegian language, (iv) provided written informed consent to participate, and (v) responded on all relevant study variables.

An overview of the process of participant recruitment is presented in Figure 3.1 (Panel B). More details about participant recruitment and sample characteristics are provided in Paper IV.

3.5.1.1 Study selection analyses

In an effort to explore the study sample's representativity, a series of study selection analyses were performed. First, characteristics of the study sample were compared to information reported in an official evaluation of OHS' in Norway (188). Comparisons were made on the basis of (i) OHS professionals' background, (ii) number of employees in the OHS', and (iii) number of employers served by the OHS'. These analyses are described in detail in Paper IV (Additional file 3, Table A3,1). Results indicated that distributions in the study sample were mostly quite similar (non-significantly different) from distributions reported in the official evaluation. There were, however, a few exceptions: Physical therapists (17.3 % vs 9.4 %, p <.001) and OHS units serving between 2 and 49 companies (28.8 % vs 13.0 %, p <.01) were somewhat overrepresented in the study sample.

Second, OHS professionals who responded on all relevant items in the questionnaire (responders; n = 295) were compared with those who only responded to the sociodemographic items (non-responders; n = 57). There were no significant differences regarding age, gender and professional background. However, responders had somewhat longer OHS experience than non-responders (median 10.0 vs 7.0 years, p <.05). More detailed results are presented in Paper IV (Additional file 3, Table A3,2).

3.5.2 Measures and variables

The main study variables in Paper IV were alcohol prevention activity targeting employees (outcomes) and perceived implementation barriers (predictors). Variables, measures and applications are thoroughly described in Paper IV. An overview is presented in Table 3.8.

Table 3.8
Overview of variables, measures and applications in Paper IV

	Item	Response scale/ categories	Application(s)
Outcomes (dependent variables)			
Primary alcohol prevention activity	The extent to which the OHS unit engages in primary alcohol prevention activity	Five-point Likert scale (1=not at all; 2=to a small extent; 3=to some extent; 4=to a large extent; 5=to a very large extent)	*In t-tests and regression analysis:* Categorical ordinal (higher score = higher activity)
Secondary alcohol prevention activity	The extent to which the OHS unit engages in secondary alcohol prevention activity	Five-point Likert scale (1=not at all; 2=to a small extent; 3=to some extent; 4=to a large extent; 5=to a very large extent)	*In t-tests and regression analysis:* Categorical ordinal (higher score = higher activity)
Tertiary alcohol prevention activity	The extent to which the OHS unit engages in tertiary alcohol prevention activity	Five-point Likert scale (1=not at all; 2=to a small extent; 3=to some extent; 4=to a large extent; 5=to a very large extent)	*In t-tests and regression analysis:* Categorical ordinal (higher score = higher activity)
Overall alcohol prevention activity	The extent to which the OHS unit engages in alcohol prevention activity	Composite measure (primary, secondary and tertiary activity summarised: potential range: 1-15)	*In regression analysis:* Continuous (higher score = higher activity)
Predictors (independent variables)			
Internal implementation barriers	Barriers internal to the OHS' organisation; concerning OHS competence, time and resources*	Numerical scale 1-33; composite score based on three barriers**, each measured on a VAS (1-11)	*In regression analyses:* Continuous (higher score = higher barrier perception)
External implementation barriers	Barriers external to the OHS' organisation; concerning employees and employers*	Numerical scale 1-44; composite score based on four barriers*, each measured on a VAS (1-11)	*In regression analyses:* Continuous (higher score = higher barrier perception)

Covariates
*Drinking social norms**** (mean score of seven items); *Frequency of alcohol cases* (seven-point Likert scale); *Challenge perception* (five-point Likert scale); *Attitudes towards increased alcohol prevention activity* (five-point Likert scale); *Age* (years); *OHS experience* (years); *gender* (male; female); *Professional background* (occupational therapist; nutritionist; physical therapist; physician; psychologist; nurse; occupational hygienist; other)

VAS = visual analogue scale; *Choice of barriers based on qualitative interview panels and previous research in primary care settings; **Barrier structure based on factor analysis (see Paper IV, Additional file 1); ***Drinking Norms Scale (109)

Questionnaire items used in Paper IV is presented in Appendix B (section B3).

3.5.3 Data analysis

The study objectives were reached by analysing data with descriptive statistics, analysis of variance (ANOVA), paired-samples t-tests and multiple linear regression analyses. Additionally, a series of preliminary tests were applied: (i) factor analysis and analysis of internal consistency were used to perform data reduction on the implementation barrier items, (ii) chi square tests of independence and Fisher's exact tests were used in study selection analyses, and (iii) Mann-Whitney U tests were utilised for exploring possible differences on the outcome variables between (a) OHS professionals who worked with alcohol cases and those who did not, and (b) male and female OHS professionals.

Sample size and exploration of test assumptions were decisive in selection of statistical procedures. Significant results were defined as $p < .05$. All analyses were performed with IBM SPSS version 24. More detailed descriptions of data analytical procedures are presented in Paper IV.

3.6 Ethics

Participants in the empirical studies (Papers I, III and IV) were treated in accordance with the World Medical Association's Declaration of Helsinki (217). Systematic efforts were made to promote and ensure participants' dignity, integrity, right to self-determination, privacy and confidentiality. Participants were thoroughly informed about the studies' aims, assured that

participation was voluntary and that they had the right to withdraw their consent at any given time.

Principle 17 in the Declaration of Helsinki (217) states that measures to minimise risks to participants must be implemented in research. Thorough risk analyses were conducted, aimed at assessing potential physical, psychological and social risks to participants. Participation comprised responding on questionnaires. Hence, no physical risks were identified. Psychological risks, e.g., undesired changes in cognition and emotion, were not considered likely. However, participants' privacy may to some extent have been invaded by exploring their level of alcohol consumption (Papers I and III), which can be conceived as a private and sensitive issue associated with personal lifestyle. Implemented measures to counteract this potential risk included providing participants with explicit and clearly stated information about the questionnaire at the time they were invited to participate. Participation did likely involve potential social risks, insofar that breaches of confidentiality (e.g., disclosure of alcohol consumption pattern) could have resulted in embarrassment and stigmatisation for the participants or perhaps, more seriously, loss of employment. In order to minimise social risks, strict procedures for protecting participants' personal information were implemented. The WIRUS Screening study (Papers I and III) was approved by the Regional Committee for Medical and Health Research in Norway (REK) (reference number 2014/647). The WIRUS Implementation study (Paper IV) was approved by the Norwegian Centre for Research Data (NSD) (reference number 58038). Paper II is a systematic review of the literature and did not involve human participants. Hence, it was not considered necessary to obtain ethical approval for Paper II.

4. Summary of results

An overview of the four papers' main results and associated objectives is presented in Table 4.1.

Table 4.1
Overview of the four papers' objectives and main results

	Objectives	Main results
Paper I	Explore proportions of risky drinkers, sociodemographic associations with risky drinking, and implications for intervention needs	One to three out of ten employees reported risky drinking, and risky drinking was associated with and most common among males, younger and unmarried employees, employees with low education and employees without children. The vast majority of risky drinkers scored within the lowest at-risk category, a risk level that may be appropriately addressed with low-cost secondary prevention interventions.
Paper II	Synthesise existing knowledge on alcohol-related presenteeism. Explore whether evidence supports an association between alcohol consumption and impaired work performance	The majority of identified evidence indicated that higher levels of alcohol consumption were associated with higher levels of work impairment, suggesting that alcohol-related presenteeism may be considered as a detrimental alcohol-related occupational outcome in line with absenteeism and occupational injuries. However, a lack of high quality evidence and few longitudinal studies warrant further research on the prevalence, nature and impact of alcohol-related presenteeism.
Paper III	Explore whether different aspects of alcohol consumption (frequency and intensity) demonstrate differential associations with performance decrements at work (presenteeism) and outside the workplace (impaired daily activities)	Drinking intensity was associated with higher levels of presenteeism and impaired daily activities, while drinking frequency was associated only with impaired daily activities. Drinking intensity displayed a stronger association with impaired daily activities than with presenteeism. Both aspects of alcohol consumption seem to be related to performance decrements, yet drinking intensity seems to be more important than frequency, and may thus appropriately be particularly emphasised in alcohol prevention programmes aimed at preventing alcohol-related performance decrements.
Paper IV	Explore current alcohol prevention activity in OHS', associations between prevention activity and implementation barriers, and whether barriers are dissimilarly associated with prevention activity on different levels (primary, secondary and tertiary prevention)	The majority of OHS professionals worked with alcohol prevention less than on a monthly basis, and their alcohol prevention activity was more focused on tertiary prevention than on primary and secondary prevention. Implementation barriers internal to the OHS' organisation were associated with alcohol prevention activity across all prevention levels, implying that making alcohol prevention a priority for OHS' may require increased training of OHS professionals as well as allocation of time and resources.

4.1 Paper I

DOI: https://dx.doi.org/10.1186/s12889-018-5660-x

Overall, 11 % of the employees reported risky drinking. A higher proportion of males, compared to females, were identified as risky drinkers (18.1 % vs 7.5 %). Risky drinking was most common among males without children (33.5 %), males living alone (31.4 %) and males aged <40 (26.5 %). In contrast, risky drinking was least common among married females (4.6 %), females with children (5.2 %) and females aged ≥40 (5.2 %). A multiple logistic regression analysis revealed that male employees were almost three times as likely as female employees to report risky drinking (OR = 2.97, 95 % CI [2.37, 3.71], p <.001), and that younger age (OR = 1.03, 95 % CI [1.02, 1.04], p <.001), lower educational level (OR = 1.17, 95 % CI [1.03, 1.34], p <.05), being unmarried (OR = 1.38, 95 % CI [1.05, 1.82], p <.05) and not having children (OR = 1.62, 95 % CI [1.08, 2.43], p <.05) were significantly associated with an increased likelihood of risky drinking. Employees' work position were not significantly associated with risky drinking.

Of those who reported risky drinking (11.0 %), 94.6 % scored within the moderate risk category (AUDIT sum scores 8-15), for which simple advice (secondary prevention) is the recommended intervention approach (36, 162). A minority of employees reported a drinking pattern corresponding with a need for tertiary prevention programmes (only 4.1 % and 1.3 % of risky drinkers scored within high risk (AUDIT sum scores 16-19) and dependence likely risk (AUDIT sum scores 20-40)).

4.2 Paper II

DOI: https://dx.doi.org/10.1136/bmjopen-2019-029184

Twenty-six studies, based on data from 92730 employees from 15 countries, met the eligibility criteria and were included in the systematic review. Half of the studies were based on employees in the USA and the majority of studies (21 of 26) were cross-sectional.

A total of 132 associations between alcohol consumption and work performance were tested within the 26 included studies. Almost eight out of ten (77.0 %, n = 102) of these indicated a positive relationship between alcohol consumption and impaired work performance, implying that higher levels of consumption were associated with higher levels of performance impairment. Positive associations, compared to negative associations, were considerably more

likely to be statistically significant (OR = 14.00, 95 % CI [3.1 – 65.5]; χ^2 (1, n = 127) = 17.80, *p* <.001, *phi* = .37). Among significant positive associations of moderate and high quality, alcohol exposure was primarily measured by hangover episodes and composite instruments (15 of 17 associations). However, 61 % of associations were characterised by low quality, and negative associations (compared to positive associations) were less likely to be of low quality (OR = 0.22, 95 % CI [0.1 – 0.6]; χ^2 (1, n = 127) = 11.37, *p* <.01, *phi* = -.30).

4.3 Paper III

DOI: https://dx.doi.org/10.1371/journal.pone.0186503

Two out of ten employees (19.7 %) reported frequent drinking (consumption on a weekly or almost daily basis) during the past 12 months. One out of ten (11.0 %) reported recurring binge drinking (binge drinking on a monthly, weekly or almost daily basis) during the past 12 months.

Multiple linear regression analyses (adjusting for gender, age, educational attainment, living status and employment sector) revealed that (i) drinking intensity (binge drinking) was significantly associated with impaired work performance (b = .040, 95 % CI [.012, .067], β = .057, *p* <.01), while drinking frequency was not (b = .016, 95 % CI [.006, .039], β = .028, *p* = .156), (ii) both frequency (b = .049, 95 % CI [.020, .078], β = .064, *p* <.01) and intensity (b = .120, 95 % CI [.085, .155], β = .131, *p* <.001) were significantly associated with impaired daily activities, (iii) intensity displayed a stronger association with impaired daily activities (β = .131, *p* <.001) than with impaired work performance (β = .057, *p* <.01), and (iv) compared with frequency, intensity stood out as a more important predictor for both impaired work performance ($\beta_{intensity}$ = .057, *p* <.01; $\beta_{frequency}$ = .028, *p* = ns) and impaired daily activities
($\beta_{intensity}$ = .131, *p* <.001; $\beta_{frequency}$ = .064, *p* <.01).

4.4 Paper IV

DOI: https://dx.doi.org/10.1186/s13011-019-0217-2

OHS' current alcohol prevention activity was quite limited, with seven out of ten (69.5 %) OHS professionals working with alcohol prevention less than monthly. The frequency of alcohol prevention activity differed significantly according to professional background (*F* [2,

287] = 12.4, p <.001, η^2 = 0.2), with physicians, psychologists and nurses most frequently performing such activities. OHS' alcohol prevention activity was more focused on tertiary prevention (M = 3.3, SD = 0.8) than on secondary (M = 2.9, SD = 0.7) and primary prevention (M = 2.8, SD = 0.8). The prevalence of tertiary activities were significantly higher than both primary (M_{diff} = 0.5, t [294] = 8.9, p <.001) and secondary (M_{diff} = 0.5, t [294] = 10.0, p <.001) activities.

Multiple linear regression analyses (adjusting for gender, age, professional background, OHS experience and drinking social norms) indicated that implementation barriers internal to the OHS' organisation (competence, time, resources) were significantly associated with alcohol prevention activity, both overall (β = -.22, p <.01) and across all prevention levels (primary: β = -.20, p <.01; secondary: β = -.14, p <.05; tertiary: β = -.17, p <.001). Barriers external to the OHS' organisation (concerning employees and employers) were not significantly associated with alcohol prevention activity.

5. Discussion

The aim of this thesis was to generate a better understanding of employee alcohol consumption and intervention needs, impaired work performance associated with alcohol consumption, and current practices and barriers against implementing alcohol prevention programmes in OHS'.

5.1 Discussion of main findings

The following main findings from the thesis will be discussed: (i) There seems to be an association between alcohol consumption and impaired work performance, (ii) risky drinking was quite common among employees, yet OHS' alcohol prevention activity was rather limited, and (iii) the vast majority of risky drinkers had moderate risk and could, according to international intervention guidelines, benefit from low-cost secondary prevention interventions, yet OHS' alcohol prevention activity was more focused on tertiary prevention than on secondary prevention.

5.1.1 Association between alcohol consumption and impaired work performance

Previous research has linked employees' alcohol consumption to work-related productivity decrements, such as absenteeism (23-29, 139), and studies have demonstrated that health-related absenteeism and presenteeism may lead to a variety of participation challenges (e.g., thwarted career opportunities (42-45)) that could jeopardise individuals' affiliation to the labour market. Exclusion from the labour market, e.g., due to health-related productivity decrements, may further aggravate individuals' health and well-being (38-41). Prior to this thesis, we did not know enough about presenteeism as a potential alcohol-related productivity decrement at work. In particular, there has been a dearth of synthesised evidence regarding the relationship between alcohol consumption and work performance. Furthermore, we did not know whether different drinking patterns may be dissimilarly associated with impairments across contexts. Such knowledge could be of importance when choosing and tailoring workplace interventions. This thesis adds to the existing literature by providing the first piece

of synthesised evidence exclusively focusing on alcohol-related presenteeism (Paper II). Moreover, the thesis contributes to inform the content of and emphasis in workplace interventions by exploring whether different aspects of alcohol consumption are dissimilarly associated with performance impairments at work (presenteeism) as well as outside the workplace (impaired daily activities) (Paper III).

After reviewing observational studies in the literature, Paper II concluded that there is some support for the notion of alcohol-related presenteeism. Out of 132 tested associations within 26 studies, 77 % of the associations indicated a positive relationship between exposure and outcome, i.e., that higher levels of alcohol consumption were associated with higher levels of work impairments. Positive associations were considerably more likely than negative associations to be statistically significant. Statistically significant associations between alcohol consumption and impaired work performance were found in samples of employees across occupations in Finland (218, 219), Norway (220, 221) and the USA (134, 222), as well as in a multinational sample that included employees from the Czech Republic, Denmark, Greece, Ireland, Portugal, Slovenia and Switzerland (218). Moreover, significant relationships were also found in occupation-specific samples of manufacturing employees (103, 155, 223), employees in solvent-exposed fields (224), military personnel (225, 226), fire fighters (227), community workers (228), petrochemical employees (229), and supermarket employees (230).

Research has demonstrated that drinking pattern, i.e., “the pattern by which individuals consume alcohol”, contributes to determine which and to what extent alcohol consumers experience detrimental outcomes (231, p. 495). Distinctions have been made between chronic heavy drinkers (e.g., with high drinking frequency and high overall volume) and low-level drinkers with recurring binge drinking episodes (232). Binge drinking has been specifically associated with a variety of adverse consequences across studies and populations, including hangovers and blackouts (233), unintentional injuries (234), intentional injuries (235, 236), development of AUDs (237, 238), as well as risk behaviours, e.g., unprotected sexual activity (239) and drunk driving (240). Despite consuming a similar amount of alcohol during a specified time period, infrequent drinkers with binge episodes have been found to have a higher risk of injuries than chronic heavy drinkers (232), and neuroimaging studies have revealed that recurring binge drinking is associated with neurophysiological impairments (241, 242).

Paper III in this thesis provides support for the notion that different drinking patterns are dissimilarly associated with performance impairments at work and outside the workplace, and thus extends previous findings focused on health-related outcomes. Drinking intensity (binge drinking, adjusted for drinking frequency) was significantly associated with impaired performance both at work (presenteeism) and outside the workplace (impaired daily activities), while drinking frequency (adjusted for drinking intensity) was only weakly associated with impaired daily activities. These findings may reflect that recurrent binge drinking episodes lead to impairments that translate into performance decrements across domains. Interestingly, binge drinking displayed a stronger association with impaired daily activities than with impaired work performance. This may be due to binge episodes primarily occurring during weekends and holidays, and as a result of employees applying a higher degree of self-regulation during work hours in order to avoid formal and informal sanctions in the workplace. Hence, by means of both primary/original research (Paper III) and secondary/synthesised research (Paper II), this thesis does provide support for the notion of an association between alcohol consumption and impaired work performance.

Interestingly, all but two of the tested associations included in Paper II measured workforce overall consumption rather than work-related alcohol consumption. According to Frone's conceptual model of employee substance use and productivity (2, 71), on-the-job performance is hypothesised primarily to result from on-the-job drinking (work-related consumption) (pathway BG in Figure 1.2), which to some extent has been demonstrated in psychopharmacological and experimental workplace simulation studies (121-124). Off-the-job drinking (which is captured in measures of overall consumption) is, first and foremost, thought to induce performance decrements in terms of absenteeism (pathway AE in Figure 1.2), which has been supported by studies of the association between alcohol consumption and absenteeism (28). This thesis provides some support for an indirect path between drinking context and impairment context, where off-the-job drinking seems to be associated with on-the-job impairments (pathway ACG in Figure 1.2). This indirect pathway is hypothesised as possible by Frone (2, 71), but has until now been sparsely subjected to secondary research efforts.

It is, however, important to emphasise the complexity of the relationship between alcohol consumption and work performance. Even though Paper II provides overall support for the notion of alcohol-related presenteeism, evidence should still be considered inconclusive as to

whether alcohol constitutes a *risk factor* for impaired work performance. First, included data in Paper II were overall characterised by low quality (61 % of associations suffered from small sample sizes and/or high risk of confounding), and there was a lack of longitudinal studies (21 of 26 studies were based on cross-sectional designs). Second, measurements of both alcohol consumption and work performance were highly heterogeneous, rendering it difficult to compare results across associations/studies. For instance, measured aspects of alcohol consumption included abstainer vs drinker, frequency, volume, binge drinking, hangovers, composite instruments, and dependence/abuse diagnoses. Third, a not negligible proportion of associations (19 %) were negative (implying that higher alcohol consumption was associated with lower impairment), while five associations (4 %) were not possible to classify as positive or negative (found no differences between groups, found differences between groups without a linear pattern, or found a J-shaped pattern where abstainers scored higher on impairment than moderate drinkers yet lower than heavy drinkers). However, only two negative associations were statistically significant (both reported in Friedman et al. (230)), and these two tested the relationship between duration of alcohol use and work performance (finding that longer duration was associated with lower work impairments than shorter duration). Rather than indicating that higher consumption levels per se are associated with lower impairment levels, these two associations may indicate that drinkers with more experience have developed higher tolerance and more sophisticated coping skills than less experienced drinkers.

5.1.2 Considerable risky drinking, yet limited OHS alcohol prevention activity

Alcohol consumption is associated with a variety of detrimental health outcomes (3-14). Despite alcohol consumption constituting a well-established field in research, we did not know enough about risky drinking in the workforce, e.g., with regard to the scope of risky drinking behaviour and factors that characterise employees at particular risk. Specifically, there was a lack of recent studies, studies utilising internationally validated alcohol screening instruments, studies who are not restricted to specific subgroups in the workforce, and studies explicitly investigating intervention needs among employees. Reducing harmful drinking has been underscored as a keystone in sustainable development (1). OHS may constitute a favourable context for implementation of alcohol prevention programmes targeting

employees (68-70, 192, 194, 195, 243, 244), yet research on the role of the OHS in alcohol prevention has been scant (192, 193). This thesis adds to existing literature by studying risky drinking in a heterogeneous samples of employees beyond specific subgroups, by utilising an internationally validated screening instrument (AUDIT (36, 101)), by exploring intervention needs in accordance with WHO international alcohol intervention guidelines (36, 162), and by exploring current practices of and implementation barriers against alcohol prevention in OHS'. As such, the thesis contributes to illuminate the relationship between intervention needs in the workforce and intervention activity in occupational health settings.

Results from Paper I indicate that the vast majority of employees (9 out of 10) consume alcohol at no-risk or low-risk levels. Stated differently, risky drinkers constitute a minority (1 out of 10). Even though risky drinking has been conceptualised, operationalised and measured quite differently across studies, similar findings have been reported in other employee samples (e.g., industrial workers in Australia: 9 % (35); managers in the USA: 7 % (30); restaurant workers in Norway: 6 % (32); private sector employees in Norway: 11 % (34); Canadian employees in various occupations: 8 % (33); computer factory employees in Japan: males 13 %, females 4 % (31)). The active workforce seems to be less prone to risky drinking than the general population. For instance, 17 % of respondents scored within the range of risky drinking in a Norwegian general population sample (114). General population samples do, however, comprise subgroups known to be particularly exposed to high levels of alcohol consumption, such as students (115, 116) and unemployed (245, 246). One out of ten may still be perceived as a considerable amount. In the Norwegian workforce of approximately 2.8 million employees (247), this would translate into 280000 risky drinkers, which is comparable to the total number of inhabitants in Norway's second largest city (248).

Results from Paper I indicate that the likelihood of risky drinking was not evenly distributed throughout the sample of employees. Significant predictors for risky drinking were being male, younger age, not having higher education, being unmarried and not having children. While one out of ten in the overall sample reported risky drinking, the proportion of risky drinkers was approximately three out of ten for males without children, males living alone and males aged <40. These findings support previous research that has demonstrated that men consistently drink more than women (249), and that alcohol consumption tends to decrease with age (250, 251). In line with Paper I, previous studies have indicated that living with a

partner or spouse, and having children may constitute protective factors against high levels of drinking (33, 116, 118).

The finding that lower educational attainment was associated with an increased likelihood of risky drinking is somewhat contradictory to results obtained in previous studies. Although lower socioeconomic status (SES, e.g., defined by educational attainment) in general tends to be related to increased health-risk behaviour (252), the relationship between SES and alcohol consumption is more complex (253). Several studies have revealed that higher SES is associated with higher alcohol consumption, both at an individual level (254) and a societal level (255). Such relationships may be due to the fact that alcohol is a costly commodity (256). Internationally, there is a considerable correlation between education and income (257), providing well-educated employees with better access to alcohol than employees with lower education. There are, however, exceptions to this general picture. Some studies have identified the positive SES-alcohol association solely among females and in specific countries, while others have found binge drinking and higher overall AUDIT-scores to be particularly prevalent among males with low SES (252, 253, 258). Increased risk for developing alcohol dependence has been found among high-school drop outs compared to individuals with higher education (259), and a Danish study (260) revealed that heavy drinking was more prevalent among individuals with low education. The negative association between educational attainment and risky drinking identified in this thesis may, at least partly, be due to a weaker relationship between education and income in Norway, compared to for instance the USA and the United Kingdom (261). Measuring educational attainment solely in terms of duration (as done in this thesis) may hide potent income inequalities between industries. A Norwegian study of average life cycle incomes (261) indicated considerable heterogeneity within university/college educated employees. Some university/college educated groups had average annual incomes at age 40 that were considerably higher than employees with only upper secondary education (medicine: +136 %; economy/business: +100 %; engineering: +81 %; law: +73 %), while other university/college educated groups actually had lower average annual incomes than employees with upper secondary education (preschool teacher: -16 %; nurse: -9 %; social worker: -8 %; teacher: -6 %).

Despite Paper I demonstrating that risky drinking constitutes a quite prevalent phenomenon in the workforce, Paper IV revealed that the majority of OHS professionals (7 out of 10) reported that they worked with alcohol prevention less than on a monthly basis. OHS' alcohol

prevention activity was quite limited, despite the fact that a majority of OHS professionals reported that employees alcohol consumption constitutes a public health challenge (80 %) and that OHS' should focus more on integrating alcohol prevention in their routine practice (67 %). As such, this thesis suggests a quite fundamental mismatch between workforce intervention needs and intervention activity in occupational health settings.

Barriers against implementing alcohol prevention in routine practice may reside on different levels in an organisation, and knowledge of the nature of implementation barriers is a crucial step on the path to the development of strategies for successful implementation (262). According to the i-PARIHS implementation framework (78, 79) (see Figure 1.5) barriers may be localised on three major levels: The recipient level (individuals involved in the implementation processes, i.e., the OHS professionals), the inner context level (local and organisational context, i.e., the OHS units, the OHS structure and employers/companies), and the outer context level (system and policy level, i.e., the health care system, the health care and labour authorities, and the government). A key research objective in Paper IV was to explore OHS professionals' perceptions of implementation barriers and how these barriers were associated with alcohol prevention activity. Somewhat surprisingly, results indicated a discrepancy between how OHS professionals descriptively rated different implementation barriers, and how their perception of barriers was actually associated with prevention activity. On a purely descriptive basis, barriers related to the OHS professionals themselves (recipient level; the belief that alcohol is a personal matter) and employers (inner, organisational level; companies' disinterest in targeting their employees' alcohol consumption) were emphasised. In contrast, adjusted analyses revealed that barriers internal to the OHS' organisation (lack of competence, time and resources) were significantly associated with lower prevention activity, while barriers external to the OHS' organisation were not. The antecedents of this discrepancy remain unknown, but may be related to a possible organisational-level self-serving bias where barriers to achieving important organisational goals are attributed to external factors rather than to the organisation itself (263-265). The identification of competence, time and resources as barriers significantly associated with lower prevention activity in the OHS' is in line with previous research conducted in primary care settings where similar barriers have been underscored (61, 169, 179, 180).

5.1.3 Risky drinking employees primarily need secondary prevention, yet OHS primarily focus on tertiary prevention

In Paper I it was found that one out of ten employees could be characterised as risky drinkers. Furthermore, it was revealed that the vast majority of risky drinkers scored within the range of moderate risk. Moderate-risk drinkers (AUDIT 8-15) constituted 94.6 % of risky drinkers (10.4 % of the total sample), while 4.1 % of risky drinkers were at high risk (0.4 % of the total sample). Very few reported drinking at risk for dependence (1.3 % of risky drinkers, 0.2 % of the total sample).

Risky drinking, as conceptualised in this thesis, does comprise a broad spectrum of drinking habits and consumption levels, from moderate to dependence likely risk, operationalised as a score of 8 or higher on the AUDIT (see Figure 1.4). Obviously, scores in the lower and upper ends of the risky drinking interval (8-40) represent quite different drinking patterns that should be targeted by means of different intervention approaches. Approximately nine out of ten risky drinkers reported moderate risk, and could therefore benefit from secondary prevention programmes. The WHO international intervention guidelines (36, 162) recommend simple advice on how to reduce alcohol consumption for those within the range of moderate risk. Brief interventions may be characterised as secondary prevention programmes aimed at reducing alcohol consumption and consumption-related harms among risky drinkers who do not actively seek treatment for alcohol problems (51). Such programmes comprise a wide range of approaches, but have in common that they are based on social-cognitive theory and are structured in accordance with the FRAMES principle (Feedback on alcohol use, risks and negative consequences; emphasis on the individuals' Responsibility; Advice on how to reduce consumption; providing a Menu of options for how to achieve behavioural change; Empathic and non-judgemental approach; and building the individuals' Self-efficacy) (51, 266, 267).

In Paper IV, it was found that tertiary prevention activities were significantly more prevalent than secondary (and primary) activities in the OHS'. As such, this thesis indicates that the OHS, at least when it comes to alcohol prevention, is more focused on employees who have already experienced alcohol-related problems than on employees who have not or are only at risk of developing such problems. This finding is interesting, given that Paper I suggested a considerably greater need for secondary than for tertiary prevention activity (only 1 out of 10

risky drinkers reported high or dependence likely risk, while 9 out of 10 reported moderate risk). This discrepancy represents a further extension of the argument that OHS alcohol prevention practice is mismatched with workforce intervention needs.

The mechanisms underlying this discrepancy are likely quite complex and are perhaps a reflection of the OHS being a part of the larger health care system. It is plausible to suggest that the health care system is more focused on treatment than on prevention, which may reflect that, despite an increasing awareness of benefits associated with prevention, the health care system is still largely characterised by a reactive or pathogenic approach (158, 268, 269). Even though operating in a time where chronic and non-communicable diseases constitute the greatest challenges to public health, the health care system, designed in an era where treating infectious diseases was most pivotal, may not have been appropriately restructured (269). In order to remedy alcohol-related problems, including impaired work performance, one may argue that the OHS should increase its overall alcohol prevention activity, and shift its emphasis from tertiary to secondary (and primary) intervention activities.

5.2 Implications for practice

5.2.1 Preventing alcohol-related impaired work performance

Assuming an association between alcohol consumption and impaired work performance, the question of intervention implications arises. The concept of presenteeism and its relationship with other occupational outcomes (e.g., absenteeism) is far from straightforward. Intuitively, presenteeism stands out as a detrimental outcome that should be targeted and prevented, especially if presenteeism is conceptualised as decreased on-the-job performance (143, 151, 152), i.e., as an alternative to optimal work performance. On the other hand, it is possible to argue that presenteeism represents an alternative to absenteeism (rather than to optimal work performance). In this sense, it is plausible to reach an opposite conclusion, i.e., that active efforts to prevent presenteeism may lead to increased absenteeism (the absence of productivity) rather than to increased work performance. The illness flexibility model (72, 73) (see Figure 1.3) conceptualises both absenteeism and presenteeism as chosen behaviours resulting from an employee's subjective appraisal of his or her work ability in light of health problems and a set of contextual factors. In this model, work attendance despite loss of

function (presenteeism) is more likely than not attending work (absenteeism) when the employee experiences high adjustment latitude and a high attendance motivation (as a result of high attendance requirements and incentives).

Presuming a relationship between presenteeism and absenteeism, the question of whether and how to intervene directly against such productivity decrements is complex. First, the source of the underlying health condition or function loss may be more or less controllable. Some conditions may be due to largely controllable problem or risk behaviours, e.g., impairments due to risky drinking or otherwise problematic alcohol consumption. Conversely, other impairments may be of fundamentally non-controllable origins, such as physical diseases and mental disorders. Faced with largely controllable impairments (e.g., alcohol-induced loss of function), it seems more pivotal to target and prevent the problem behaviour rather than to focus on preventing a specific occupational outcome. Second, health conditions may be contagious or non-contagious (non-communicable). Pichler and Ziebarth (270) distinguished between contagious presenteeism and non-contagious absenteeism. They defined contagious presenteeism as "when employees with a contagious disease (e.g., a common cold) go to work sick and spread the disease to coworkers, customers, and the general population", and non-contagious absenteeism as "when employees without a contagious disease (e.g., back pain) call in sick" (270, p. 15). Absenteeism is probably favourable in the case of acute contagious diseases, while the opposite may be true for more chronic non-communicable conditions. Third, optimal work performance is more crucial in some jobs than in others. For instance, impaired work performance carries critical safety implications for employees operating heavy machinery. In sum, the cause(s) of the loss of function, the nature of the health condition(s), and the nature of the job should all be factors to consider when determining whether and how to intervene directly against performance impairments at work.

In the case of non-controllable, chronic and non-communicable diseases, presenteeism may generally be preferable over absenteeism. From the employees' perspective, attending work may ensure access to important economic and psychosocial resources, while employers would benefit from some degree of employee productivity as the alternative to the absence of productivity. In accordance with the illness flexibility model (72, 73), an increased likelihood of choosing presenteeism over absenteeism could be achieved by ensuring appropriate adjustment latitude (e.g., task and pace flexibility) as well as by increasing attendance requirements and incentives. On the other hand, absenteeism would probably be preferable for

both employees and employers in cases of more acute and contagious conditions. Alcohol-induced impairments are somewhat less straightforward. Alcohol may affect work performance through different mechanisms. One may argue that employees suffering from active alcohol intoxication should not be allowed into the workplace, while employees experiencing hangover symptoms could in some instances benefit from attending work, insofar that safety concerns do not preclude this.

Although providing some support for alcohol-related presenteeism as a work-related productivity decrement, this thesis does not imply that interventions should target presenteeism behaviour directly. Rather, this thesis provides further support for targeting the underlying problem behaviour (alcohol consumption), with the aim of employees not being forced into situations in which they experience alcohol-related impairments that may lead to a choice between presenteeism and absenteeism.

5.2.2 Preventing risky drinking

Assuming a conceptual model in which effects of alcohol consumption on work performance may be mediated by health decrements and impairment (see Figure 1.1), directly targeting risky drinking (or otherwise problematic alcohol consumption) may be more fruitful than targeting specific occupational outcomes.

5.2.2.1 Secondary prevention approaches: Moderate-risk drinkers

The vast majority of risky drinkers identified in Paper I would, in line with WHOs international intervention recommendations (36, 162), benefit from secondary prevention activities, e.g., in the form of brief interventions. Brief interventions may be performed by means of a few face-to-face consultations with a health care professional (e.g., a OHS professional), or in a web-based format where the individual receives the intervention on a digital platform. A large body of evidence has indicated that brief alcohol interventions carry favourable effects. In a review of studies exploring effects of face-to-face interventions of maximum four sessions in health care settings, Cuijpers, Riper and Lemmers (49) found that brief interventions appeared to reduce mortality among heavy drinkers (PF = 0.33, implying that one in three deaths was prevented). In a review of 24 systematic reviews of studies in

primary care settings published between 2002 and 2012, O'Donnell et al. (52) concluded that brief alcohol interventions consistently reported favourable outcomes, particularly for middle-aged males. In an updated Cochrane review of face-to-face brief interventions in primary care samples (51), it was concluded that participants in intervention groups on average consumed 20 grams less pure alcohol per week than controls 12 months after intervention. Brief web-based alcohol interventions have demonstrated similar effects. In a review of 14 RCTs in college student, employee and general population samples, Riper et al. (56) found that participants who received single-session personalised feedback interventions without therapeutic guidance reduced their alcohol consumption post intervention, compared to controls (d = 0.22, 95 % CI: [0.16, 0.29]). Another review of 16 RCTs (57) found that brief web-based interventions not only reduced average weekly consumption of pure alcohol (M_{diff} = 22 grams), but revealed that participants who received these interventions were more likely to adhere to low-risk guidelines post intervention (RD = 0.13, 95 % CI: [0.09, 0.17], p <.001).

Some studies have explored effects of brief alcohol interventions in samples of employees. Schulte et al. (37) reviewed the literature and found that eight out of nine studies conducted in workplace settings demonstrated favourable results of both face-to-face and web-based interventions. For instance, in a study of Japanese manufacturing plant employees, Araki et al. (47) demonstrated a reduction from 24.8 to 12.1 grams of pure alcohol per day, Anderson and Larimer (46) found a reduction in drinking days per week from 2.39 to 1.95 among employees in food and retail services in the USA, and Osilla et al. (55) revealed a reduction from 7.56 to 4.67 peak drinks per occasion in a heterogeneous employee sample in the USA. In a French study, Michaud et al. (54) found that employees in various occupations reduced their overall AUDIT score from 7.55 to 6.59, while Doumas and Hannah (50) estimated a reduction from 2.42 to 1.87 drinks per weekend among American employees, and Matano et al. (53) demonstrated that risky drinkers reduced their binge drinking by 48 % after receiving a brief web-based intervention. In a recent study among employees in Germany, Boß et al. (48) found that an internet intervention not only reduced alcohol consumption (by 4.9 standard alcohol units; b = -4.85, 95 % CI: [-7.02, -2.58], p <.001), but also improved general as well as work-related mental health (reduced stress, anxiety, depression and irritation).

Although several studies have demonstrated favourable results of secondary alcohol prevention programmes in workplace settings, both results and quality are somewhat mixed. For instance, in a one-year randomised trial among Swedish employees who underwent

voluntary alcohol screening (271), no significant difference on risky drinking was found between the intervention and control group. However, the authors noted that the alcohol screening itself may have carried favourable effects, which could have explained the lack of difference between the groups. In an Australian cluster non-randomised three-year trial of a worksite alcohol harm reduction intervention (272), no significant effect on risky drinking was found. The researchers did, however, find significant favourable effects on alcohol policy awareness and awareness of employee assistance. In a review of workplace alcohol prevention programmes with a particular emphasis on studies' methodological properties (273), it was concluded that all included RCTs were tainted by methodological problems related to both internal and external validity. Similarly, quality assessment of included studies in another review (37) revealed that the majority of studies did not contain adequate descriptions of selection procedures.

Despite some inconsistencies regarding results and quality, the overall picture painted by a large body of evidence implies favourable effects of secondary brief alcohol interventions. Face-to-face and web-based interventions may have different strengths and weaknesses. For instance, face-to-face sessions have advantages with regard to individual tailoring, while web-based interventions ensure participants' anonymity and may be disseminated broadly at a low cost.

In Paper I, it was estimated that certain factors (being male, young, unmarried, having low education and not having children) were associated with risky drinking. Identification of a set of sociodemographic correlates of risky drinking may be important in determining workplaces' systematic HSE efforts, even though these associations are not appropriate for constructing check lists that employers may use to assess individual employees' likelihood of risky drinking. Group-level relationships cannot be directly deduced to individuals, but may nevertheless be directive in determining which and to what extent companies should integrate alcohol prevention in their HSE efforts. Although one can argue that integrating alcohol prevention in routine HSE efforts is serviceable for all companies, this thesis implies that it may be particularly important for companies who largely employ males, younger and unmarried employees, employees with low education and employees without children.

In Paper III, it was found that binge drinking was more strongly associated with performance impairments than drinking frequency, which does imply that alcohol prevention programmes

should include a particular emphasis on binge drinking behaviour. Some authors have argued that binge drinking constitutes a defining aspect of risky drinking (240), and key sociodemographic factors associated with binge drinking – e.g., being male, young and having low education (274) – do correspond with factors associated with risky drinking identified in this thesis (Paper I). Hence, one may argue that preventing risky drinking should involve an emphasis on (reducing) binge drinking. This seems particularly true with respect to the Norwegian population. The Norwegian population is largely characterised by a large proportion of regular drinkers (Norway: 79 %; Nordic countries: 73 %; USA: 72 %; Europe: 60 %; world: 43 %), a relatively low annual consumption volume per inhabitant (Norway: 9.4 litres of pure alcohol; Nordic countries: 13.5 litres; USA: 13.7 litres; Europe: 17.2 litres; world: 15.1 litres), and a high rate of recurrent binge drinkers (Norway: 32 %; Nordic countries: 28 %; USA: 26 %; Europe: 26 %; world: 18 %) (1). Correspondingly, the Norwegian drinking culture has been described as a "dry" drinking culture, characterised by weekday abstention combined with weekend binge drinking (275, 276). Although studies have demonstrated somewhat mixed evidence (277-279), brief interventions targeting binge drinking behaviour have generally yielded promising results (233), with regard to both face-to-face approaches (280-282) and web-based approaches (283-286).

5.2.2.2 Primary prevention approaches: Low-risk drinkers

Even though this thesis implies that risky drinking among employees constitutes a phenomenon that deserves more attention, it should be kept in mind that the majority of employees reported low-risk drinking. Nine out of ten scored below the threshold for risky drinking. Hence, the majority of employees would reside within the group who could benefit from primary prevention activities. According to the WHO (36, 162), this group should receive general alcohol education aimed at maintaining low-risk drinking.

General alcohol education is based on the assumption that individuals' likelihood of making serviceable choices (e.g., maintaining a low consumption level or reducing a high consumption level) increases by providing them with information about alcohol and associated risks (287). Research has primarily focused on evaluating secondary and tertiary prevention programmes, leaving less attention for exploring effects of primary prevention activities, such as health promotion programmes (288, 289). Moreover, the research that does exist on alcohol education interventions in workplace settings generally show more

inconsistent results, compared to research on secondary activities, such as brief interventions targeting risky drinking.

In a sample of construction workers in the USA, there were no significant differences in alcohol consumption between a control group and an intervention group that received a primary prevention programme (163). Participants in the intervention group did, however, show improved motivation for reducing their alcohol consumption. Similarly, Richmond et al. (290) found no significant reductions in alcohol consumption after participating in a broad health promotion programme among Australian postal workers. On the other hand, significant reductions in heavy drinking have been found among American restaurant workers who participated in a training workshop that included group discussions, role play and practice activities (164). Two studies have explored effects of primary alcohol education interventions among employees in Sweden. In a study of employees working in the finance/insurance sector (166), employees received two brief lectures. Compared to a control company in the same sector, employees who had received the intervention displayed a significantly increased risk knowledge, although there were no significant differences in actual alcohol consumption. The second study (165) explored effects of a day-long alcohol education programme in a sample of Swedish municipality employees. Overall, employees who received that programme did not score lower on the AUDIT than those who did not. However, stratified analyses (stratified by consumption level) revealed that the programme significantly reduced binge drinking frequency among those with high consumption levels. Noteworthy, these high-consumption employees were at the high end of (but still within) the low-risk drinking category.

Inconsistent results for primary prevention interventions may, of course, reflect truly weak or non-existent effects of such activities. On the other hand, it seems important to keep in mind that studying effects of such interventions may be quite challenging. In contrast to secondary prevention interventions that aim to reduce risky drinking (reduce alcohol consumption), primary prevention programmes may aim to maintain a low-risk level or prevent the development of a risky drinking behaviour. Stated differently, studying reduced rates of risky drinking (an undesirable end-state) may be more straightforward than studying the maintenance of a desirable end-state. Samples included in primary prevention studies likely consist of large proportions of low-consuming employees who do not experience alcohol-related problems (166). Hence, significant reductions in consumption would be difficult to detect. Insofar that primary alcohol prevention programmes in workplace settings have been

found to improve motivation for reducing alcohol consumption (163), to some extent reduce heavy drinking and binge drinking frequency (164, 165), and improve knowledge of alcohol-related risks (166), they should not be depreciated as potentially important tools in preventing risky drinking among employees.

5.2.2.3 Tertiary prevention approaches: High- and dependence likely risk drinkers

As identified in Paper I, only a small proportion of risky drinkers (one out of ten) reported high or dependence likely risk that would necessitate tertiary prevention approaches. The WHO recommend counselling, consecutive monitoring and referral to diagnostic evaluation for these risk groups (36, 162). High-risk drinkers may benefit from counselling and monitoring by means of face-to-face brief alcohol interventions, at least as a first step prior to a potential referral to diagnostic evaluation or more comprehensive treatment. Web-based approaches would probably be quite futile for these individuals.

5.2.3 Development of implementation strategies

Despite indicating a quite limited alcohol prevention activity in the OHS', this thesis provides support for the notion of the OHS' constituting a serviceable context for implementing alcohol prevention programmes targeting employee risky drinking. In Paper IV, it was found that eight out of ten OHS professionals perceived alcohol consumption among employees to constitute a public health challenge, and that seven out of ten agreed that alcohol prevention should be emphasised more in OHS' routine practice.

This thesis implies that strategies for successful (increased) implementation of alcohol prevention programmes in OHS settings should target all three levels specified in the i-PARIHS implementation framework (78, 79), which reflects the WHO's Ottawa Charter's emphasis on health promotion as a broad collaboration between authorities, industries, local stakeholders and organisations (77). On the recipient level, one should focus on OHS professionals' knowledge of the importance of alcohol prevention and knowledge on how to conduct prevention programmes (based on the identified association between lack of knowledge and prevention activity), as well as on attitudes towards the nature of alcohol consumption and the scope of alcohol-related problems (due to OHS professionals

descriptively rating beliefs that alcohol is a personal matter as the most salient implementation barrier). On the inner and outer context levels, based on the identified association between time/resources and prevention activity, one should ensure adequate time and resources to enable OHS' to prioritise and integrate alcohol prevention activities in their systematic HSE efforts. This may include establishing a thorough alcohol training programme for OHS professionals, which is related to lack of knowledge on the recipient level.

Lessons learned from the Risk Drinking Project (RDP) in Sweden (291) – a national initiative aimed at implementing brief alcohol interventions and alcohol issues in routine primary, child, maternity and occupational health care – may serve as a point of departure for establishing appropriate strategies for targeting implementation barriers identified in this thesis. Actively facilitating the implementation of alcohol prevention programmes in the OHS may necessitate commitment from executive system stakeholders, such as health and labour authorities. One may, therefore, argue that the process of facilitation should begin by targeting relevant stakeholders on the outer context level in order to secure commitment, funding and other necessary resources, with the aim of establishing an implementation programme that enables active facilitation within and across OHS units. Research evidence on the importance of working with alcohol prevention among employees (detrimental health and occupational outcomes associated with alcohol consumption; benefits of favouring prevention over treatment), workforce intervention needs, and OHS' potential in alcohol prevention could represent important elements in ensuring commitment on a system level.

Facilitation comprises the facilitator role as well as the process of facilitation (78, 79). Building a sense of ownership among OHS professionals is important (291), and on the recipient and inner context levels, one may appoint a facilitator in each OHS unit. Different professions could inhabit such a role, and experiences from the RDP (291) imply that the facilitator role do not necessarily have to be filled by professionals who most often work with alcohol prevention. In Paper IV, it was found that physicians and psychologists were most often involved in alcohol prevention activities, yet the facilitator role may also be ascribed professionals with different educational background, such as nurses and occupational therapists.

Experiences from the RDP imply that contextual adaptation is an important factor for success, i.e., that existing OHS routine should be modified rather than subjected to pervasive change.

Stated differently: It may be more serviceable for facilitators to facilitate an integration of alcohol prevention activities into routine practice than to aspire a fundamental change in existing routines. In the RDP, alcohol screening was not introduced as a new, sequestered effort, but was integrated in routine lifestyle examinations (291). The principle of contextual adaptation would also imply that the choice of alcohol prevention programme should not be standardised. For instance, an OHS providing services for companies within transportation and health care may need a somewhat different approach to alcohol prevention than an OHS serving companies in the restaurant industry. It is, however, important to ensure that alcohol prevention activities are performed in accordance with efforts that have demonstrated positive effects in research. Detailed implications for contextual adaptations of alcohol prevention programmes cannot be drawn from this thesis, although one may argue that contextual adaptation should be a prioritised focus within the facilitator role.

Establishing a sound training programme for OHS professionals (recipient level), as well as for appointed facilitators, could be achieved with a multifaceted approach by means of knowledge translation interventions. Knowledge translation involves synthesising, adapting and disseminating knowledge with the aim of providing better health services (262). Knowledge of the importance of working with alcohol prevention, and knowledge on how to perform alcohol prevention activities in an occupational health setting (such as secondary brief interventions), could be disseminated to OHS professionals (by their trained facilitators) by means of audit and feedback processes (292) in combination with multifaceted educational interventions (293). Research has demonstrated that educational interventions are most effective when including interactive elements (e.g., group discussions (293)), and that audit and feedback processes benefit from utilising internal facilitators (a leader or colleague rather than an external consultant (292)).

On an organisational inner context level, the facilitator could ensure an appropriate cooperation with companies' management and other relevant partners. In a Norwegian context, a close collaboration with Akan would be important.

5.3 Methodological considerations

Methodological strengths and weaknesses specifically related to each paper are discussed more detailed in the papers. Some executive methodological issues associated with the thesis are raised in the following.

5.3.1. Internal validity issues

5.3.1.1 Research design

The empirical studies in this thesis (Papers I, III and IV) were based on cross-sectional designs, which precludes any causal inferences regarding the relationship between variables. In Paper IV, for instance, it was not possible to establish that lack of knowledge among OHS professionals was the *cause* of low alcohol prevention activity. It may well be that low activity caused a lack of knowledge, or that some extraneous factors were the cause of both. Although this may be conceived as a major limitation, its potential impact must be appraised in accordance with the study aims. The empirical studies in this thesis did not aim to reveal causal mechanisms, but rather to explore associations between variables, with inclusion of sets of control variables in order to minimise possible confounding. As such, cross-sectional designs stand out as appropriate (294).

Although effects of exposures on outcomes are best studied with experimental designs (294), certain epidemiological topics are not easily amenable to investigation by means of randomised trials. For instance, it may be both unethical and impractical to randomise employees into different levels of alcohol exposure at work in order to study the effects on work impairments. For this reason, only observational studies (case-control, cohort and cross-sectional studies) were included in the review study (Paper II). The ultimate goal of observational studies may, nevertheless, be to reach conclusions similar to those that would have been arrived at by utilising experimental trials (295). Hence, the fact that cross-sectional designs made up the majority of included studies in the systematic review does represent a potent limitation that carries substantial implications for future research. This is thoroughly discussed in Paper II.

5.3.1.2 Measures and analyses

The empirical papers in the thesis were based on self-reported data from employees (Papers I and III) and OHS professionals (Paper IV), which may involve risks of measuring bias. Survey participants may misunderstand questionnaire items, have difficulties remembering information (recall bias), and may modify their responses in order to project a favourable image of themselves (social desirability bias) (296). The latter may be of particular concern when measuring alcohol consumption, and studies have found a discrepancy between self-reported alcohol consumption and actual alcohol sales (297). Hence, socially undesirable behaviours and phenomena, such as alcohol consumption and impaired work performance, may have been underestimated in the thesis. Nevertheless, authors have argued that self-reported alcohol measures often represent the best available data sources, particularly in studies involving large samples (298, 299). Collateral-reported data represent an alternative. In most instances, however, the use of collateral ratings would suffer from the same limitations as self-reported data (300). Collaterals can, like the subjects themselves, commit cognitive errors (misunderstand and recall incorrectly) and may, as a result of being socially connected with the subjects, modify information about socially undesirable behaviours. Even biological tests (e.g., hair, breath, urine and blood tests) are plagued by major shortcomings. Frone (2) underscored that biological tests suffer from relatively short detection times and not being able to inform about drinking pattern and context. He concludes that in order to "obtain detailed data on the pattern and context of employee substance involvement, one needs to rely on self-reports of individuals participating in epidemiological surveys" (2, p. 25). Consequently, one may argue that – rather than questioning the expediency of utilising self-reports – it is more appropriate to question the quality of the self-reported measures that were applied.

In this thesis, alcohol consumption and risky drinking were measured with the AUDIT (36, 101) (the full 10-item version in Paper I and selected items in Paper III), which may be considered as a strength insofar that this instrument has demonstrated psychometric properties superior to other alcohol screening instruments (102). Moreover, factor analysis and analysis of internal consistency (Table 3.6) revealed that the AUDIT demonstrated measurement properties that are comparable to previous research (102, 211, 214). Other validated measures included in the thesis were the Work Productivity and Activity Impairment questionnaire (WPAI (200)) for measuring impaired work performance (Paper III), and the Drinking Norms

Scale (DNS (109)) for measuring drinking social norms (Paper IV). On the other hand, potential measurement limitations are related to (i) some measures having been developed specifically for this thesis (e.g., measurement of implementation barriers in Paper IV), and (ii) some constructs being assessed with single-item measures (e.g., exposures and outcomes in Paper III). The measurement of implementation barriers in Paper IV was, however, based on results from qualitative interview panels and factor analysis, and single-item assessments have demonstrated satisfactory reliability when inquiring about rather objective facts (301).

5.3.2. Representativity and external validity issues

Issues of external validity, i.e., the "generalizability of findings *to* or *across* target populations" (302, p. 229), are of particular importance for the three empirical studies in this thesis (Papers I, III and IV) as a result of being cross-sectionally designed and aimed at making inferences about populations based on samples of individuals who volunteered to participate.

Papers I and III, based on samples of employees, included relatively large samples (Paper I: N = 3571; Paper III: N = 3278), yet the final response rates were quite low (Paper I: 29.8 %; Paper III: 22.8 %). Non-response bias becomes a threat to external validity when those who participate systematically deviate from those who do not, and in particular when it is reason to believe that the study variables (e.g., alcohol consumption) interact with attributes of the individuals included in the study (e.g., sociodemographic characteristics) (302). Studies have demonstrated that non-responders in health surveys tend to be less healthy than responders (294), and that males, heavy drinkers and individuals with low socioeconomic status tend to be overrepresented among non-responders (303, 304). The importance of comparing study samples to invited samples (eligible samples) and populations, as well as comparing responders with non-responders, has been stressed (294).

Study selection analyses (see Table 3.3) revealed that the study samples in Papers I and III, based on distributions of gender and age, were quite representative for the invited sample. However, the samples were significantly different from the national workforce, with a sample overrepresentation of females, older employees and employees with higher education. On the other hand, the study samples were considerably more similar to the population of public

sector employees. A comparison between responders (those who responded to the AUDIT items) and non-responders (those who responded to the sociodemographic items but not the AUDIT items) revealed that responders were characterised by a slight overrepresentation of males, older employees and employees with higher education (see Table 3.4).

Paper IV, based on a sample of OHS professionals, included a smaller sample size (N = 295), yet a higher response rate (49.1 %). Study selection analyses demonstrated that OHS units and professionals in the sample were mostly non-significantly different from the population of approved OHS' in Norway (regarding OHS professionals' educational background, number of employees in the OHS' and number of employers served by the OHS'; see Paper IV, Additional file 3, Table A3,1). Moreover, responding professionals (those who responded on all study items) were – with regard to age, gender and educational background – not significantly different from non-responding professionals (those who only responded to the sociodemographic items) (see Paper IV, Additional file 3, Table A3,2).

Taken together, issues of representativity and external validity do pose certain limitations. In particular, generalisations from Papers I and III should be done with ample caution. Insofar that the samples were considerably more representative for public sector employees than for the national workforce, one may argue that this thesis primarily carries implications for the former. The significant underrepresentation of males, younger employees and employees with lower education may have resulted in an underestimation of alcohol consumption, risky drinking and alcohol-related impaired work performance.

5.3.3 Conceptualisations and operationalisations

Some of the concepts prominent in this thesis (in particular risky drinking and presenteeism) have been subject of debate among scholars. *Risky drinking* has in this thesis been conceptualised as a drinking pattern that increases the risk of social, legal, medical, occupational, domestic and economic problems (36). The term "risky drinking" was preferred over alternative terms (e.g., problem drinking) due to the thesis' prevention perspective ("problem" may indicate that drinking-related problems have already occurred and may thus preclude at-risk drinking that has not yet materialised in adverse consequences). Risky drinking was operationalised as a sum score of eight or higher on the AUDIT, comprising

three distinct risk levels (moderate, high and dependence likely risk) (36, 101). The term could have been operationalised in alternative manners, e.g., by means of (i) national drinking guidelines specifying amounts of consumed alcohol within a specified time frame, (ii) another composite alcohol screening instrument (such as the CAGE questionnaire (305)), or (iii) another threshold for risky drinking on the AUDIT. A composite screening instrument was favoured over a national drinking guideline since the former is better able to capture differences in consumption patterns and, at the same time, less vulnerable to international variations in drinking norms. The AUDIT was favoured over other composite instruments for two reasons. First, the AUDIT has demonstrated psychometric properties superior to other screening instruments (102). Second, the AUDIT has a scoring system that easily enables estimations of intervention needs in accordance with WHO international intervention guidelines (162). A cut-off of eight points on the AUDIT was chosen based on research demonstrating that this threshold represents a satisfactory compromise between sensitivity and specificity (36) or, as stated by Conigrave et al. (306, p. 1349), "a reasonable approximation to the optimal for a variety of endpoints". It should be noted, however, that several studies have applied higher thresholds (307, 308), and that some authors have suggested to operate with different cut-offs based on gender (214, 309). A higher threshold would increase sensitivity, yet at the cost of specificity. Studies exploring the AUDIT in non-clinical samples have generally adopted cut-offs between six and eight (310-313). Although a sum score of eight could suggest the presence of a risky drinking pattern, this score does not automatically imply that the individual is in need for intervention. For instance, the risk of developing or experiencing alcohol-related problems would probably be quite different for a healthy and active young individual than for an elderly individual plagued by several medical issues, even though they both may score eight points on the AUDIT. Although the utilisation of a relatively low threshold for risky drinking has been found to represent an acceptable compromise between sensitivity and specificity, it may result in a not neglible proportion of false positives. When applying alcohol screening in practical contexts, practitioners should therefore be aware of the potential risk of pathologising individuals' lifestyle choices. As a general rule, and individual's AUDIT score should be interpreted with some caution, and not without taking other relevant factors into account.

In this thesis, *presenteeism* has been conceptualised as "decreased on-the-job performance due to health problems" (151, p. 503), rather than simply "showing up for work even when one is ill" (142, p. 519). As such, this thesis takes a perspective on presenteeism that

presupposes de facto productivity loss. While several authors have advocated such an understanding (143, 151, 152), others (142, 145) have contended that this view on presenteeism involves a definition that ascribes valence to the phenomenon, and that conflates cause and effect by assuming a particular outcome (productivity loss). In an organisational context, one may argue that occurrences of attending work while ill primarily become of interest when productivity decrements are involved. In order to avoid conflating cause and effect, alcohol-related presenteeism has in this thesis been operationalised as the product of a (positive) relationship between alcohol consumption and impaired work performance. This understanding underpins the inclusion criteria in Paper II (exposure: alcohol consumption; outcome: work performance). In Paper III, however, one may argue that the outcome measurements of performance impairments (items from the WPAI) do in fact conflate cause and effect by asking employees to what extent they have experienced productivity loss due to alcohol consumption. In light of how the research question in Paper III was formulated, however, a possible conflation may be conceived as less problematic (insofar that the study aimed to compare how two distinct drinking patterns were associated with alcohol-related performance impairments).

5.4 Implications for future research

This thesis represents a step on the path to a better and more integrated understanding of employee alcohol consumption and intervention needs, impaired work performance associated with alcohol consumption, and implementation of alcohol prevention programmes in OHS'. The thesis has revealed considerable limitations in existing research literature, and the studies included in the thesis do themselves suffer from certain limitations. Hence, further research is warranted.

First, although the thesis provides support for the notion of alcohol-related presenteeism (Papers II and III), the review study (Paper II) revealed the need for more robust studies. The vast majority of identified studies were cross-sectional and the majority of statistical associations tested within these studies were characterised by relatively low sample sizes and/or considerable risk of confounding. More sophisticated designs, such as retrospective

case-control and prospective cohort studies, are needed in order to establish the nature and impact of alcohol-related presenteeism in the workforce.

Second, this thesis has underscored challenges related to conceptual and measurement heterogeneity in the literature, regarding measurement of risky drinking (as shown in Paper I) as well as alcohol-related presenteeism (Paper II). Such heterogeneity renders it difficult to compare results across studies and populations, and constituted the primary reason for why it was considered inappropriate to conduct meta-analyses in Paper II. Progress in the field seems to depend on researchers' ability to reach more consensus on the topic of conceptualisation and measurement, and future research would benefit from measurement triangulation. For instance, application of validated self-report instruments could be combined with objective and/or collateral measures. In the case of alcohol consumption, a self-reported screening instrument (e.g., the AUDIT) may be used in combination with (i) questionnaire items differentiating between on-the-job and off-the-job drinking, and (ii) a biomarker test (e.g., carbohydrate-deficient transferrin, CDT). In the case of work performance, a self-reported composite measure (e.g., the Stanford Presenteeism Scale (150)) may be used in combination with (i) supervisors' (collaterals') ratings of work performance, and (ii) register data on employee task performance (where possible). Moreover, inclusion of relevant confounders, mediators and moderators (e.g., sociodemographics and variables related to general health, work and lifestyle) is pivotal.

Third, although this thesis provides support for the OHS constituting a serviceable arena for alcohol prevention activity, the implementation study (Paper IV) did only explore the general potential for alcohol prevention in OHS' (rather than implementation of specific alcohol prevention programmes). Further research on implementation processes in OHS' is warranted, and future studies would benefit from conducting effect studies as well as process evaluations in order to examine effects and implementation of different types of alcohol prevention programmes (e.g., face-to-face versus digital/web-based interventions) in different employee groups (e.g., sub-group analyses based on individual and work-related characteristics) in different sectors and industries.

6. Conclusions

Alcohol is deeply integrated in cultural contexts and social situations, yet consumption of alcohol represents a major public health challenge related to both health and participation. Reducing harmful alcohol consumption has been defined as a keystone in sustainable development, and although alcohol prevention programmes have demonstrated favourable effects in research, it has proved difficult to implement them in practice. This thesis aimed to generate a better understanding of employee alcohol consumption and intervention needs, impaired work performance associated with alcohol consumption, current practices and barriers against implementing alcohol prevention programmes in OHS'.

The thesis found (i) that there seems to be an association between alcohol consumption and impaired work performance (alcohol-related presenteeism), (ii) that risky drinking was quite common among employees, yet OHS' alcohol prevention activity was limited, and (iii) that the vast majority of risky drinkers would benefit from low-cost secondary prevention interventions, yet OHS' alcohol prevention activities was more focused on tertiary prevention than on secondary prevention. Hence, the thesis suggests that although the OHS stands out as a serviceable arena for alcohol prevention activities, there seems to be a fundamental mismatch between workforce intervention needs and intervention activity in occupational health settings.

Even though further research is warranted, this thesis carries the promising message that OHS' may constitute an abeyant asset for preventing alcohol problems among employees, and thus contribute to remedy health and participation challenges benefiting individuals as well as societies, insofar that OHS professionals are ensured adequate training, time and resources.

7. References

1. World Health Organization. Global status report on alcohol and health 2018. Geneva, Switzerland: World Health Organization; 2018.

2. Frone MR. Alcohol and illicit drug use in the workforce and workplace. Washington, DC: American Psychological Association; 2013.

3. Griswold MG, Fullman N, Hawley C, Arian N, Zimsen SRM, Tymeson HD, et al. Alcohol use and burden for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet. 2018;392(10152):1015-35 doi:10.1016/S0140-6736(18)31310-2.

4. Room R, Babor T, Rehm J. Alcohol and public health. Lancet. 2005;365(9458):519-30 doi:10.1016/s0140-6736(05)70276-2.

5. Wood AM, Kaptoge S, Butterworth AS, Willeit P, Warnakula S, Bolton T, et al. Risk thresholds for alcohol consumption: combined analysis of individual-participant data for 599 912 current drinkers in 83 prospective studies. The Lancet. 2018;391(10129):1513-23 doi:10.1016/S0140-6736(18)30134-X.

6. Cortes VF, Taveira A, Cruz HM, Reis AA, Cezar JS, Silva BS, et al. Prevalence of hepatitis B and C virus infection among alcoholic individuals: Importance of screening and vaccination. Revista do Instituto de Medicina Tropical de Sao Paolo. 2017;59 doi:10.1590/s1678-9946201759047.

7. Rehm J, Gmel GE, Gmel G, Hasan OSM, Imtiaz S, Popova S, et al. The relationship between different dimensions of alcohol use and the burden of disease - an update. Addiction. 2017;112(6):968-1001 doi:10.1111/add.13757.

8. Sarkar D, Jung MK, Wang HJ. Alcohol and the immune system. Alcohol Research: Current Reviews. 2015;37(2):153-5.

9. Bagnardi V, Rota M, Botteri E, Tramacere I, Islami F, Fedirko V, et al. Alcohol consumption and site-specific cancer risk: A comprehensive dose-response meta-analysis. British Journal of Cancer. 2014;112(3):580-93 doi:10.1038/bjc.2014.579.

10. Bellos S, Skapinakis P, Rai D, Zitko P, Araya R, Lewis G, et al. Cross-cultural patterns of the association between varying levels of alcohol consumption and the common mental disorders of depression and anxiety: Secondary analysis of the WHO collaborative study of psychological problems in general health care. Drug and Alcohol Dependence. 2013;133(3):825-31 doi:10.1016/j.drugalcdep.2013.08.030.

11. Boden JM, Fergusson DM. Alcohol and depression. Addiction. 2011;106(5):906-14 doi:10.1111/j.1360-0443.2010.03351.x.

12. Brown SA, McGue M, Maggs J, Schulenberg J, Hingson R, Swartzwelder S, et al. A developmental perspective on alcohol and youths 16 to 20 years of age. Pediatrics. 2008;121(4):290-310 doi:10.1542/peds.2007-2243d.

13. Spear LP. Effects of adolescent alcohol consumption on the brain and behaviour. Nature Reviews Neuroscience. 2018;19(4):197-214 doi:10.1038/nrn.2018.10.

14. Strid C, Andersson C, Öjehagen A. The influence of hazardous drinking on psychological functioning, stress and sleep during and after treatment in patients with mental health

problems: A secondary analysis of a randomised controlled intervention study. BMJ Open. 2018;8(3):e019128 doi:10.1136/bmjopen-2017-019128.

15. Borges G, Bagge CL, Cherpitel CJ, Conner KR, Orozco R, Rossow I. A meta-analysis of acute use of alcohol and the risk of suicide attempt. Psychological Medicine. 2017;47(5):949-57 doi:10.1017/s0033291716002841.

16. Brady JE, Li G. Trends in alcohol and other drugs detected in fatally injured drivers in the United States, 1999-2010. American Journal of Epidemiology. 2014;179(6):692-9 doi:10.1093/aje/kwt327.

17. Duke AA, Giancola PR, Morris DH, Holt JCD, Gunn RL. Alcohol dose and aggression: Another reason why drinking more is a bad idea. Journal of Studies on Alcohol and Drugs. 2011;72(1):34-43 doi:10.15288/jsad.2011.72.34.

18. Foster GR, Dunbar JA, Whittet D, Fernando GCA. Contribution of alcohol to deaths in road traffic accidents in Tayside 1982-6. BMJ. 1988;296(6634):1430-2 doi:10.1136/bmj.296.6634.1430.

19. Kuhns JB, Exum ML, Clodfelter TA, Bottia MC. The prevalence of alcohol-involved homicide offending. Homicide Studies. 2014;18(3):251-70 doi:10.1177/1088767913493629.

20. Mitra B, Charters KE, Spencer JC, Fitzgerald MC, Cameron PA. Alcohol intoxication in non-motorised road trauma. Emergency Medicine Australasia. 2017;29(1):96-100 doi:10.1111/1742-6723.12682.

21. Seedat M, van Niekerk A, Jewkes R, Suffia S, Ratele K. Violence and injuries in South Africa: Prioritising an agenda for prevention. Lancet. 2009;374(9694):1011-22 doi:10.1016/s0140-6736(09)60948-x.

22. Tomlinson MF, Brown M, Hoaken PNS. Recreational drug use and human aggressive behavior: A comprehensive review since 2003. Aggression and Violent Behavior. 2016;27:9-29 doi:10.1016/j.avb.2016.02.004.

23. Andreasson S, Holder HD, Norström T, Österberg E, Rossow I. Estimates of harm associated with changes in Swedish alcohol policy: results from past and present estimates. Addiction. 2006;101(8):1096-105 doi:10.1111/j.1360-0443.2006.01485.x.

24. Ervasti J, Kivimäki M, Pentti J, Halonen JI, Vahtera J, Virtanen M. Changes in drinking as predictors of changes in sickness absence: A case-crossover study. Journal of Epidemology and Community Health. 2018;72(1):61-7 doi:10.1136/jech-2017-209777.

25. Kaila-Kangas L, Koskinen A, Leino-Arjas P, Virtanen M, Härkänen T, Lallukka T. Alcohol use and sickness absence due to all causes and mental- or musculoskeletal disorders: A nationally representative study. BMC Public Health. 2018;18(1) doi:10.1186/s12889-018-5059-8.

26. Morois S, Airagnes G, Lemogne C, Leclerc A, Limosin F, Goldberg S, et al. Daily alcohol consumption and sickness absence in the GAZEL cohort. European Journal of Public Health. 2017;27(3):482-8 doi:10.1093/eurpub/ckx012.

27. Norström T, Moan IS. Per capita alcohol consumption and sickness absence in Norway. European Journal of Public Health. 2009;19(4):383-8 doi:10.1093/eurpub/ckp044.

28. Schou L, Moan IS. Alcohol use–sickness absence association and the moderating role of gender and socioeconomic status: A literature review. Drug and Alcohol Review. 2016;35(2):158-69 doi:10.1111/dar.12278.

29. Schou LA, Storvoll EE, Moan IS. Alcohol-related sickness absence among young employees: Gender differences and the prevention paradox. European Journal of Public Health. 2014;24(3):480-5 doi:10.1093/eurpub/cku035.

30. Howland J, Mangione T, Kuhlthau K, Bell N, Heeren T, Lee M, et al. Work-site variation in managerial drinking. Addiction. 1996;91(7):1007-17 doi:10.1111/j.1360-0443.1996.tb03597.x.

31. Kawakami N, Haratani T, Hemmi T, Araki S. Prevalence and demographic correlates of alcohol-related problems in Japanese employees. Social Psychiatry and Psychiatric Epidemiology. 1992;27(4):198-202 doi:10.1007/BF00789006.

32. Kjaerheim K, Mykletun R, Aasland OG, Haldorsen T, Andersen A. Heavy drinking in the restaurant business: The role of social modelling and structural factors of the work-place. Addiction. 1995;90(11):1487-95 doi:10.1111/j.1360-0443.1995.tb02811.x.

33. Marchand A, Parent-Lamarche A, Blanc ME. Work and High-Risk Alcohol Consumption in the Canadian Workforce. International Journal of Environmental Research and Public Health. 2011;8(7):2692-705 doi:10.3390/ijerph8072692.

34. Nesvåg S, Lie T. Rusmiddelbruk blant ansatte i norsk privat arbeidsliv [Drug use among employees in Norwegian private sector]. Nordisk Alkohol- og Narkotikatidsskrift. 2004;21(2):91-109.

35. Webb GR, Redman S, Hennrikus D, Rostas JAP, Sanson-Fisher RW. The prevalence and sociodemographic correlates of high-risk and problem drinking at an industrial worksite. British Journal of Addiction. 1990;85(4):495-507 doi:10.1111/j.1360-0443.1990.tb01670.x.

36. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. AUDIT: The alcohol use disorders identification test. Guidelines for use in primary health care. Geneva, Switzerland: World Health Organization; 2001.

37. Schulte B, O'Donnell AJ, Kastner S, Schmidt CS, Schäfer I, Reimer J. Alcohol screening and brief intervention in workplace settings and social services: A comparison of literature. Frontiers in Psychiatry. 2014;5 doi:10.3389/fpsyt.2014.00131.

38. Dodu N. Is employment good for well-being? A literature review. Journal of Occupational Psychology, Employment and Disability. 2005;7(1):17-33.

39. Marks N, Shah H. A well-being manifesto for a flourishing society. Journal of Public Mental Health. 2004;3(4):9-15 doi:10.1108/17465729200400023.

40. Mead LM. The new paternalism. Supervisory approaches to poverty. Washington, DC: Brookings Institute Press; 1997.

41. Waddell G, Burton AK. Is work good for your health and well-being? London, UK: TSO; 2006.

42. Baker-McClearn D, Greasley K, Dale J, Griffith F. Absence management and presenteeism: The pressures on employees to attend work and the impact of attendance on performance. Human Resource Management Journal. 2010 doi:10.1111/j.1748-8583.2009.00118.x.

43. Carmichael L. Firm-specific human capital and promotion ladders. The Bell Journal of Economics. 1983;14(1):251 doi:10.2307/3003551.

44. Sanderson K, Cocker F. Presenteeism: Implications and health risks. Australian Family Physician. 2013;42(4):172-5.

45. Sieurin L, Josephson M, Vingård E. Positive and negative consequences of sick leave for the individual, with special focus on part-time sick leave. Scandinavian Journal of Public Health. 2009;37(1):50-6 doi:10.1177/1403494808097171.

46. Anderson BK, Larimer ME. Problem drinking and the workplace: An individualized approach to prevention. Psychology of Addictive Behaviors. 2002;16(3):243-51 doi:10.1037/0893-164x.16.3.243.

47. Araki I, Hashimoto H, Kono K, Matsuki H, Yano E. Controlled trial of worksite health education through face-to-face counseling vs. e-mail on drinking behavior modification. Journal of Occupational Health. 2006;48(4):239-45 doi:10.1539/joh.48.239.

48. Boß L, Lehr D, Schaub MP, Castro RP, Riper H, Berking M, et al. Efficacy of a web-based intervention with and without guidance for employees with risky drinking: Results of a three-arm randomized controlled trial. Addiction. 2018;113(4):635-346 doi:10.1111/add.14085.

49. Cuijpers P, Riper H, Lemmers L. The effects on mortality of brief interventions for problem drinking: A meta-analysis. Addiction. 2004;99(7):839-45 doi:10.1111/j.1360-0443.2004.00778.x.

50. Doumas DM, Hannah E. Preventing high-risk drinking in youth in the workplace: A web-based normative feedback program. Journal of Substance Abuse Treatment. 2008;34(3):263-71 doi:10.1016/j.jsat.2007.04.006.

51. Kaner EF, Beyer FR, Muirhead C, Campbell F, Pienaar ED, Bertholet N, et al. Effectiveness of brief alcohol interventions in primary care populations. The Cochrane database of systematic reviews. 2018;2(2):CD004148 doi:10.1002/14651858.CD004148.pub4.

52. O'Donnell P, Anderson P, Newbury-Birch D, Schulte B, Schmidt C, Reimer J, et al. The impact of brief alcohol interventions in primary healthcare: A systematic review of reviews. Alcohol and Alcoholism. 2014;49(1):66-78 doi:10.1093/alcalc/agt170.

53. Matano RA, Koopman C, Wanat SF, Winzelberg AJ, Whitsell SD, Westrup D, et al. A pilot study of an interactive web site in the workplace for reducing alcohol consumption. Journal of Substance Abuse Treatment. 2007;32(1):71-80 doi:10.1016/j.jsat.2006.05.020.

54. Michaud P, Kunz V, Demortiere G, Lancrenon S, Carre A, Menard C, et al. Efficiency of brief interventions on alcohol-related risks in occupational medicine. Global Health Promotion. 2013;20(2):99-105 doi:10.1177/1757975913483339.

55. Osilla KC, Zellmer SP, Larimer ME, Neighbors C, Marlatt GA. A brief intervention for at-risk drinking in an employee assistance program. Journal of Studies on Alcohol and Drugs. 2008;69(1):14-20 doi:10.15288/jsad.2008.69.14.

56. Riper H, van Straten A, Keuken M, Smit F, Schippers G, Cuijpers P. Curbing problem drinking with personalized-feedback interventions. American Journal of Preventive Medicine. 2009;36(3):247-55 doi:10.1016/j.amepre.2008.10.016.

57. Riper H, Blankers M, Hadiqijaya H, Cunningham J, Clarke S, Wiers R, et al. Effectiveness of guided and unguided low-intensity internet interventions for adult alcohol misuse: A meta-analysis. PLoS ONE. 2014;9(6):e99912 doi:10.1371/journal.pone.0099912.

58. Aalto M, Pekuri P, Seppä K. Obstacles to carrying out brief intervention for heavy drinkers in primary health care: A focus group study. Drug and Alcohol Review. 2003;22(2):169-73 doi:10.1080/09595230100100606.

59. Aira M, Kauhanen J, Larivaara P, Rautio P. Factors influencing inquiry about patients' alcohol consumption by primary health care physicians: Qualitative semi-structured interview study. Family Practice. 2003;20(3):270-5 doi:10.1093/fampra/cmg307.

60. Babor TF, Higgins-Biddle JC. Alcohol screening and brief intervention: Dissemination strategies for medical practice and public health. Addiction. 2000;95(5):677-86 doi:10.1046/j.1360-0443.2000.9556773.x.

61. Barry KL, Blow FC, Willenbring M, McCormick R, Brockmann LM, Visnic S. Use of alcohol screening and brief interventions in primary care settings: Implementation and barriers. Substance Abuse. 2004;25(1):27-36 doi:10.1300/J465v25n01_05.

62. Heather N. The public health and brief interventions for excessive alcohol consumption: The British experience. Addictive Behaviors. 1996;21(6):857-68 doi:10.1016/0306-4603(96)00040-8.

63. Kaner EF, Lock CA, McAvoy BR, Heather N, Gilvarry E. A RCT of three training and support strategies to encourage implementation of screening and brief alcohol intervention by general practitioners. The British Journal of General Practice. 1999;49(446):699 doi:10.3399/bjgp10X502047.

64. Lid TG, Nesvåg S, Meland E. When general practitioners talk about alcohol: Exploring facilitating and hampering factors for pragmatic case finding. Scandinavian Journal of Public Health. 2015;43(2):153-8 doi:10.1177/1403494814565129.

65. Wilson GB, Lock CA, Heather N, Cassidy P, Christie MM, Kaner EFS. Intervention against excessive alcohol consumption in primary health care: A survey of GPs' attitudes and practices in Englang 10 years on. Alcohol and Alcoholism. 2011;46(5):570-7 doi:10.1093/alcalc/agr067.

66. Roman PM, Blum TC. The workplace and alcohol problem prevention. Alcohol Research and Health. 2002;26(1):49-57.

67. World Health Organization. Workplace health promotion undated [Available from: https://www.who.int/occupational_health/topics/workplace/en/.

68. Ames GM, Grube JW, Moore RS. Social control and workplace drinking norms: A comparison of two organizational cultures. Journal of Studies on Alcohol. 2000;61(2):203 doi:10.15288/jsa.2000.61.203.

69. Kuokkanen M, Heljälä L. Early identification and brief Intervention for risky drinkers in Finnish occupational health services. Scandinavian Journal of Work and Environmental Health. 2005(1):35-7.

70. Richmond R, Wodak A, Bourne S, Heather N. Screening for unhealthy lifestyle factors in the workplace. Australian and New Zealand Journal of Public Health. 1998;22(3):324-31 doi:10.1111/j.1467-842X.1998.tb01386.x.

71. Frone MR. Alcohol, drugs, and workplace safety outcomes: A view from a general model of employee substance use and productivity. In: Barling J, Frone MR, editors. The psychology of workplace safety. Washington, DC: American Psychological Association; 2004. p. 127-56.

72. Johansson G, Lundberg I. Adjustment latitude and attendance requirements as determinants of sickness absence or attendance. Empirical tests of the illness flexibility model. Social Science & Medicine. 2004;58(10):1857-68 doi:10.1016/s0277-9536(03)00407-6

73. Johansson G, Lundberg I. Sjukflexibilitetsmodellen - utgångspunkter och resultat [The illness flexibility model – points of departure and results]. In: Marklund S, Bjurvald M, Hogstedt C, Palmer E, Theorell T, editors. Den höga sjukfrånvaron – problem och lösningar [The high sick leave rates – problems and solutions]. Stockholm, Sweden: National Institute for Working Life; 2005. p. 229-42.

74. Clark D, MacMahon B. Preventive medicine. Boston, MA: Little, Brown & Co; 1967.

75. Nightengale E, Cureton M, Kalmar V. Perspectives on health promotion and disease prevention in the United States. Washington, DC: Institute of Medicine, National Academy of Science; 1978.

76. Coohey C, Marsh JC. Promotion, prevention, and treatment: What are the differences? Research on Social Work Practice. 1995;5(4):524-38 doi:10.1177/104973159500500409.

77. World Health Organization. The Ottawa charter for health promotion 1986 [Available from: https://www.who.int/healthpromotion/conferences/previous/ottawa/en/.

78. Harvey G, Kitson A. PARIHS re-visited: Introducing i-PARIHS. In: Harvey G, Kitson A, editors. Implementing evidence-based practice in health care: A facilitation guide. Oxon, UK: Routledge; 2015. p. 25-46.

79. Harvey G, Kitson A. PARIHS revisited: From heuristic to integrated framework for the successful implementation of knowledge into practice. Implementation Science. 2016;11(1) doi:10.1186/s13012-016-0398-2.

80. World Health Organization. The ICD-10 classification of mental and behavioural disorders. Clinical descriptions and diagnostic guidelines. Geneva, Switzerland: World Health Organization; 1992.

81. Grønbæk M. The positive and negative health effects of alcohol- and the public health implications. Journal of Internal Medicine. 2009;265:407-20 doi:10.1111/j.1365-2796.2009.02082.x.

82. Littleton J, Barron S, Prendergast M, Nixon SJ. Smoking kills (alcoholics)! Shouldn't we do something about it? Alcohol and Alcoholism. 2007;42(3):167-73 doi:10.1093/alcalc/agm019.

83. Substance Abuse and Mental Health Services Administration. Results from the 2013 national survey on drug use and health. Summary of national findings. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014.

84. Lewin F, Norell SE, Johansson H, Gustavsson P, Wennerberg J, Biörklund A, et al. Smoking tobacco, oral snuff, and alcohol in the etiology of squamous cell carcinoma of the head and neck. Cancer. 1998;82(7):1367-75 doi:10.1002/(sici)1097-0142(19980401)82:7<1367::aid-cncr21>3.0.co;2-3.

85. Pihl RO, Hoaken PNS. Biological bases of addiction and aggression in close relationships. In: Wekerle C, Wall AM, editors. The violence and addiction equation: Theoretical and clinical issues in substance abuse and relationship violence. New York, NY: Brunner-Routledge; 2001. p. 25-43.

86. Peterson JB, Rothfleisch J, Zalazo PD, Pihl RO. Acute alcohol intoxication and cognitive functioning. Journal of Studies on Alcohol. 1990;51(2):114-22 doi:10.15288/jsa.1990.51.114.

87. Pliner P, Cappell H. Modification of affective consequences of alcohol: A comparison of social and solitary drinking. Journal of Abnormal Psychology. 1974;83(4):418-25 doi:10.1037/h0036884.

88. Room R, Ferris J, Laslett AM, Livingston M, Mugavin J, Wilkinson C. The drinker's effect on the social environment: A conceptual framework for studying alcohol's harm to others. International Journal of Environmental Research and Public Health. 2010;7(4):1855-71 doi:10.3390/ijerph7041855.

89. Karriker-Jaffe KJ, Room R, Giesbrecht N, Greenfield TK. Alcohol's harm to others: Opportunities and challenges in a public health framework. Journal of Studies on Alcohol and Drugs. 2018;79(2):239-43 doi:10.15288/jsad.2018.79.239.

90. Henriksen TB, Hjollund NH, Jensen TK, Bonde JP, Andersson AM, Kolstad H, et al. Alcohol consumption at the time of conception and spontaneous abortion. American Journal of Epidemiology. 2004;160(7):661-7 doi:10.1093/aje/kwh259.

91. Baumberg B. The global economic burden of alcohol: A review and some suggestions. Drug and Alcohol Review. 2006;25(6):537-51 doi:10.1080/09595230600944479.

92. Skog OJ. Public health consequences of the J-curve hypothesis of alcohol problems. Addiction. 1996;91(3):325-37 doi:10.1046/j.1360-0443.1996.9133253.x.

93. Corrao G, Rubbiati L, Bagnardi V, Zambon A, Poikolainen K. Alcohol and coronary heart disease: a meta-analysis. Addiction. 2000;95:1505-23 doi:10.1046/j.1360-0443.2000.951015056.x.

94. Poikolainen K. Alcohol and mortality: A review. Journal of Clinical Epidemiology. 1995;48(4):455-65 doi:10.1016/0895-4356(94)00174-O.

95. Zakhari S. Vulnerability to cardiac disease. Recent Developments in Alcoholism. 1991;9:225-62.

96. Østby KA, Czajkowski N, Knudsen GP, Ystrøm E, Gjerde LC, Kendler KS, et al. Does low alcohol use increase the risk of sickness absence? A discordant twin study. BMC Public Health. 2016;16(1) doi:10.1186/s12889-016-3502-2.

97. Taylor SE. Health psychology. 7th ed. New York, NY: McGraw-Hill; 2009.

98. Dawson DA. Defining risk drinking. Alcohol Research: Current Reviews. 2011;34(2):144-56.

99. Devos-Komby L, Lange J. "My drink is larger than yours"? A literature review of self-defined drink sizes and standard drinks. Current Drug Abuse Reviews. 2008;1(2):162-76 doi:10.2174/1874473710801020162.

100. Skogen JC. Alkohol og permanent arbeidsuførhet. Høyt forbruk av alkohol eller alkoholproblemer - hva er forskjellen? [Alcohol and permanent work disability. High consumption of alcohol or alcohol problems - what is the difference?]. In: Sagvaag H, Sikveland B, editors. Alkohol + arbeidsliv = sant? En vitenskapelig antologi [Alcohol + work = true? A scientific anthology]. Oslo, Norway: Gyldendal; 2014. p. 215-25.

101. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. Addiction. 1993;88(6):791-804 doi:10.1111/j.1360-0443.1993.tb02093.x

102. de Meneses-Gaya C, Zuardi AW, Loureiro SR, Crippa JAS. Alcohol Use Disorders Identification Test (AUDIT): An updated systematic review of psychometric properties. Psychology & Neuroscience. 2009;2(1):83-97 doi:10.3922/j.psns.2009.1.12.

103. Ames GM, Grube JW, Moore RS. The relationship of drinking and hangovers to workplace problems: an empirical study. Journal of Studies on Alcohol. 1997;58(1):37-47 doi:10.15288/jsa.1997.58.37.

104. Mangione TW, Howland J, Amick B, Cote J, Lee M, Bell N, et al. Employee drinking practices and work performance. Journal of Studies on Alcohol. 1999;60(2):261-70 doi:10.15288/jsa.1999.60.261.

105. Nordaune K, Skarpaas LS, Sagvaag H, Haveraaen L, Rimstad S, Kinn LG, et al. Who initiates and organises situations for work-related alcohol use? The WIRUS culture study. Scandinavian Journal of Public Health. 2017;45(8):749-56 doi:10.1177/1403494817704109.

106. Moan IS, Halkjelsvik T. Alkohol og arbeidsliv. En undersøkelse blant norske arbeidstakere [Alcohol and work. A survey among Norwegian employees]. Oslo, Norway: Norwegian Institute of Public Health; 2016.

107. Moan IS, Halkjelsvik T. Alkohol og arbeidsliv II. Bruk, konsekvenser og retningslinjer ved ulike typer arbeidsplasser i Norge [Alcohol and work II. Use, consequences and guidelines at different workplaces in Norway]. Oslo, Norway: Norwegian Institute of Public Health; 2019.

108. Nesvåg S, Duckert F. Work-related drinking and processes of social integration and marginalization in two Norwegian workplaces. Culture and Organization. 2017;23(3):157-76 doi:10.1080/14759551.2015.1021800.

109. Barrientos-Gutierrez T, Gimeno D, Mangione TW, Harrist RB, Amick BC. Drinking social norms and drinking behaviours: a multilevel analysis of 137 workgroups in 16 worksites. Occupational and Environmental Medicine. 2007;64(9):602 doi:10.1136/oem.2006.031765.

110. Delaney WP, Ames G. Work team attitudes, drinking norms, and workplace drinking. Journal of Drug Issues. 1995;25(2):275-90 doi:10.1177/002204269502500205.

111. Yang MJ, Yang MS, Kawachi I. Work experience and drinking behavior: Alienation, occupational status, workplace drinking subculture and problem drinking. Public Health. 2001;115(4):265-71 doi:10.1038/sj.ph.1900761.

112. Biron M, Bamberger P, Noyman T. Work-related risk factors and employee substance use: Insights from a sample of Israeli blue-collar workers. Journal of Occupational Health Psychology. 2011;16(2):247-63 doi:10.1037/a0022708.

113. Marchand A. Alcohol use and misuse: What are the contributions of occupation and work organization conditions? BMC Public Health. 2008;8(1) doi:10.1186/1471-2458-8-333.

114. Halkjelsvik T, Storvoll E. Andel av befolkningen i Norge med et risikofylt alkoholkonsum målt gjennom Alcohol Use Disorders Identification Test (AUDIT) [Proportion of the population in Norway with a risky alcohol consumption measured by Alcohol Use Disorders Identification Test (AUDIT)]. Nordic Studies on Alcohol and Drugs. 2014;32(1):61-7 doi:10.2478/nsad-2014-0035.

115. Myrtveit SM, Askeland KG, Knudsen AK, Knapstad M, Olsen R, Nedregård T, et al. Risky drinking among Norwegian students: Associations with participation in the introductory week, academic performance and alcohol-related attitudes. Nordic Studies on Alcohol and Drugs. 2016;33(4):361-80 doi:10.1515/nsad-2016-0031.

116. Shah AA, Bazargan-Hejazi S, Lindstrom RW, Wolf KE. Prevalence of at-risk drinking among a national sample of medical students. Substance Abuse. 2009;30(2):141-9 doi:10.1080/08897070902802067.

117. Yan T, Xu H, Ettner SL, Barnes AJ, Moore AA. At-risk drinking and outpatient healthcare expenditures in older adults. Journal of the American Geriatrics Society. 2014;62(2):325-8 doi:10.1111/jgs.12636.

118. Fleming MF, Manwell LB, Barry KL, Johnson K. At-risk drinking in an HMO primary care sample: Prevalence and health policy implications. American Journal of Public Health. 1998;88(1):90-3 doi:10.2105/ajph.88.1.90.

119. Allamani A, Beccaria F, Voller F. The puzzle of Italian drinking. Trends in alcohol consumption, harms and policy: Italy 1990-2010. Nordic Studies on Alcohol and Drugs. 2010;27(5):465-78 doi:10.1177/145507251002700504.

120. Mäkelä P, Tigerstedt C, Mustonen H. The Finnish drinking culture: Change and continuity in the past 40 years. Drug and Alcohol Review. 2012;31(7):831-40 doi:10.1111/j.1465-3362.2012.00479.x.

121. Glencross DJ. Alcohol and human performance. Drug and Alcohol Review. 1990;9(2):111-8 doi:10.1080/09595239000185161.

122. Martin CS. Measuring acute alcohol impairment. In: Karch SB, editor. Drug abuse handbook. 2nd ed. New York, NY: CRC Press; 2007. p. 316-33.

123. Price DL, Liddle RJ. The effect of alcohol on a manual arc welding task. Welding Journal. 1982;61:15-9.

124. Streufert S, Pogash R, Roache J, Severs W, Ginrich D, Landis R, et al. Alcohol and managerial performance. Journal of Studies on Alcohol. 1994;55(2):230-8 doi:10.15288/jsa.1994.55.230.

125. Blood Alcohol Content calculator [cited 2019 March 8]. Available from: https://www.drinkdriving.org/drink_driving_information_bloodalcoholcontentcalculator.php.

126. Jung J. Psychology of alcohol and other drugs. Thousand Oaks, CA: Sage; 2001.

127. Meyer JS, Quenzer LF. Psychopharmacology: Drugs, the brain, and behavior. Sunderland, MA: Sinauer Associates; 2005.

128. Prat G, Adan A, Pérez-Pàmies M, Sànchez-Turet M. Neurocognitive effects of alcohol hangover. Addictive Behaviors. 2008;33(1):15-23 doi:10.1016/j.addbeh.2007.05.002.

129. Verster JC. The alcohol hangover: A puzzling phenomenon. Alcohol and Alcoholism. 2008;43(2):124-6 doi:10.1093/alcalc/agm163.

130. McKechnie J, Hill EM. Alcoholism in older women religious. Substance Abuse. 2009;30(2):107-17 doi:10.1080/08897070902802026.

131. Saarni SI, Suvisaari J, Sintonen H, Pirkola S, Koskinen S, Aromaa A, et al. Impact of psychiatric disorders on health-related quality of life: General population survey. British Journal of Psychiatry. 2007;190(4):326-32 doi:0.1192/bjp.bp.106.025106.

132. Rodriguez LM, DiBello AM, Neighbors C. Perceptions of partner drinking problems, regulation strategies and relationship outcomes. Addictive Behaviors. 2013;38(12):2949-57 doi:10.1016/j.addbeh.2013.08.028.

133. Bacharach SB, Bamberger P, Biron M. Alcohol consumption and workplace absenteeism: The moderating effect of social support. Journal of Applied Psychology. 2010;92(2):334-48 doi:10.1037/a0019750.

134. Blum TC, Roman PM, Martin JK. Alcohol consumption and work performance. Journal of Studies on Alcohol. 1993;54(1):61-70 doi:10.15288/jsa.1993.54.61.

135. Taylor B, Irving HM, Kanteres F, Room R, Borges C, Cherpitel C, et al. The more you drink, the harder you fall: A systematic review and meta-analysis of how acute alcohol consumption and injury or collision risk increase together. Drug and Alcohol Dependence. 2010;110(1-2):108-16 doi:10.1016/j.drugalcdep.2010.02.011.

136. Williams M, Mohsin M, Weber D, Jalaludin B, Crozier J. Alcohol concumption and injury risk: A case-crossover study in Sydney, Australia. Drug and Alcohol Review. 2011;30(4):344-54 doi:10.1111/j.1465-3362.2010.00226.x.

137. Ervasti J, Kivimäki M, Head J, Goldberg M, Airagnes G, Pentti J, et al. Sickness absence diagnoses among abstainers, low-risk drinkers and at-risk drinkers: Consideration of the U-shaped association between alcohol use and sickness absence in four cohort studies. Addiction. 2018;113(9):1633-42 doi:10.1111/add.14249.

138. Jørgensen MB, Thygesen LC, Becker U, Tolstrup JS. Alcohol consumption and risk of unemployment, sickness absence and disability pension in Denmark: A prospective cohort study. Addiction. 2017;112(10):1754-64 doi:10.1111/add.13875.

139. Norström T. Per capita alcohol consumption and sickness absence. Addiction. 2006;101(10):1421-7 doi:10.1111/j.1360-0443.2006.01446.x.

140. Steen J, Bjøru EC, Ibenholt K. Kostnader ved rusrelatert fravær og ineffektivitet [Costs of drug-related absence and ineffectivity]. Oslo, Norway: Economics Norway; 2018.

141. Hemp P. Presenteeism: At work - But out of it. Harvard Business Review. 2004;82(10):49-58.

142. Johns G. Presenteeism in the workplace: A review and research agenda. Journal of Organizational Behavior. 2010;31(4):519-42 doi:10.1002/job.630.

143. Chapman LS. Presenteeism and its role in worksite health promotion. American Journal of Health Promotion. 2005;19(4 suppl):1-8.

144. Gosselin E, Lemyre L, Corneil W, Hurrell JJ. Presenteeism and Absenteeism: Differentiated Understanding of Related Phenomena. Journal of Occupational Health Psychology. 2013;18(1):75-86 doi:10.1037/a0030932.

145. Aronsson G, Gustafsson K, Dallner M. Sick but yet at work. An empirical study of sickness presenteeism. Journal of Epidemiology & Community Health. 2000;54(7):502-9 doi:10.1136/jech.54.7.502.

146. Hansen CD, Andersen JH. Going ill to work - What personal circumstances, attitudes and work-related factors are associated with sickness presenteeism? Social Science & Medicine. 2008;67(6):956-64 doi:10.1016/j.socscimed.2008.05.022.

147. Lau B, Dye AH, Aarseth S. Lederes erfaringer med oppfølging av sykmeldte [Managers' experiences with follow-up of employees on sick leave]. Tidsskrift for Norsk psykologforening. 2018;56(7):586-97.

148. Skagen K, Collins AM. The consequences of sickness presenteeism on health and wellbeing over time: A systematic review. Social Science & Medicine. 2016;161(C):169-77 doi:10.1016/j.socscimed.2016.06.005.

149. Caverley N, Cunningham JB, MacGregor JM. Sickness presenteeism, sickness absenteeism, and health following restructuring in a public service organization. Journal of Management Studies. 2007;44(2):304-19 doi:10.1111/j.1467-6486.2007.00690.x

150. Koopman C, Pelletier KR, Murray JF, Sharda CE, Berger ML, Turpin RS, et al. Stanford Presenteeism Scale: Health status and employee productivity. Journal of Occupational and Environmental Medicine. 2002;44(1):14-20 doi:10.1097/00043764-200201000-00004.

151. Schultz A, Edington D. Employee health and presenteeism: A systematic review. Journal of Occupational Rehabilitation. 2007;17(3):547-79 doi:10.1007/s10926-007-9096-x.

152. Loeppke R, Hymel PA, Lofland JH, Pizzi LT, Konicki DL, Anstadt GW, et al. Health-related workplace productivity measurement: General and migraine-specific recommendations from the ACOEM expert panel. Journal of Occupational and Environmental Medicine. 2003;45(4):349-59 doi:10.1097/01.jom.0000063619.37065.e2.

153. Johansson G, Lundberg I. Components of the illness flexibility model as explanations of socioeconomic differences in sickness absence. International Journal of Health Services. 2009;39(1):123-38 doi:10.2190/hs.39.1.f

154. Martimo KP, Varonen H, Husman K, Viikari-Juntura E. Factors associated with self-assessed work ability. Occupational Medicine. 2007;57(5):380-2 doi:10.1093/occmed/kqm028

155. Kirkham HS, Clark BL, Bolas CA, Lewis GH, Jackson AS, Fisher D, et al. Which modifiable health risks are associated with changes in productivity costs? Population Health Management. 2015;18(1):30-8 doi:10.1089/pop.2014.0033.

156. Buvik K, Moan IS, Halkjelsvik T. Alcohol-related absence and presenteeism: Beyond productivity loss. International Journal of Drug Policy. 2018;58:71-7 doi:10.1016/j.drugpo.2018.05.005

157. Ford MT, Cerasoli CP, Higgins JA, Decesare AL. Relationships between psychological, physical, and behavioural health and work performance: A review and meta-analysis. Work & Stress. 2011;25(3):185-204 doi:10.1080/02678373.2011.609035.

158. Rheinberger CM, Herrera-Araujo D, Hammitt JK. The value of disease prevention vs treatment. Journal of Health Economics. 2016;50:247-55 doi:10.1016/j.jhealeco.2016.08.005.

159. Sobell MB, Sobell LC. It is time for low-risk drinking goals to come out of the closet. Addiction. 2011;106(10):1715-7 doi:10.1111/j.1360-0443.2011.03509.x.

160. World Health Organization. Prevention and promotion in mental health. Geneva, Switzerland: World Health Organization; 2002.

161. Richards DA. The complex interventions framework. In: Richards DA, Hallberg IR, editors. Complex interventions in health An overview of research methods. 2nd ed. Oxon, UK: Routledge; 2015. p. 2-15.

162. Babor TF, Higgins-Biddle JC. Brief intervention for hazardous and harmful drinking: A manual for use in primary care. Geneva, Switzerland: World Health Organization; 2001.

163. Cook RF, Hersch RK, Back AS, McPherson TL. The prevention of substance abuse among construction workers: A field test of a social-cognitive program. Journal of Primary Prevention. 2004;25(3):337-57 doi:10.1023/b:jopp.0000048025.11036.32.

164. Broome KM, Bennett JB. Reducing heavy alcohol consumption in young restaurant workers. Journal of Studies on Alcohol and Drugs. 2011;72(1):117-24 doi:10.15288/jsad.2011.72.117.

165. Tinghög ME, Tinghög P. Preventing alcohol problems and improving drinking habits among employees: An evaluation of alcohol education. Work. 2016;53(2):421-8 doi:10.3233/wor-152231.

166. Tinghög ME. The workplace as an arena for universal alcohol prevention - what can we expect? An evaluation of a short educational intervention. Work. 2014;47(4):543-51 doi:10.3233/WOR-131733.

167. Anderson P, Laurant M, Kaner E, Wensing M, Grol R. Engaging general practitioners in the management of hazardous and harmful alcohol consumption: Results of a meta-analysis. Journal of Studies on Alcohol. 2004;65(2):191-9 doi:10.15288/jsa.2004.65.191.

168. Gual A, Sabadini MBA. Implementing alcohol disorders treatment throughout the community. Current Opinion in Psychiatry. 2011;24(3):203-7 doi:10.1097/yco.0b013e3283459256.

169. Johnson M, Jackson R, Guillaume L, Meier P, Goyder E. Barriers and facilitators to implementing screening and brief intervention for alcohol misuse: a systematic review of qualitative evidence. Journal of Public Health. 2011;33(3):412-21 doi:10.1093/pubmed/fdq095.

170. Kaner E. Brief alcohol intervention: Time for translational research. Addiction. 2010;105(6):960-1 doi:10.1111/j.1360-0443.2009.02848.x.

171. Nilsen P, Aalto M, Bendtsen P, Seppä K. Effectiveness of strategies to implement brief alcohol intervention in primary healthcare. Scandinavian Journal of Primary Health Care. 2006;24(1):5-15 doi:10.1080/02813430500475282.

172. Durlak JA, DuPre EP. Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. American Journal of Community Psychology. 2008;41(3-4):327-50 doi:10.1007/s10464-008-9165-0.

173. Kitson A, Harvey G, McCormack B. Enabling the implementation of evidence based practice: A conceptual framework. Quality and Safety in Health Care. 1998;7(3):149-58 doi:10.1136/qshc.7.3.149.

174. Kitson AL, Rycroft-Malone J, Harvey G, McCormack B, Seers K, Titchen A. Evaluating the successful implementation of evidence into practice using the PARiHS framework: Theoretical and practical challenges. Implementation Science. 2008;3 doi:10.1186/1748-5908-3-1.

175. Flottorp SA, Oxman AD, Krause J, Musila NR, Wensing M, Godycki-Cwirko M, et al. A checklist for identifying determinants of practice: A systematic review and synthesis of frameworks and taxonomies of factors that prevent or enable improvements in healthcare professional practice. Implementation Science. 2013;8(1) doi:10.1186/1748-5908-8-35.

176. Helfrich CD, Damschroder LJ, Hagedorn HJ, Daggett GS, Sahay A, Ritchie M, et al. A critical synthesis of literature on the promoting action on research implementation in health services (PARIHS) framework. Implementation Science. 2010;5(1) doi:10.1186/1748-5908-5-82.

177. Tabak RG, Khoong EC, Chambers DA, Brownson RC. Bridging research and practice. American Journal of Preventive Medicine. 2012;43(3):337-50 doi:10.1016/j.amepre.2012.05.024.

178. Rycroft-Malone J, Seers K, Chandler J, Hawkes CA, Crichton N, Allen C, et al. The role of evidence, context, and facilitation in an implementation trial: Implications for the development of the PARIHS framework. Implementation Science. 2013;8(1) doi:10.1186/1748-5908-8-28.

179. Babor TF, Higgins-Biddle J, Dauser D, Higgins P, Burleson JA. Alcohol screening and brief intervention in primary care settings: implementation models and predictors. Journal of Studies on Alcohol. 2005;66(3):361-8 doi:10.15288/jsa.2005.66.361

180. Broyles LM, Rodriguez KL, Kraemer KL, Sevick MA, Price PA, Gordon AJ. A qualitative study of anticipated barriers and facilitators to the implementation of nurse-delivered alcohol screening, brief intervention, and referral to treatment for hospitalized patients in a Veterans Affairs medical center. Addiction Science & Clinical Practice. 2012;7(1):7 doi:10.1186/1940-0640-7-7.

181. Rantanen J, Lehtinen S, Valenti A, Iavicoli S. A global survey on occupational health services in selected international commission on occupational health (ICOH) member countries. BMC Public Health. 2017;17(1) doi:10.1186/s12889-017-4800-z.

182. World Health Organization. Global strategy on occupational health for all. Geneva, Switzerland: World Health Organization; 1995.

183. World Health Organization. Global plan of action on workers' health 2008-2017. Geneva, Switzerland: World Health Organization; 2007.

184. Grooten WJA, M. M, Forsman M, Kjellberg K, Toomingas A, Äng BO, et al. Health risk appraisals in Swedish occupational health services. Work. 2016;55(4):849-59 doi:10.3233/wor-162443.

185. Khadjesari Z, Newbury-Birch D, Murray E, Shenker D, Marston L, Kaner E. Online health checks for reducing alcohol intake among employees: A feasibility study in six workplaces across England. PLoS ONE. 2015;10(3):e0121174 doi:10.1371/journal.pone.0121174.

186. Lie A, Bjørnstad O. Accreditation of occupational health services in Norway. Occupational Medicine. 2015 doi:10.1093/occmed/kqv120.

187. Working Environment Act. Act relating to working environment, working hours and employment protection, etc. Oslo, Norway: Norwegian Ministry of Labour and Social Affairs; 2005.

188. Mandal R, Dyrstad K, Melby L, Midtgård T. Evaluering av bedriftshelsetjenesten i Norge [Evaluation of the occupational health service in Norway]. Oslo, Norway: Sintef; 2016.

189. Proba Samfunnsanalyse [Proba Research]. Gjennomgang av Akan - organisering og virkemidler [Evaluation of Akan - organisation and methods]. Oslo, Norway: Proba Samfunnsanalyse; 2017.

190. Frøyland K, Grimsmo A, Sørensen BA. Evaluering av AKAN - Rusmiddelforebygging i norsk arbeidsliv [Evaluation of AKAN - Drug prevention in Norwegian working life]. Oslo, Norway: Work Research Institute (AFI); 2005.

191. Mathisen AS. Evaluering av telefonveiledningstjensten i AKAN [Evaluation of the phone counselling service in AKAN]. Oslo, Norway: Norwegian Social Research (NOVA); 2008.

192. Holmqvist M, Hermansson U, Nilsen P. Towards increased alcohol intervention activity in Swedish occupational health services. International Journal of Occupational Medicine and Environmental Health. 2008;21(2):179-87 doi:10.2478/v10001-008-0012-1.

193. Kääriäinen J, Sillanaukee P, Poutanen P, Seppä K. Opinions on alcohol-related issues among professionals in primary, occupational, and specialized health care. Alcohol and Alcoholism. 2001;36(2):141-6 doi:10.1093/alcalc/36.2.141.

194. Hermansson U, Helander A, Huss A, Brandt L, Rönnberg S. The Alcohol Use Disorders Identification Test (AUDIT) and carbohydrate-deficient transferrin (CDT) in a routine workplace health examination. Alcoholism: Clinical and Experimental Research. 2000;24(2):180-7 doi:10.1111/j.1530-0277.2000.tb04589.x.

195. Hermansson U, Knutsson A, Rönnberg S, Brandt L. Feasibility of brief intervention in the workplace for the detection and treatment of excessive alcohol consumption. International Journal of Occupational and Environmental Health. 1998;4(2):71-8 doi:10.1179/oeh.1998.4.2.71.

196. Andreasson S, Danielsson AK, Wallhed-Finn S. Preferences regarding treatment for alcohol problems. Alcohol and Alcoholism. 2013;48(6):694-9 doi:10.1093/alcalc/agt067.

197. Hulshof CT, Verbeek JH, van Dijk FJ, van Der Weide WE, Braam IT. Evaluation research in occupational health services: general principles and a systematic review of empirical studies. Occupational and Environmental Medicine. 1999;56(6):361 doi:10.1136/oem.56.6.361.

198. Nilsson PM, Klasson E-B, Nyberg P. Life-style intervention at the worksite - reduction of cardiovascular risk factors in a randomized study. Scandinavian Journal of Work, Environment & Health. 2001;27(1):57-62 doi:10.5271/sjweh.587.

199. Verbeek J, Husman K, van Dijk F, Jauhiainen M, Pasternack I, Vainio H. Building an evidence base for occupational health interventions. Scandinavian Journal Of Work, Environment & Health. 2004;30(2):164-8.

200. Reilly MC, Zbrozek AS, Dukes EM. The validity and reproducibility of a work productivity and activity impairment instrument. PharmacoEconomics. 1993;4(5):353-65 doi:10.2165/00019053-199304050-00006.

201. Malterud K. Theory and interpretation in qualitative studies from general practice: Why and how? Scandinavian Journal of Public Health. 2016;44(2):120-9 doi:10.1177/1403494815621181.

202. Creswell JW. Research design. Qualitative, quantitative & mixed methods approaches. 4th ed. Thousand Oaks, CA: Sage; 2014.

203. WIRUS (Workplace-based Interventions preventing Risky alcohol Use and Sick leave): Cristin (Current Research Information System In Norway); [cited 2019 August 28]. Available from: https://app.cristin.no/projects/show.jsf?id=515383.

204. Enabling implementation of interventions in the first line services towards risky alcohol use (The WIRUS-project): Research Council of Norway; [cited 2019 August 28]. Available from: https://prosjektbanken.forskningsradet.no/#/project/NFR/260640/Sprak=no.

205. The WIRUS-project (Workplace Interventions preventing Risky alcohol Use and Sick leave): Research Gate; [cited 2019 August 28]. Available from: https://www.researchgate.net/project/The-WIRUS-project-Workplace-Interventions-preventing-Risky-alcohol-Use-and-Sick-leave.

206. Eurostat. NACE rev. 2. Statistical classification of economic activities in the European community. Luxembourg, Luxembourg: Eurostat; 2008.

207. Blair AH, Pearce ME, Katamba A, Malamba SS, Muyinda H, Schechter MT, et al. The Alcohol Use Disorders Identification Test (AUDIT): Exploring the factor structure and cutoff thresholds in a representative post-conflict population in northern Uganda. Alcohol and Alcoholism. 2017;52(3):318-27 doi:10.1093/alcalc/agw090.

208. Doyle SR, Donovan DM, Kivlahan DR. The factor structure of the Alcohol Use Disorders Identification Test (AUDIT). Journal of Studies on Alcohol and Drugs. 2007;68(3):474-9 doi:10.15288/jsad.2007.68.474.

209. Hallinan P, McGilloway S, Dempster M, Donnelly M. Factor structure and validity of the Alcohol Use Disorders Identification Test (AUDIT) in a sample of mentally disordered offenders. Journal of Forensic Psychiatry & Psychology. 2011;22(4):586-602 doi:10.1080/14789949.2011.607174.

210. Karno M, Granholm E, Lin A. Factor structure of the Alcohol Use Disorders Identification Test (AUDIT) in a mental health clinic sample. Journal of Studies on Alcohol. 2000;61(5):751-8 doi:10.15288/jsa.2000.61.751.

211. Moehring A, Krause K, Guertler D, Bischof G, Hapke U, Freyer-Adam J, et al. Measurement invariance of the Alcohol Use Disorders Identification Test: Establishing its factor structure in different settings and across gender. Drug and Alcohol Dependence. 2018;189:55-61 doi:10.1016/j.drugalcdep.2018.05.002.

212. Peng CZ, Kristjanson AF, Benson P, Wilsnack SC. Gender differences in the factor structure of the Alcohol Use Disorders Identification Test in multinational general population surveys. Drug and Alcohol Dependence. 2012;124(1-2):50-6 doi:10.1016/j.drugalcdep.2011.12.002.

213. Skogen JC, Thørrisen MM, Olsen E, Hesse M, Aas RW. Evidence for essential unidimensionality of AUDIT and measurement invariance across gender, age and education. Results from the WIRUS study. Drug and Alcohol Dependence. 2019;202:87-92 doi:10.1016/j.drugalcdep.2019.06.002.

214. Reinert DF, Allen JP. The Alcohol Use Disorders Identification Test: An update of research findings. Alcoholism: Clinical and Experimental Research. 2007;31(2):185-99 doi:10.1111/j.1530-0277.2006.00295.x.

215. Horn JL. A rationale and test for the number of factors in factor analysis. Psychometrika. 1965;30(2):179-85 doi:10.1007/bf02289447.

216. Higgins JPT, Green S. Cochrane handbook for systematic reviews of interventions (version 5.1.0): The Cochrane Collaboration; 2011 [updated March 2011. Available from: http://handbook.cochrane.org.

217. World Medical Association. World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4 doi:10.1001/jama.2013.281053.

218. Odlaug B, Gual A, DeCourcy J, Perry R, Pike J, Heron L, et al. Alcohol dependence, co-occurring conditions and attributable burden. Alcohol and Alcoholism. 2016;51(2):201-9 doi:10.1093/alcalc/agv088.

219. Pensola T, Haukka E, Kaila-Kangas L, Neupane S, Leino-Arjas P. Good work ability despite multisite musculoskeletal pain? A study among occupationally active Finns. Scandinavian journal of public health. 2016;44(3):300-10 doi:10.1177/1403494815617087.

220. Aas RW, Haveraaen L, Sagvaag H, Thørrisen MM. The influence of alcohol consumption on sickness presenteeism and impaired daily activities. The WIRUS screening study. PLoS ONE. 2017;12(10) doi:10.1371/journal.pone.0186503

221. Schou L, Moan IS, Storvoll E. Attitudes toward alcohol-related sickness absence and presenteeism: differences across subgroups of the population? Journal of Substance Use. 2017;22(2):225-31 doi:10.1080/14659891.2016.1216617.

222. Kessler RC, Frank RG. The impact of psychiatric disorders on work loss days. Psychological Medicine. 1997;27(4):861-73 doi:10.1017/s0033291797004807.

223. Moore S, Grunberg L, Greenberg E. The relationships between alcohol problems and well-being, work attitudes, and performance: Are they monotonic? Journal of Substance Abuse. 2000;11(2):183-204 doi:10.1016/S0899-3289(00)00020-1.

224. Furu H, Sainio M, Hyvärinen HK, Kaukiainen A. Work ability score of solvent-exposed workers. International Archives of Occupational and Environmental Health. 2018;91(5):559-69 doi:10.1007/s00420-018-1306-7.

225. Adler DA, Possemato K, Mavandadi S, Lerner D, Chang H, Klaus J, et al. Psychiatric status and work performance of veterans of Operations Enduring Freedom and Iraqi Freedom. Psychiatric Services. 2011;62(1):39-46 doi:10.1176/ps.62.1.pss6201_0039.

226. Fisher CA, Hoffman KJ, Austin-Lane J, Kao T. The relationship between heavy alcohol use and work productivity loss in active duty military personnel: a secondary analysis of the 1995 Department of Defense Worldwide Survey. Military Medicine. 2000;165(5):355-61 doi:10.1093/milmed/165.5.355.

227. Airila A, Hakanen J, Punakallio A, Lusa S, Luukkonen R. Is work engagement related to work ability beyond working conditions and lifestyle factors? International Archives of Occupational and Environmental Health. 2012;85(8):915-25 doi:10.1007/s00420-012-0732-1.

228. Tsuchiya M, Kawakami N, Ono Y, Nakane Y, Nakamura Y, Fukao A, et al. Impact of mental disorders on work performance in a community sample of workers in Japan: The World Mental Health Japan Survey 2002-2005. Psychiatry Research. 2012;198(1):140-5 doi:10.1016/j.psychres.2011.10.014.

229. Yu J, Wang S, Yu X. Health risk factors associated with presenteeism in a Chinese enterprise. Occupational Medicine. 2015;65(9):732-8 doi:10.1093/occmed/kqv115.

230. Friedman AS, Granick S, Utada A, Tomko LA. Drug Use/Abuse and Supermarket Workers' Job Performance. Employee Assistance Quarterly. 1992;7(4):17-34 doi:10.1300/J022v07n04_02.

231. Heckley G, Jarl J, Gerdtham UG. Frequency and intensity of alcohol consumption: new evidence from Sweden. European Journal of Health Economics. 2017;18(4):495-517 doi:10.1007/s10198-016-0805-2.

232. Gmel G, Kuntsche E, Rehm J. Risky single-occasion drinking: bingeing is not bingeing. Addiction. 2011;106(6):1037-45 doi:10.1111/j.1360-0443.2010.03167.x.

233. Kuntsche E, Kuntsche S, Thrul J, Gmel G. Binge drinking: Health impact, prevalence, correlates and interventions. Psychology & Health. 2017;32(8):976-1017 doi:10.1080/08870446.2017.1325889.

234. Hingson RW, Zha W. Age of drinking onset, alcohol use disorders, frequent heavy drinking, and unintentionally injuring oneself and others after drinking. Pediatrics. 2009;123(6):1477-84 doi:0.1542/peds.2008-2176.

235. Brewer RD, Swahn MH. Binge drinking and violence. JAMA. 2005;294(5):616-8 doi:10.1001/jama.294.5.616.

236. Norström T, Rossow I. Alcohol consumption as a risk factor for suicide behavior: A systematic review of associations at the individual and at the population level. Archives of Suicide Research. 2016;20(4):489-506 doi:10.1080/13811118.2016.1158678.

237. Dawson DA, Li TK, Grant BF. A prospective study of risk drinking: At risk for what? Drug and Alcohol Dependence. 2008;95(1-2):62-72 doi:10.1016/j.drugalcdep.2007.12.007.

238. Viner RM, Taylor B. Adult outcomes of binge drinking in adolescence: findings from a UK national birth cohort. Journal of Epidemiology & Community Health. 2007;61(10):902-7 doi:10.1136/jech.2005.038117.

239. Perkins HW. Social norms and the prevention of alcohol misuse in collegiate contexts. Journal of Studies on Alcohol. 2002(s14):164-72 doi:10.15288/jsas.2002.s14.164.

240. Hingson RW, Zha W, White AM. Drinking beyond the binge threshold: Predictors, consequences, and changes in the U.S. American Journal of Preventive Medicine. 2017;52(6):717-27 doi:10.1016/j.amepre.2017.02.014.

241. Maurage P, Joassin F, Speth A, Modave J, Philippot P, Campanella S. Cerebral effects of binge drinking: Respective influences of global alcohol intake and consumption pattern. Clinical Neurophysiology. 2012;123(5):892-901 doi:10.1016/j.clinph.2011.09.018.

242. Petit G, Maurage P, Kornreich C, Verbanck P, Campanella S. Binge drinking in adolescents: A review of neurophysiological and neuroimaging research. Alcohol and Alcoholism. 2014;49(2):198-206 doi:10.1093/alcalc/agt172.

243. Holmqvist M, Hermansson U, Bendtsen P, Spak F, Nilsen P. Alcohol prevention activity in Swedish primary health care and occupational health services. Asking patients about their drinking. Nordic Studies on Alcohol and Drugs. 2008;25(6):7 doi:10.1177/145507250802500607.

244. Nilsen P, Holmqvist M, Hermansson U. Alcohol prevention in Swedish occupational health care. Occupational Medicine. 2011;61(7):472-9 doi:10.1093/occmed/kqr070.

245. Janlert U, Hammarström A. Alcohol consumption among unemployed youths: results from a prospective study. Addiction. 1992;87(5):703-14 doi:10.1111/j.1360-0443.1992.tb02716.x.

246. Reine I, Novo M, Hammarström A. Unemployment and ill health - A gender analysis: Results from a 14-year follow-up of the northern Swedish cohort. Public Health. 2013;127(3):214-22 doi:10.1016/j.puhe.2012.12.005.

247. Statistics Norway. Sysselsatte per 4. kvartal, etter region, næring, kjønn, alder og år [Employees per 4th quarter, by region, industry, gender, age and year] Oslo, Norway: Statistics Norway; [cited 2019 February 15]. Available from: https://www.ssb.no/statbank/table/07984/.

248. Statistics Norway. Population 2019 [cited 2019 June 18]. Available from: https://www.ssb.no/en/befolkning/statistikker/folkemengde.

249. Wilsnack RW, Wilsnack SC, Kristjanson AF, Vogeltanz-Holm ND, Gmel G. Gender and alcohol consumption: Patterns from the multinational GENACIS project. Addiction. 2009;104(9):1487-500 doi:10.1111/j.1360-0443.2009.02696.x.

250. Andersson A, Mårdby AC, Holmgren K, Hensing G. Associations between leisure activities and binge drinking in adults: Findings from a Swedish newly sick-listed sample. Work. 2014;48(2):143-53 doi:10.3233/WOR-131606.

251. Eigenbrodt ML, Mosley TH, Hutchinson RG, Watson RL, Chambless LE, Szklo M. Alcohol consumption with age: A cross-sectional and longitudinal study of the Atherosclerosis Risk in Communities (ARIC) study, 1987-1995. American Journal of Epidemiology. 2001;153(11):1102-11 doi:10.1093/aje/153.11.1102.

252. Foster HME, Celis-Morales CA, Nicholl BI, Petermann-Rocha F, Pell JP, Gill JMR, et al. The effect of socioeconomic deprivation on the association between an extended measurement of unhealthy lifestyle factors and health outcomes: A prospective analysis of the UK Biobank cohort. The Lancet Public Health. 2018;3(12):e576-e85 doi:10.1016/s2468-2667(18)30200-7.

253. Roche A, Kostadinov V, Fischer J, Nicholas R. Evidence review: The social determinants of inequities in alcohol consumption and alcohol-related health outcomes. Victoria, Australia: VicHealth; 2015.

254. Bloomfield K, Grittner U, Kramer S, Gmel G. Social inequalities in alcohol consumption and alcohol-related problems in the study countries of the EU concerted action 'gender, culture and alcohol problems: A multi-national study'. Alcohol and Alcoholism. 2006;41(suppl1):i26-i36 doi:10.1093/alcalc/agl073.

255. Probst C, Manthey J, Rehm J. Understanding the prevalence of lifetime abstinence from alcohol: An ecological study. Drug and Alcohol Dependence. 2017;178:126-9 doi:10.1016/j.drugalcdep.2017.05.008.

256. Kan MY, Lan M. Comparing alcohol affordability in 65 cities worldwide. Drug and Alcohol Review. 2013;32(1):19-26 doi:10.1111/j.1465-3362.2012.00476.x.

257. Psacharopoulos G, Patrinos HA. Returns to investment in education: A decennial review of the global literature. Education Economics. 2018;26(5):445-58 doi:10.1080/09645292.2018.1484426.

258. Lewer D, Meier P, Beard E, Boniface S, Kaner E. Unravelling the alcohol harm paradox: A population-based study of social gradients across very heavy drinking thresholds. BMC Public Health. 2016;16(1) doi:10.1186/s12889-016-3265-9.

259. Crum RM, Helzer JE, Anthony JC. Level of education and alcohol abuse and dependence in adulthood: A further inquiry. American Journal of Public Health. 1993;83(6):830-7 doi:10.2105/ajph.83.6.830.

260. Schnohr C, Højberre L, Riegels M, Ledet L, Larsen T, Schultz-Larsen K, et al. Does educational level influence the effects of smoking, alcohol, physical activity, and obesity on mortality? A prospective population study. Scandinavian Journal of Public Health. 2004;32(4):250-6 doi:10.1177/140349480403200403.

261. Kirkebøen LJ. Forskjeller i livsløpsinntekt mellom utdanningsgrupper [Differences in life cycle income between educational groups]. Oslo, Norway: Statistics Norway; 2010.

262. Straus SE, Tetroe J, Graham I. Defining knowledge translation. Canadian Medical Association Journal. 2009;181(3-4):165-8 doi:10.1503/cmaj.081229.

263. Fletcher GJO, Ward C. Attribution theory and processes: A cross-cultural perspective. In: Bond MA, editor. The cross-cultural challenge to social psychology. Newbury Park, CA: Sage; 1988. p. 230-44.

264. Hogg MA, Vaughan GM. Social psychology. 6 ed. Harlow, UK: Pearson Education Limited; 2011.

265. Gioia DA, Sims HP. Self-serving bias and actor-observer differences in organizations: An empirical analysis. Journal of Applied Social Psychology. 1985;15(6):547-63 doi:10.1111/j.1559-1816.1985.tb00919.x

266. Hester RK, Miller WR. Handbook of alcoholism treatment approaches. 2nd ed. Boston, MA: Pearson Education; 1995.

267. Miller WR, Sanchez VC. Motivating young adults for treatment and lifestyle change. In: Howard GS, Nathan PE, editors. Alcohol use and misuse by young adults. Notre Dame, IN: University of Notre Dame Press; 1994. p. 55-81.

268. Fries CJ. Healing health care: From sick care towards salutogenic healing systems. Social Theory & Health. 2019 doi:10.1057/s41285-019-00103-2.

269. Marvasti FF, Stafford RS. From sick care to health care - Reengineering prevention into the U.S. system. New England Journal of Medicine. 2012;367(10):889-91 doi:10.1056/nejmp1206230.

270. Pichler S, Ziebarth NR. The pros and cons of sick pay schemes: Testing for contagious presenteeism and noncontagious absenteeism behavior. Journal of Public Economics. 2017;156:14-33 doi:10.1016/j.jpubeco.2017.07.003.

271. Hermansson U, Helander A, Brandt L, Huss A, Rönnberg S. Screening and brief intervention for risky alcohol consumption in the workplace: Results of a 1-year randomized controlled study. Alcohol and Alcoholism. 2010;45(3):252-7 doi:10.1093/alcalc/agq021.

272. Pidd K, Roche A, Cameron J, Lee N, Jenner L, Duraisingam V. Workplace alcohol harm reduction intervention in Australia: Cluster non-randomised controlled trial. Drug and Alcohol Review. 2018;37(4):502-13 doi:10.1111/dar.12660.

273. Webb G, Shakeshaft A, Sanson-Fisher R, Havard A. A systematic review of work-place interventions for alcohol-related problems. Addiction. 2009;104(3):365-77 doi:10.1111/j.1360-0443.2008.02472.x.

274. Naimi TS, Nelson DE, Brewer RD. The intensity of binge alcohol consumption among U.S. adults. American Journal of Preventive Medicine. 2010;38(2):201-7 doi:0.1016/j.amepre.2009.09.039.

275. Room R, Mäkelä K. Typoligies of the cultural position of drinking. Journal of Studies on Alcohol. 2000;61(3):475-83 doi:10.15288/jsa.2000.61.475.

276. Simpura J, Karlsson T. Trends in drinking patterns among adult population in 15 European countries, 1950 to 2000: a review. Nordic Studies on Alcohol and Drugs. 2001;18(1):31 doi:10.1177/145507250101801s08.

277. Cherpitel CJ, Ye Y, Moskalewicz J, Swiatkiewicz G. Does brief intervention work for heavy episodic drinking? A comparison of emergency department patients in two cultures. Alcoholism and Drug Addiction. 2015;28(3):145-62 doi:10.1016/j.alkona.2015.05.001.

278. Clarke NC, Field M, Rose AK. Evaluation of a brief personalised intervention for alcohol consumption in college students. PLoS ONE. 2015;10(6):e0131229 doi:10.1371/journal.pone.0131229.

279. Dedert EA, McDuffie JR, Stein R, McNiel JM, Kosinski AS, Freiermuth CE, et al. Electronic interventions for alcohol misuse and alcohol use disorders. Annals of Internal Medicine. 2015;163(3):205 doi:10.7326/m15-0285.

280. Kohler S, Hofmann A. Can motivational interviewing in emergency care reduce alcohol consumption in young people? A systematic review and meta-analysis. Alcohol and Alcoholism. 2015;50(2):107-17 doi:10.1093/alcalc/agu098.

281. Schmidt CS, Schulte B, Seo HN, Kuhn S, O'Donnell A, Kriston L, et al. Meta-analysis on the effectiveness of alcohol screening with brief interventions for patients in emergency care settings. Addiction. 2016;111(5):783-94 doi:10.1111/add.13263.

282. Wurdak M, Wolstein J, Kuntsche E. Effectiveness of a drinking-motive-tailored emergency-room intervention among adolescents admitted to hospital due to acute alcohol intoxication - A randomized controlled trial. Preventive Medicine Reports. 2016;3:83-9 doi:10.1016/j.pmedr.2015.12.009.

283. Bhochhibhoya A, Hayes L, Branscum P, Taylor L. The use of the internet for prevention of binge drinking among the college population: A systematic review of evidence. Alcohol and Alcoholism. 2015;50(5):526-35 doi:10.1093/alcalc/agv047.

284. Black N, Mullan B, Sharpe L. Computer-delivered interventions for reducing alcohol consumption: meta-analysis and meta-regression using behaviour change techniques and theory. Health Psychology Review. 2016;10(3):341-57 doi:10.1080/17437199.2016.1168268.

285. Fowler LA, Holt SL, Joshi D. Mobile technology-based interventions for adult users of alcohol: A systematic review of the literature. Addictive Behaviors. 2016;62:25-34 doi:10.1016/j.addbeh.2016.06.008.

286. Voogt C, Kuntsche E, Kleinjan M, Poelen E, Engels R. Using ecological momentary assessment to test the effectiveness of a web-based brief alcohol intervention over time among heavy-drinking students: Randomized controlled trial. Journal of Medical Internet Research. 2014;16(1):e5 doi:10.2196/jmir.2817.

287. Moskowitz JM. The primary prevention of alcohol problems: A critical review of the research literature. Journal of Studies on Alcohol. 1989;50(1):54-88 doi:10.15288/jsa.1989.50.54.

288. Ames G. Research and strategies for the primary prevention of workplace alcohol problems. Alcohol Health & Research World. 1993;17(1):19-27.

289. Eriksson M, Olsson B, Osberg J. Alcohol prevention in the Swedish workplace - who cares? Contemporary Drug Problems. 2004;31(2):263-85 doi:10.1177/009145090403100205.

290. Richmond R, Kehoe L, Heather N, Wodak A. Evaluation of a workplace brief intervention for excessive alcohol consumption: The Workscreen Project. Preventive Medicine. 2000;30(1):51-63 doi:10.1006/pmed.1999.0587.

291. Nilsen P, Wåhlin S, Heather N. Implementing brief interventions in health care: Lessons learned from the Swedish risk drinking project. International Journal of Environmental Research and Public Health. 2011;8(9):3609-27 doi:10.3390/ijerph8093609.

292. Ivers N, Jamtvedt G, Flottorp S, Young JM, Odgaard-Jensen J, French SD, et al. Audit and feedback: effects of professional practice and healthcare outcomes. Cochracne Database of Systematic Reviews. 2012 doi:10.1002/14651858.CD000259.pub3.

293. Forsetlund L, Bjørndal A, Rashidian A, Jamtvedt G, O'Brien MA, Wolf FM, et al. Continuing education meetings and workshops: effects on professional practice and health care outcomes. Cochracne Database of Systematic Reviews. 2009 doi:10.1002/14651858.CD003030.pub2.

294. Altman DG. Practical statistics for medical research. London: Chapman and Hall; 1991.

295. Gray-Donald K, Kramer MS. Causality inference in observational vs. experimental studies: An empirical comparison. American Journal of Epidemiology. 1988;127(5):885-92 doi:10.1093/oxfordjournals.aje.a114891.

296. Rosenman R, Tennekoon V, Hill LG. Measuring bias in self-reported data. International Journal of Behavioural and Healthcare Research. 2011;2(4):320 doi:10.1504/ijbhr.2011.043414.

297. Boniface S, Kneale J, Shelton N. Drinking pattern is more strongly associated with under-reporting of alcohol consumption than socio-demographic factors: evidence from a mixed-methods study. BMC Public Health. 2014;14(1) doi:10.1186/1471-2458-14-1297.

298. Baldwin W. Information no one else knows: The value of self-report. In: Stone AA, Turkkan JS, Bacharach CA, Jobe JB, Kurtzman HS, Cain VS, editors. The science of self-report: Implications for research and practice. Mahwah, NJ: Erlbaum; 2000. p. 3-7.

299. Turkkan JS. General issues in self-report. In: Stone AA, Turkkan JS, Bacharach CA, Jobe JB, Kurtzman HS, Cain VS, editors. The science of self-report: Implications for research and practice. Mahwah, NJ: Erlbaum; 2000. p. 1-2.

300. Connors GJ, Maisto SA. Drinking reports from collateral individuals. Addiction. 2003;98:21-9 doi:10.1046/j.1359-6357.2003.00585.x.

301. Dollinger SJ, Malmqvist D. Reliability and validity of single-item self-reports: With special relevance to college students' alcohol use, religiosity, study, and social life. Journal of General Psychology. 2009;136(3):231-42 doi:10.3200/genp.136.3.231-242.

302. Pedhazur EJ, Schmelkin LP. Measurement, design, and analysis: An integrated approach. Hillsdale, NJ: Lawrence Erlbaum Associates; 1991.

303. Knudsen AK, Hotopf M, Skogen JC, Overland S, Mykletun A. The health status of nonparticipants in a population-based health study: The Hordaland health study. American Journal of Epidemiology. 2010;172(11):1306-14 doi:10.1093/aje/kwq257.

304. Boniface S, Scholes S, Shelton N, Connor J. Assessment of non-response bias in estimates of alcohol consumption: Applying the continuum of resistance model in a general population survey in England. PLoS ONE. 2017;12(1):e0170892 doi:10.1371/journal.pone.0170892.

305. Ewing JA. Detecting alcoholism. The CAGE questionnaire. JAMA. 1984;252(14):1905-7 doi:10.1001/jama.252.14.1905.

306. Conigrave KM, Hall WD, Saunders JB. The AUDIT questionnaire: choosing a cut-off score. Addiction. 1995;90(10):1349-56 doi:10.1111/j.1360-0443.1995.tb03552.x.

307. Gache P, Michaud P, Landry U, Accietto C, Arfaoui S, Wenger O, et al. The Alcohol Use Disorders Identification Test (AUDIT) as a screening tool for excessive drinking in primary care: Reliability and validity of a French version. Alcoholism: Clinical & Experimental Research. 2005;29(11):2001-7 doi:10.1097/01.alc.0000187034.58955.64.

308. Pal HR, Jena R, Yadav D. Validation of the Alcohol Use Disorders Identification Test (AUDIT) in urban community outreach and de-addiction center samples in north India. Journal of Studies on Alcohol. 2004;65(6):794-800 doi:10.15288/jsa.2004.65.794.

309. Reinert DF, Allen JP. The Alcohol Use Disorders Identification Test (AUDIT): A review of recent research. Alcoholism: Clinical & Experimental Research. 2002;26(2):272-9 doi:10.1097/00000374-200202000-00016.

310. Aalto M, Tuunanen M, Sillanaukee P, Seppä K. Effectiveness of structured questionnaires for screening heavy drinking in middle-aged women. Alcoholism: Clinical & Experimental Research. 2006;30(11):1884-8 doi:10.1111/j.1530-0277.2006.00233.x.

311. Giang KB, Spak F, Dzung TV, Allebeck P. The use of AUDIT to assess level of alcohol problems in rural Vietnam. Alcohol and Alcoholism. 2005;40(6):578-83 doi:10.1093/alcalc/agh198.

312. Selin KH. Test-retest reliability of the Alcohol Use Disorder Identification Test in a general population sample. Alcoholism: Clinical & Experimental Research. 2003;27(9):1428-35 doi:10.1097/01.alc.0000085633.23230.4a.

313. Tuunanen M, Aalto M, Seppä K. Binge drinking and its detection among middle-aged men using AUDIT, AUDIT-C and AUDIT-3. Drug and Alcohol Review. 2007;26(3):295-9 doi:10.1080/09595230701247756.

Appendix A

Information to participants

A1. Information to participants in the WIRUS screening study (Papers I and III)

A2. Information to participants in the WIRUS implementation study (Paper IV)

A1. Information to participants in the WIRUS screening study (Papers I and III)

Til ansatte i [virksomhet]

Som ansatt i [virksomhet] fyller du kriteriene for deltakelse i en forskningsstudie som er finansiert av Helsedirektoratet og Norges forskningsråd. Universitetet i Stavanger gjennomfører studien i samarbeid med flere andre institusjoner (se listen nedenfor). Studien er godkjent av regional komité for medisinsk og helsefaglig forskningsetikk. Å delta i denne studien innebærer kun å fylle ut et spørreskjema som tar 10-15 minutter. **Dette gjør du ved å klikke på denne linken:** [link]

Det er viktig for resultatenes pålitelighet at svarprosenten blir høy. Derfor håper vi du vil delta. Vi ber om at du, av hensyn til ditt personvern, ikke videresender denne e-posten.

Bakgrunn: Alkohol har en naturlig plass i de fleste menneskers liv og så mange som 95 prosent av norske arbeidstakere drikker alkohol. Samtidig som at alkoholkonsumet blant unge er redusert, har det vært en betydelig vekst i konsumet blant voksne. I en norsk studie fant forskerne at rundt halvparten av det totale alkoholforbruket var knyttet til jobbrelaterte situasjoner. Mange har oppfatninger om dette temaet. Vi er interessert i dine erfaringer med alkohol og også forhold som har med arbeidssituasjonen din å gjøre.

Formål: Formålet med denne studien er å bidra til ny kunnskap om positive og negative sider ved alkoholbruk i arbeidssituasjoner. Dette vil vi gjøre gjennom å se på ulike måter man kan bruke alkohol på i jobbsammenhenger, hvilken plass alkoholen har i ulike jobbsituasjoner, og hva som kan påvirke alkoholkonsumet. Vi ønsker også å få mer kunnskap om sammenhengen mellom alkoholbruk, sykefravær og sykenærvær (å være på jobb uten å være helt i form). Vi vil innhente sykefraværsdata fra databasen FD-trygd og informasjon fra personalregisteret i din virksomhet. Til dette formålet trenger vi ditt personnummer.

Basert på denne undersøkelsen vil noen senere bli tilbudt en frivillig helseundersøkelse hos bedriftshelsetjenesten.

Personvern og informasjonssikkerhet: Alle som jobber med prosjektet har taushetsplikt. Arbeidsgiver vil ikke bli kjent med hvem som deltar. All informasjon om deg skal bare benyttes på den måte som er beskrevet ovenfor og vil bli oppbevart på et trygt og passordbeskyttet område. En ID knytter deg og dine opplysninger til en liste med navn og personnummer (avidentifisering). Det er kun en prosjektsekretær som har adgang til denne listen og som kan finne tilbake til den enkelte. Det vil ikke være mulig å identifisere enkeltpersoner og hva de har svart. Vi kommer til å publisere vitenskapelige artikler på bakgrunn av materialet og vil derfor følge opp den enkelte gjennom registerdata i inntil 20 år. Men alle data vil altså være avidentifisert. Etter dette tidspunktet vil alle dataene bli anonymisert.

Det er frivillig å delta i studien og du kan når som helst, og uten å oppgi grunn, trekke ditt samtykke tilbake. Hvis du trekker deg fra studien, kan du kreve å få slettet innsamlede opplysninger om deg selv, med mindre opplysningene allerede er inngått i analyser eller brukt i rapporter eller vitenskapelige artikler. Du har som deltaker rett til innsyn i publikasjonene fra studien. Du kan få dem ved henvendelse til kontaktpersonene som er nevnt under.

Ta gjerne kontakt med oss dersom du har spørsmål om studien og din deltakelse. **Vår kontaktperson er Mikkel M. Thørrisen, PhD-stipendiat i Wirus, e-post: mikkel-magnus.thorrisen@oslomet.no**.

Med vennlig hilsen Randi Wågø Aas, PhD, Prosjetleder/faglig ansvarlig for studien, Universitetet i Stavanger.

Institusjoner som samarbeider om WIRUS: Universitetet i Stavanger, KoRus Vest Stavanger, Presenter – Making Sense of Science, OsloMet – storbyuniversitetet (tidl. Høgskolen i Oslo og Akershus), Folkehelseinstituttet, SERAF, Universitetet i Oslo, KORFOR ved Stavanger Universitetssykehus, Karolinska Institutet i Stockholm og Vrije University i Amsterdam.

Prosjektteam: Randi Wågø Aas (prosjektleder forskning), Åsa Sjøgren (prosjektleder rekruttering), Hildegunn Sagvaag DrPH, Jens C. Skogen PhD, Mikkel M. Thørrisen Mphil, Neda Hashemi MSc, Lise Haveraaen MSc, Lisebet Skeie Skarpaas MSc, Håvar Brendryen PhD, Willy Pedersen Prof./PhD, Silje Lill Rimstad MSc, Unnur O. Sigurdsdottir MSc, Kristin Nordaune MSc og Ditte Staldgaard MSc.

A2. Information to participants in the WIRUS implementation study (Paper IV)

Til deg som er ansatt i bedriftshelsetjenesten

INVITASJON TIL Å DELTA I ET NASJONALT FORSKNINGSPROSJEKT OM ALKOHOL, ARBEIDSLIV OG BEDRIFTSHELSETJENESTE

Som ansatt i en godkjent bedriftshelsetjeneste inviteres du herved til å delta i en nasjonal forskningsstudie om alkohol, arbeidsliv og bedriftshelsetjenestens rolle. Studien søker å belyse bedriftshelsetjenestens praksis med alkoholrelatert arbeid overfor virksomheter og hvordan ansatte i bedriftshelsetjenesten opplever muligheter og barrierer for slikt arbeid. Din deltakelse i prosjektet er viktig og vi håper du ønsker å bidra til ny kunnskap på dette området, selv om du kanskje til vanlig ikke jobber med rus-/alkoholrelaterte temaer.

Skadelig alkoholbruk er et folkehelseproblem. Forskning viser at mellom 10 og 35 prosent av arbeidstakere drikker alkohol på et risikofylt nivå og at det er en sammenheng mellom alkoholbruk og arbeidslivsrelaterte utfordringer som sykefravær og redusert arbeidskapasitet (sykenærvær).

Studien gjennomføres av forskningsgruppen «Samfunnsdeltagelse i skole og arbeidsliv» ved Det helsevitenskapelige fakultet, Universitetet i Stavanger (UiS) og samarbeidspartnere (se liste under). Prosjektet denne delstudien er knyttet til heter WIRUS. Ett av delprosjektene i WIRUS handler om bedriftshelsetjenestens rolle. WIRUS er finansiert av Helsedirektoratet, Norges forskningsråd og OsloMet – storbyuniversitetet. Ansvarlig prosjektleder er professor Randi Wågø Aas, PhD.

Hva innebærer deltakelse i studien?
Å delta i denne studien innebærer at du svarer på et spørreskjema. **Klikk på denne linken for å komme til spørreskjemaet:** [link] Det vil maksimalt ta 10-15 minutter å svare på spørreskjemaet.

Forskningsetikk og personvern
Forskningsprosjektet er etisk godkjent av Personvernombudet, ved Norsk senter for forskningsdata (NSD). Alle som jobber med prosjektet har taushetsplikt. Prosjektet innebærer ikke sensitive spørsmål. Du vil heller ikke bli bedt om å oppgi navn eller andre opplysninger som kan identifisere deg. Din e-postadresse vil ikke bli oppbevart sammen med svardata. All anonymisert informasjon innsamlet i prosjektet vil bli lagret på en sikret og passordbeskyttet server ved UiS. Materialet vil bli slettet ved prosjektslutt.

Det er frivillig å delta i studien og du kan når som helst, og uten å oppgi grunn, trekke ditt samtykke tilbake. Hvis du trekker deg fra studien, kan du kreve å få slettet opplysningene du har oppgitt, med mindre opplysningene allerede er inngått i analyser eller brukt i rapporter eller vitenskapelige publikasjoner. Ta gjerne kontakt med oss dersom du har spørsmål om studien og din deltakelse. **Vår kontaktperson er Mikkel M. Thørrisen, PhD stipendiat, e-post: mikkel-magnus.thorrisen@oslomet.no**

Med vennlig hilsen

Randi Wågø Aas, PhD, Prosjektleder/Professor, Universitetet i Stavanger og OsloMet – storbyuniversitetet, randi.w.aas@uis.no, tlf 91182266

Mikkel M. Thørrisen, PhD stipendiat, OsloMet – storbyuniversitetet, mikkel-magnus.thorrisen@oslomet.no, tlf 46634758

Institusjoner som samarbeider om WIRUS: Universitetet i Stavanger, KoRus Vest Stavanger, Presenter – Making Sense of Science, OsloMet – storbyuniversitetet (tidl. Høgskolen i Oslo og Akershus), Folkehelseinstituttet, SERAF, Universitetet i Oslo, KORFOR ved Stavanger Universitetssykehus, Karolinska Institutet i Stockholm og Vrije University i Amsterdam.

Prosjektteam: Randi Wågø Aas (prosjektleder forskning), Åsa Sjøgren (prosjektleder rekruttering), Hildegunn Sagvaag DrPH, Jens C. Skogen PhD, Mikkel M. Thørrisen Mphil, Neda Hashemi MSc, Lise Haveraaen MSc, Lisebet Skeie Skarpaas MSc, Håvar Brendryen PhD, Willy Pedersen Prof./PhD, Silje Lill Rimstad MSc, Unnur O. Sigurdsdottir MSc, Kristin Nordaune MSc og Ditte Staldgaard MSc.

Appendix B

Questionnaire items

B1. Questionnaire items used in Paper I

B2. Questionnaire items used in Paper III

B3. Questionnaire items used in Paper IV

B1. Questionnaire items used in Paper I

Samtykke til å del ta i studien

❑ Jeg har lest informasjonen i eposten, og jeg ønsker å delta i studien

Spørsmål om deg

Alder

____ (antall år)

Kjønn

❑ Mann

❑ Kvinne

Hva er ditt høyeste fullførte utdanningsnivå? (sett ett kryss)

❑ Grunnskolenivå (ca 9 års skolegang)

❑ videregående skolenivå (ca 12 års skolegang)

❑ Høyskole/- universitetsnivå til og med 4 år

❑ Høyskole/-universitetsnivå i mer enn 4 år

Nåværende sivilstand (sett ett kryss):

❑ Ugift

❑ Samboer

❑ Gift/registrert partner

❑ Separert

❑ Skilt (spesifiser årstall) _____

❑ Enke/enkemann (spesifiser årstall) _____

Jeg bor (sett ett kryss):

❑ Alene

❑ Sammen med andre (antall personer du bor sammen med foruten deg selv) _____

Antall barn (hvis ingen, skriv 0):

____ (antall barn)

Antall hjemmeboende barn (hvis ingen, skriv 0):

____ (antall barn)

Spørsmål om din jobb

Hva er ditt stillingsnivå? (sett ett kryss)

❑ Vanlig ansatt

❑ Mellomleder

❑ Toppleder

- ❑ Annet, spesifiser _____

Spørsmål om ditt alkoholforbruk

Hvor ofte har du drukket alkohol det siste året?

- ❑ Aldri
- ❑ Månedlig eller sjeldnere
- ❑ 2-4 ganger i måneden
- ❑ 2-3 ganger i uken
- ❑ 4 ganger i uken eller mer

Hvor mange alkoholenheter tar du på en «typisk drikkedag»? Men én standard alkoholenhet menes et glass vin (12 cl), en liten flaske pils (35 cl), en drink brennevin (4 cl), et glass hetvin (8 cl).

- ❑ 0-2
- ❑ 3-4
- ❑ 5-6
- ❑ 7-9
- ❑ 10 eller flere

I løpet av det siste året, hvor ofte har du drukket seks alkoholenheter eller mer?

- ❑ Aldri
- ❑ Sjelden
- ❑ Noen ganger i måneden
- ❑ Noen ganger i uken
- ❑ Nesten daglig

Hvor ofte i løpet av det siste året var du ikke i stand til å stoppe å drikke etter at du hadde begynt?

- ❑ Aldri
- ❑ Sjelden
- ❑ Noen ganger i måneden
- ❑ Noen ganger i uken
- ❑ Nesten daglig

Hvor ofte i løpet av det siste året unnlot du å gjøre ting du skulle ha gjort på grunn av drikking?

- ❑ Aldri
- ❑ Sjelden
- ❑ Noen ganger i måneden
- ❑ Noen ganger i uken
- ❑ Nesten daglig

Hvor ofte i løpet av det siste året startet du dagen med alkohol?

- ❑ Aldri
- ❑ Sjelden
- ❑ Noen ganger i måneden
- ❑ Noen ganger i uken
- ❑ Nesten daglig

Hvor ofte i løpet av det siste året har du hatt skyldfølelse på grunn av drikking?

- ❑ Aldri
- ❑ Sjelden
- ❑ Noen ganger i måneden
- ❑ Noen ganger i uken
- ❑ Nesten daglig

Hvor ofte i løpet av det siste året har det vært umulig å huske hva som hendte kvelden før på grunn av drikking?

- ❑ Aldri
- ❑ Sjelden
- ❑ Noen ganger i måneden
- ❑ Noen ganger i uken
- ❑ Nesten daglig

Har du eller andre blitt skadet som følge av at du har drukket?

- ❑ Nei
- ❑ Ja, men ikke i løpet av det siste året
- ❑ Ja, i løpet av det siste året

Har en slektning, venn eller lege bekymret seg over drikkingen din, eller antydet at du bør redusere?

- ❑ Nei
- ❑ Ja, men ikke i løpet av det siste året
- ❑ Ja, i løpet av det siste året

Har du noen kommentarer eller tilføyelser?

_____

_____

_____

Takk for at du tok deg tid til å delta i denne undersøkelsen

B2. Questionnaire items used in Paper III

Samtykke til å del ta i studien

❑ Jeg har lest informasjonen i eposten, og jeg ønsker å delta i studien

Spørsmål om deg

Alder

____ (antall år)

Kjønn

❑ Mann

❑ Kvinne

Hva er ditt høyeste fullførte utdanningsnivå? (sett ett kryss)

❑ Grunnskolenivå (ca 9 års skolegang)

❑ videregående skolenivå (ca 12 års skolegang)

❑ Høyskole/- universitetsnivå til og med 4 år

❑ Høyskole/-universitetsnivå i mer enn 4 år

Jeg bor (sett ett kryss):

❑ Alene

❑ Sammen med andre (antall personer du bor sammen med foruten deg selv) _____

Spørsmål om ditt alkoholforbruk

Hvor ofte har du drukket alkohol det siste året?

❑ Aldri

❑ Månedlig eller sjeldnere

❑ 2-4 ganger i måneden

❑ 2-3 ganger i uken

❑ 4 ganger i uken eller mer

I løpet av det siste året, hvor ofte har du drukket seks alkoholenheter eller mer?

❑ Aldri

❑ Sjelden

❑ Noen ganger i måneden

❑ Noen ganger i uken

❑ Nesten daglig

Hvor stor innvirkning hadde ditt alkoholforbruk på din produktivitet <u>mens du arbeidet</u> i løpet av de siste 7 dagene? Tenk tilbake på dager da det var begrenset hvor mye du kunne gjøre eller hva slags arbeid du kunne utføre, dager der du oppnådde mindre enn du ønsket, eller dager der du ikke kunne utføre arbeidet like omhyggelig som vanlig

Sett et kryss ved det tallet som passer best med din opplevelse

0	1	2	3	4	5	6	7	8	9	10
❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Alkoholforbruket hadde ingen innvirkning på mitt arbeid										Alkoholforbruket hindret meg fullstendig i å arbeide

Hvor stor innvirkning hadde ditt alkoholforbruk på din evne til å utføre vanlige, daglige aktiviteter, <u>utenom arbeid</u> i løpet av de siste 7 dagene? Tenk tilbake på de gangene det var begrenset hvor mye du kunne gjøre eller hva slags aktiviteter du kunne delta i, og ganger du fikk gjort mindre enn du ønsket

Sett et kryss ved det tallet som passer best med din opplevelse

0	1	2	3	4	5	6	7	8	9	10
❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Alkoholforbruket hadde ingen innvirkning på mitt arbeid										Alkoholforbruket hindret meg fullstendig i å arbeide

Har du noen kommentarer eller tilføyelser?

_____

_____

_____

Takk for at du tok deg tid til å delta i denne undersøkelsen

B3. Questionnaire items used in Paper IV

Samtykke til å del ta i studien

❑ Jeg har lest informasjonen i eposten, og jeg ønsker å delta i studien

Spørsmål om deg og din stilling

Kjønn

❑ Mann

❑ Kvinne

Alder

____ (antall år)

Din utdanningsbakgrunn

❑ Ergoterapeut

❑ Ernæringsfysiolog

❑ Fysioterapeut

❑ Lege

❑ Psykolog

❑ Sosionom

❑ Sykepleier

❑ Yrkeshygieniker

❑ Annet, beskriv: _____

Hvor mange år har du jobbet i bedriftshelsetjenesten?

____ (antall år)

Vi vil nå stille deg noen spørsmål om dine holdninger til alkoholbruk

Angi i hvilken grad du er enig i følgende utsagn:

	Helt uenig	Uenig	Enig	Helt enig
Å ta et glass vin/en øl/en drink eller to etter jobb er en harmløs måte å slappe av på	❑	❑	❑	❑
Å møte kolleger etter jobb for å ta et glass vin/en øl/en drink en gang i blant kan være med på å øke de ansattes arbeidsmoral	❑	❑	❑	❑
Å ta et glass vin/en øl/en drink med kunder eller klienter kan være bra for bedriften/virksomheten	❑	❑	❑	❑
Ledere kan gå glipp av verdifull informasjon hvis de ikke sosialiseres med kolleger over et glass øl eller vin	❑	❑	❑	❑
Et glass vin eller øl om dagen kan være bra for helsen	❑	❑	❑	❑
Jo oftere en blir eksponert for alkohol, jo mer sannsynlig er det at en utvikler et alkoholproblem	❑	❑	❑	❑

Å servere alkohol på sosiale arrangement i regi av bedriften setter et dårlig eksempel for de ansatte	❑	❑	❑	❑

Nå vil vi stille noen spørsmål om din erfaring med bedriftshelsetjenestens arbeid. Vi er her interessert i hvordan dere jobber opp mot virksomheten(e) dere gir tjenester til. Når vi her sier «ansatte», mener vi ansatte i virksomheten(e) dere gir tjenester til, ikke ansatte i selve bedriftshelsetjenesten.

Hvor ofte jobber du med saker som handler om alkohol (på individ- eller gruppenivå)?

- ❑ Aldri
- ❑ Sjeldnere enn årlig
- ❑ Årlig
- ❑ Sjeldnere enn månedlig
- ❑ Månedlig
- ❑ Ukentlig
- ❑ Daglig

Opplever du at alkoholbruk blant ansatte er et problem i arbeidslivet?

- ❑ Nei, ikke i det hele tatt
- ❑ Nei, i liten grad
- ❑ I noen grad
- ❑ Ja, i stor grad
- ❑ Ja, i svært stor grad
- ❑ Vet ikke

De fleste ansatte drikker alkohol. Forskning viser at vi kan dele inn i tre grupper:
*- **Grønn gruppe:** De fleste drikker alkohol i små/moderate mengder*
*- **Gul gruppe:** Noen drikker mer enn anbefalt og står i fare for å utvikle alkoholproblemer*
*- **Rød gruppe:** Noen har allerede utviklet et alkoholproblem*

Vi vil nå stille noen spørsmål om hvordan din bedriftshelsetjeneste jobber med temaet alkohol overfor virksomheten(e) dere gir tjenester til. Først vil vi fokusere på hvordan dere jobber generelt helsefremmende, dvs. overfor ansatte generelt eller ansatte som kan antas å være i grønn gruppe.

I hvilken grad vil du si at bedriftshelsetjenesten jobber med temaet alkohol på generelt helsefremmende nivå (overfor ansatte som kan antas å være i grønn gruppe)?

- ❑ Ikke i det hele tatt
- ❑ I liten grad
- ❑ I noen grad
- ❑ I stor grad
- ❑ I svært stor grad

- ❑ Vet ikke

Vi vil nå fokusere på hvordan dere jobber overfor ansatte som kan antas å være i gul gruppe, dvs. ansatte som kan antas å drikke mer enn anbefalt.

I hvilken grad vil du si at bedriftshelsetjenesten jobber med temaet alkohol overfor ansatte som kan antas å være i gul gruppe, dvs. drikke mer enn anbefalt?

- ❑ Ikke i det hele tatt
- ❑ I liten grad
- ❑ I noen grad
- ❑ I stor grad
- ❑ I svært stor grad
- ❑ Vet ikke

Vi vil nå fokusere på hvordan dere jobber overfor ansatte som kan antass å være i rød gruppe, dvs. ansatte som kan ha et alkoholproblem.

I hvilken grad vil du si at bedriftshelsetjenesten jobber med temaet alkohol overfor ansatte som kan antas å være i rød gruppe, dvs. ansatte som kan ha et alkoholproblem?

- ❑ Ikke i det hele tatt
- ❑ I liten grad
- ❑ I noen grad
- ❑ I stor grad
- ❑ I svært stor grad
- ❑ Vet ikke

Vi vil nå spørre om dine synspunkter på hvordan bedriftshelsetjenesten <u>bør</u> jobbe med temaet alkohol overfor virksomheten(e) dere gir tjenester til.

I hvilken grad mener du at bedriftshelsetjenester i Norge generelt bør arbeide med temaet alkohol?

- ❑ Mye mindre enn i dag
- ❑ Mindre enn i dag
- ❑ I samme grad som i dag
- ❑ Mer enn i dag
- ❑ Mye mer enn i dag
- ❑ Vet ikke

Vi vil nå stille deg noen spørsmål om muligheter og begrensninger for bedriftshelsetjenesten i å utføre alkoholforebyggende arbeid overfor virksomheten(e).

I hvilken grad opplever du følgende som barrierer mot å jobbe med temaet alkoholbruk overfor virksomheten(e)?

	I svært liten grad 1	2	3	4	5	6	7	8	9	10	I svært stor grad 11
Alkohol er en privatsak	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Virksomheten(e) er uinteressert i fokus på alkoholbruk	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Virksomheten(e) motarbeider et fokus på alkoholbruk	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Mangel på kunnskap i bedriftshelsetjenesten om viktigheten av alkoholforebyggende arbeid	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Mangel på kunnskap i bedriftshelsetjenesten til å gjennomføre alkoholforebyggende tiltak	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Mangel på tid/ressurser	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Oppfatninger om at andre enn bedriftshelsetjenesten har ansvaret	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

Tusen takk for at du tok deg tid til å svare på dette spørreskjemaet

Paper I

Thørrisen, M. M., Skogen, J. C., & Aas, R. W. (2018). The associations between employees' risky drinking and sociodemographics, and implications for intervention needs. BMC Public Health, 18(1). DOI: **https://dx.doi.org/10.1186/s12889-018-5660-x**

Thørrisen et al. BMC Public Health (2018) 18:735
https://doi.org/10.1186/s12889-018-5660-x

BMC Public Health

RESEARCH ARTICLE Open Access

The associations between employees' risky drinking and sociodemographics, and implications for intervention needs

Mikkel Magnus Thørrisen[1*], Jens Christoffer Skogen[2,3] and Randi Wågø Aas[1,4,5]

Abstract

Background: Harmful alcohol consumption is a major risk factor for ill-health on an individual level, a global public health challenge, and associated with workplace productivity loss. This study aimed to explore the proportion of risky drinkers in a sample of employees, investigate sociodemographic associations with risky drinking, and examine implications for intervention needs, according to recommendations from the World Health Organization (WHO).

Methods: In a cross-sectional design, sociodemographic data were collected from Norwegian employees in 14 companies ($n = 3571$) across sectors and branches. Risky drinking was measured with the Alcohol Use Disorders Identification Test (AUDIT). The threshold for risky drinking was set at ≥8 scores on the AUDIT. Based on WHO guidelines, risky drinkers were divided into three risk categories (moderate risk: scores 8–15, high risk: scores 16–19, and dependence likely risk: scores 20–40). The association between sociodemographic variables and risky drinking were explored with chi square tests for independence and adjusted logistic regression. The risk groups were then examined according to the WHO intervention recommendations.

Results: 11.0% of the total sample reported risky drinking. Risky drinking was associated with male gender (OR = 2.97, $p < .001$), younger age (OR = 1.03, $p < .001$), low education (OR = 1.17, $p < .05$), being unmarried (OR = 1.38, $p < .05$) and not having children (OR = 1.62, $p < .05$). Risky drinking was most common among males without children (33.5%), males living alone (31.4%) and males aged ≤39 (26.5%). 94.6% of risky drinkers scored within the lowest risk category. Based on WHO guidelines, approximately one out of ten employees need simple advice, targeting risky drinking. In high-risk groups, one out of three employees need interventions.

Conclusions: A considerable amount of employees (one to three out of ten), particularly young, unmarried males without children and higher education, may be characterised as risky drinkers. This group may benefit from low-cost interventions, based on recommendations from the WHO guidelines.

Keywords: Alcohol consumption, Risky drinking, Employees, Workplace, Workforce

* Correspondence: mikkel-magnus.thorrisen@oslomet.no
[1]Faculty of Health Sciences, Department of Occupational Therapy, Prosthetics and Orthotics, OsloMet - Oslo Metropolitan University, St. Olavs plass, NO-0130 Oslo, Norway
Full list of author information is available at the end of the article

© The Author(s). 2018 **Open Access** This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.

Background

Harmful alcohol consumption is a major risk factor for disease, disability and mortality, and has been identified as a causal agent in more than 200 disease and injury conditions [1]. According to the World Health Organization (WHO), harmful alcohol consumption is related to approximately 3.3 million annual deaths globally (5.9% of all mortality worldwide) [2]. Consumption levels have been found to be highest in the developed world.

Alcohol is by far the most used and misused psychoactive substance in the workforce and employees' alcohol consumption is associated with productivity loss, and therefore with considerable economic costs at a societal level [3]. A recently published systematic review reported that employees' alcohol consumption is associated with both short- and long-term sickness absence [4]. Some studies also indicate that alcohol consumption is related to sickness presenteeism, i.e., reduced on-the-job productivity [5–7].

Risky drinking may be defined as a drinking pattern that increases the risk of social, legal, medical, occupational, domestic, and economic problems [8]. It is, however, difficult to determine an appropriate cut off for risky drinking, even when assuming a linear relationship between alcohol consumption and harm. What constitutes risky drinking is inextricably linked to individual characteristics. General health, physiological factors, sociodemographic variables as well as lifestyle factors may affect how much a person can drink before adverse consequences emerge [9]. Whereas some definitions of risky drinking are based solely on alcohol consumption (frequency and/or intensity), measured in terms of consumed alcohol units within a specified time frame, other conceptualisations are based on instruments assuming a more complex relationship between alcohol and health [10], such as the Alcohol Use Disorders Identification Test (AUDIT) [8], which defines risky drinking as a sum score equal to or higher than a predefined scale threshold, based on items comprising symptoms of alcohol dependence and alcohol-related problems as well as alcohol consumption.

Risky drinking has been studied within different populations across countries, with prevalence estimates varying between 5.4 and 52.0% [11–16]. In a Norwegian general population sample, it was found that 17.0% of respondents scored within the range of risky drinking [17]. In a national sample of Norwegian students, 46.1% scored above the threshold of risky drinking [18]. Some studies have explored the prevalence of risky drinking within working populations, e.g., among Australian industrial workers (8.8%), U.S. managers (7.0%), Norwegian restaurant workers (6.0%), Norwegian private sector employees (11.0%), Canadian employees (8.1%), and Japanese computer factory workers (males 13.0%, females 4.0%) [19–24]. These studies may, however, not be directly comparable as a result of application of different measures of alcohol consumption and different thresholds for risky drinking. Some [20, 22, 23] were solely based on number of consumed alcohol units during a specified time frame (e.g., number of units consumed during a typical drinking day, drinking frequency during the preceding year, and number of units each day during the preceding week), while others [19, 24] applied instruments with a broader scope (e.g., the Mortimer-Filkins test of problem drinking and the Kurihama Alcoholism Screening Test). Despite the use of different tools for conceptualisation and measurement of risky drinking, taken together these studies do suggest that risky drinking is an existing phenomenon among employees that deserves greater attention, given the adverse consequences associated with harmful alcohol consumption.

Early identification and intervention may be beneficial in preventing the development of alcohol problems. Knowledge on associations between sociodemographic factors and risky drinking may aid in determining which groups of employees that may need and benefit the most from early identification and interventions targeting alcohol-related problems. Some studies have demonstrated associations between risky drinking and sociodemographic variables, generally suggesting that risky drinking is more prevalent among younger individuals and males [14, 16, 17, 23], and that individuals with higher education are more prone to risky drinking than individuals with lower education [16, 17]. Although findings are more inconsistent, some authors have demonstrated associations between living/marital status and risky drinking [11, 14, 23].

The majority of the adult population is employed and employees with a risky drinking pattern constitute a much larger group than heavy drinkers [25]. The workplace may therefore be an important arena for identification and implementation of interventions targeting risky drinking. It seems imperative to produce more knowledge on risky drinking in the working community, on the factors that characterise workers who are at particular risk of developing alcohol problems, and on intervention approaches that might be beneficial. Overall, research is rather scarce on risky drinking among employees and there is a general lack of recent studies. Updated knowledge is imperative, since drinking behaviour results from a complex set of dynamic and interacting antecedents [26], some of which are susceptible to changes over time. For instance, Mäkelä et al. [27] found, in a Finnish study, a fundamental cultural shift in alcohol consumption over time, particularly for women and people aged over 30 years, and Allamani et al. [28] emphasise a changing Western drinking pattern characterised by increased beer

and spirits consumption in social settings during evenings and weekends. Moreover, research tends to be characterised by not utilising internationally validated alcohol screening instruments [20, 22, 23], by being limited to specific subgroups within the workforce (specific sectors, industries or workers versus managers) [19–24], or by applying validated screening instruments without explicitly investigating practical implications and intervention needs in accordance with international intervention guidelines [19–22, 24]. The present study adds to the existing literature by providing updated knowledge, based on a recent sample of employees not restricted to specific subgroups, by utilising an internationally validated alcohol screening instrument, and by explicitly exploring implications for intervention needs in the workforce in accordance with international guidelines.

The aims of the study were therefore to (a) explore the proportions of risky drinkers in a sample of Norwegian employees by utilising an internationally validated alcohol screening instrument, (b) investigate sociodemographic associations with risky drinking, and (c) examine implications for intervention needs, based on World Health Organization guidelines.

Methods

Design and setting

The present study is one of several studies in the Norwegian national WIRUS-project (Workplace Interventions preventing Risky Use of alcohol and Sick leave). Other results from the WIRUS-project are published elsewhere [29, 30]. This study was designed as a cross-sectional alcohol screening study among private ($n = 5$) and public companies ($n = 9$) in Norway, employing approximately 14.353 individuals.

Alcohol consumption in the general Norwegian population per person per year (7.7 l) is somewhat lower compared to the rest of Europe (10.9 l) and the United States (9.2 l) [2]. Alcohol is a legal substance in Norway. However, restrictive policies and regulations are implemented (e.g., alcohol sale monopoly, age limits, advertising ban and taxation on products containing alcohol) [31]. Alcohol is forbidden in the workplace and infringement may result in resignation [32].

Data collection and sample

4432 employees (30.9%) responded on a web-based questionnaire designed to measure alcohol consumption as well as sociodemographic variables. 3571 employees, 32.6% males and 67.4% females, responded on all items (24.9%), and thus constitute the sample in the present study. Study sample and invited sample characteristics are presented in Table 1.

Approximately seven out of ten employees were aged 40 or older and had completed a university or college education. Only 13.9% of employees lived alone, while nearly half (43.5%) of the sample was unmarried. Almost eight out of ten employees had children, while close to six out of ten had children living in their household. Approximately two out of ten employees were classified as managers, and the majority of employees were employed within public administration (75.5%) and health care services (16.6%). Information on gender and age distributions among all employees in the 14 companies (invited sample) was collected through the companies' personnel records.

Measures

Alcohol consumption was measured with the Norwegian version of the Alcohol Use Disorders Identification Test (AUDIT), developed by the WHO [8]. The AUDIT is a widely used tool for identifying risky drinking and consists of ten questions concerning recent alcohol use, alcohol dependence symptoms and alcohol-related problems, each item with a potential score range from 0 to 4. A total score of ≥8 indicates the presence of risky drinking, and studies have demonstrated that this cut off carries favorable sensitivity and acceptable specificity [8]. Even though some studies have indicated that different thresholds for risky drinking should be applied for different groups (e.g., for males and females), a score of ≥8 has generally been accepted as an optimal cut off for identifying risky drinking [8, 33]. The threshold between low-risk and risky drinking was set at ≥8 scores on the AUDIT, and risky drinking was categorised in three risk levels, based on total scores on the AUDIT, each with a recommended procedure for intervention. Individuals with moderate risk (AUDIT scores 8–15) should be given simple advice on how to reduce risky drinking, individuals with high risk (AUDIT scores 16–19) should be provided with brief counselling and consecutive monitoring, and individuals with dependence likely risk (AUDIT scores 20–40) should be referred to further diagnostic evaluation for alcohol dependence [8, 33].

The AUDIT has been referred to as the global gold standard of alcohol screening instruments [34]. It is designed for international use, it is developed on the basis of data from a multinational sample, and it has been validated across countries and populations, with estimates of internal consistency (Cronbach's α) typically ranging from 0.59 to 0.97 [35], yielding a mean alpha coefficient of 0.80 [33]. In the present study, internal consistency for the ten AUDIT items was estimated to 0.72, with a mean inter-item correlation of 0.25. Obtained psychometric estimates for the AUDIT in the present study were deemed satisfactory and in line with findings from previous studies [33, 35].

Gender (male/female), living status (living alone/living with others), marital status (unmarried/married),

Table 1 Study sample and invited sample characteristics

Variable	Study sample % (n)	Invited sample % (n)	Difference Percentage points (*p-value*)
Gender			
Male	32.6 (1164)	34.2 (4908)	- 1.6 (ns)
Female	67.4 (2407)	65.8 (9445)	+ 1.6 (ns)
Age			
≤ 39	31.3 (1116)	35.5 (5102)	- 4.2 (< .001)
≥ 40	68.7 (2455)	64.5 (9251)	+ 4.2 (< .001)
Variable		Study sample % (n)	
Educational level	Primary/lower secondary	2.4	85
	Upper secondary	22.7	809
	University/college	75.0	2677
Living status	Living alone	13.9	496
	Living with others	86.1	3075
Marital status	Unmarried	43.5	1553
	Married	56.5	2018
Children	No	20.5	731
	Yes	79.5	2840
Children in household	No	43.1	1538
	Yes	56.9	2033
Work position	Worker[a]	81.7	2918
	Manager	18.3	653
Work division[b]	Transportation	1.8	63
	Manufacturing	5.3	191
	Public administration	75.5	2697
	Health care services	16.6	593
	Accommodation	0.8	27

[a]Category includes blue, white and pink collar workers; [b]Classification based on the European Classification of Economic Activities [49]

children (having no children/having children), children in the household (having no children at home/having children at home) and work position (worker/manager) were coded as dichotomous categorical variables. Age was collapsed into categories (≤39/≥40) for application in chi square test for independence, and treated as a continuous variable in the logistic regression model. Educational level was collapsed into two categories (without/with higher education) for utilisation in chi square test for independence, and treated as a categorical variable with four levels (primary/lower secondary, upper secondary, university/college < 4 years, university/college > 4 years) in the logistic regression model.

Analysis

Proportions of risky drinking were estimated by calculating the proportion of employees exceeding the cut off (≥8 scores) on the AUDIT, for the overall sample as well as cross-tabulated proportions for males, females and both genders according to age, educational level, living status, marital status, number of children, number of children living in the household and work position. Bivariately, a series of chi square tests for independence were applied in order to explore whether gender, age, educational level, living status, marital status, number of children, number of children living in the household and work position were significantly associated with risky drinking. Next, adjusted logistic regression was conducted to assess the influence of the sociodemographic variables on the likelihood that employees would report risky drinking. Implications for intervention needs and approaches were investigated by calculating the proportions of risky drinkers in risk levels according to sum scores on the AUDIT (moderate risk: scores 8–15; high risk: scores 16–19; dependence likely: scores 20–40), and evaluating the risk level distributions in accordance with World Health Organization intervention recommendations.

All statistical analyses were performed with IBM SPSS version 24. Significant results were defined as $p < .05$.

Ethics

Respondents were informed about the study's aim, assured confidentiality and that participation was voluntary. We

further collected written informed consent. The study was approved by the Regional Committee for Medical and Health Research in Norway (REK) (approval no. 2014/647).

Results

Proportions of risky drinkers

3179 employees (89.0%) scored within the low-risk category, while 392 employees (11.0%) had an AUDIT score equal to or above the cut off. Cross-tabulated proportions of risky drinking for males, females and both genders according to age, educational level, living status, marital status, children, children in household and work position are presented in Table 2. A higher percentage of males compared to females were identified as risky drinkers (18.1% versus 7.5%). For both genders, rates of risky drinking were higher among employees aged ≤39 (16.7%) versus employees aged ≥40 (8.4%), employees with primary or secondary education (12.9%) versus university/college education (10.3%), employees living alone (18.3%) versus living with others (9.8%), unmarried (15.6%) versus married employees (7.4%), employees without (22.6%) versus those with children (8.0%), employees without children in the household (14.6%) versus those with children living at home (8.2%), and employees characterised as workers (11.3%) versus managers (9.3%).

Table 2 Proportions of risky drinking (AUDIT ≥8) for males, females and both genders according to sociodemographics

	Males (%)	Females (%)	Both genders (%)
	18.1	7.5	11.0
Age			
≤ 39	26.5	12.4	16.7
≥ 40	14.7	5.2	8.4
Educational level			
Primary/secondary	21.3	8.6	12.9
University/college	17.0	7.2	10.3
Living status			
Living alone	31.4	12.4	18.3
Living with others	16.1	6.7	9.8
Marital status			
Unmarried	26.3	10.9	15.6
Married	12.4	4.8	7.4
Children			
No children	33.5	16.8	22.6
Children	13.8	5.2	8.0
Children in household			
No children in household	23.2	10.5	14.6
Children in household	14.3	5.3	8.2
Work position			
Worker	19.6	7.9	11.3
Manager	13.8	5.4	9.3

Risky drinking was found to be most widespread among males without children (33.5%), males living alone (31.4%), and males aged ≤39 (26.5%). Risky drinking was least widespread among married females (4.8%), females with children (5.2%) and females aged ≥40 (5.2%).

Sociodemographic associations with risky drinking

A series of unadjusted chi square tests for independence demonstrated statistically significant bivariate associations between risky drinking and gender (χ^2 (1, $n = 3571$) = 90.34, $p < .001$, $phi = 0.16$), age (χ^2 (1, n = 3571) = 53.77, $p < .001$, $phi = 0.12$), educational level (χ^2 (1, $n = 3571$) = 4.34, $p < .05$, $phi = 0.04$), living status (χ^2 (1, $n = 3571$) = 32.01, $p < .001$, $phi = 0.10$), marital status (χ^2 (1, n = 3571) = 61.33, $p < .001$, $phi = 0.13$), children (χ^2 (1, n = 3571) = 126.44, $p < .001$, $phi = 0.19$), and children in household (χ^2 (1, n = 3571) = 36.87, $p < .001$, $phi = 0.10$). Employees' work position was not significantly associated with risky drinking (χ^2 (1, n = 3571) = 2.19, $p > .05$, $phi = .03$).

The adjusted multivariate logistic regression model was statistically significant, χ^2 (8, n = 3571) = 238.19, $p < .001$, indicating that the model was able to distinguish between employees who reported risky drinking and those who did not. The model explained between 6.5% (Cox and Snell R^2) and 12.9% (Nagelkerke R^2) of the variance in risky drinking, and correctly classified 88.8% of cases. As shown in Table 3, five independent variables made unique statistically significant contributions to the model. Gender displayed an odds ratio of 2.97 ($p < .001$), indicating that male employees were almost three times as likely as female employees to report risky drinking, adjusted for all other variables in the model. For each year of age less, the odds ratio for reporting risky drinking increased by a factor of 1.03 ($p < .001$), while for each decreasing unit of education, the odds of risky drinking increased by a factor of 1.17 ($p < .05$). With an odds ratio of 1.38 ($p < .05$), unmarried employees were more likely than married employees to be risky drinkers. Employees without children had a greater odds (1.62, $p < .05$) for risky drinking compared to employees with children.

There were tendencies for employees living alone and not having children in the household to have greater odds for risky drinking, compared to employees living with others and with children in the household. These associations, however, did not reach statistical significance when adjusting for all other factors in the model. Employees' working position demonstrated neither a bivariate or a multivariate association with risky drinking.

Table 3 Associations between sociodemographic factors and risky drinking (AUDIT≥8). Multivariate logistic regression model

				95% CI for OR	
Variable	B	S.E.	OR	Lower	Upper
Gender (males are the ref.)	1.09	0.11	2.97***	2.37	3.71
Age	0.03	0.01	1.03***	1.02	1.04
Educational level	0.16	0.07	1.17*	1.03	1.34
Living status (living alone is the ref.)	0.17	0.17	1.18	0.85	1.63
Marital status (unmarried is the ref.)	0.32	0.14	1.38*	1.05	1.82
Children (no children is the ref.)	0.48	0.21	1.62*	1.08	2.43
Children in household (no children is the ref.)	0.30	0.18	1.34	0.95	1.90
Work position (worker is the ref.)	0.06	0.16	1.06	0.78	1.45

*$p < .05$; ***$p < .001$

Implications for intervention approaches

Employees' risk level assessments for the overall sample as well as for identified at-risk groups (males without children, males living alone and males aged ≤39), categorised by AUDIT sum scores and intervention recommendations, are presented in Table 4. Of those employees identified as risky drinkers in the overall sample (11.0%), 94.6% scored within the moderate risk category (AUDIT sum scores 8–15), wherein simple advice is the recommended intervention. Only 4.1 and 1.3% of risky drinkers scored within high risk (AUDIT sum scores 16–19) and the dependence likely category (AUDIT sum scores 20–40), respectively, with corresponding intervention recommendations of brief counselling/consecutive monitoring and diagnostic evaluation for alcohol dependence. Similarly, within identified at-risk groups. The vast majority of risky drinkers scored within the range of moderate risk (males without children: 95.3%; males living alone: 98.0%; males aged ≤39: 93.3%).

Discussion

The aims of the present study were to explore the proportions of risky drinkers in a sample of Norwegian employees by utilising an internationally validated alcohol screening instrument, to investigate sociodemographic associations with risky drinking, and to examine implications for intervention needs based on WHO guidelines. The following main findings will be discussed: (a) Overall, approximately one out of ten employees reported risky drinking, (b) risky drinking was found to be associated with and most common among males, younger employees, employees with low education, unmarried employees and employees without children, and (c) the majority of identified risky drinkers scored within the lowest defined risk level, i.e., with moderate risk that may be addressed by means of low-cost interventions.

Most comparable to our study, Halkjelsvik and Storvoll [17] did find, by also utilising an AUDIT threshold of ≥8, risky drinking estimates in the general Norwegian population (17.0%) that were markedly higher than those found in our sample of Norwegian employees. However, they did include students and unemployed in their sample, which may contribute to explaining their higher estimates, given that studies have found particularly high

Table 4 Employees' risk level assessment, categorised by AUDIT sum scores and intervention recommendations

Overall sample					
Risk level	AUDIT sum	Recommended intervention[a]	N	% of overall sample	% of risky drinkers
Low	0–7	Alcohol education	3179	89.0	–
Moderate	8–15	Simple advice	371	10.4	94.6
High	16–19	Brief counselling and consecutive monitoring	16	0.4	4.1
Dependence likely	20–40	Diagnostic evaluation for alcohol dependence	5	0.2	1.3
Identified at-risk groups (% of risky drinkers with moderate, high and dependence risk)					
Group			Moderate (AUDIT 8–15)	High (AUDIT 16–19)	Dependence likely (AUDIT 20–40)
Males without children			95.3	3.5	1.2
Males living alone			98.0	0.0	2.0
Males aged ≤39			93.3	6.7	0.0

[a]See [8, 48]

levels of alcohol consumption within these groups [14, 18, 36, 37]. In our study, women were also somewhat overrepresented, which could explain lower prevalence estimates of risky drinkers.

Still, the present study found estimates of risky drinking (11.0%) marginally higher than what has been found in several other studies of employees, with estimates ranging from 6.0 to 8.8% [19–21, 23]. Our estimates are in line with what was found by Nesvåg and Lie when they studied Norwegian private sector employees [22]. Their study is not directly comparable to ours, as they did not include public sector employees in their sample. Moreover, they measured risky drinking solely on the basis of number of consumed alcohol units. In general, differences in estimates across studies may be due to actual prevalence differences within populations, or be a result of different studies employing different measures of alcohol consumption and risky drinking thresholds.

In accordance with previous studies [14, 16, 17, 23], we found that risky drinking was associated with being male and young. Compared to female employees, male employees were almost three times as likely to report risky drinking, while each year of decreased age was associated with an increased odds of risky drinking. A consistent finding is that men drink more and heavier than women, and that larger proportions of females compared to males are abstainers [38]. Such universality could imply that endogenous gender differences may play a role, even though drinking patterns are probably heavily moderated by social and cultural factors.

Even though evidence on the relationship between age and alcohol consumption is somewhat inconclusive, cross-sectional studies have demonstrated lower consumption levels at older ages, and longitudinal studies have revealed decreased consumption and drinking prevalence with increasing age [39]. Also, heavy episodic drinking (binge drinking) has been found to be most common among young males [40], which may contribute to explain the association between being young, male and a risky drinker. Consistent with previous research [11, 14, 23], we found that unmarried employees and employees without children were more likely to be risky drinkers compared to those married and with children. It may well be that living with a spouse or partner and having children act as protective factors against high levels of alcohol consumption.

In line with similar studies [16, 17], the present study found an association between educational level and risky drinking. However, we found an association in the opposite direction of most studies, i.e., we found that employees with lower education were more vulnerable to risky drinking than employees with higher education. It is unclear which mechanisms underlie the relationship between educational level and risky drinking. Consistent with our findings, Crum et al. [41] revealed that high-school drop outs were significantly more likely to develop alcohol dependence than individuals with a college degree. It has been proposed that individuals with low socioeconomic status are less adherent to public health recommendations than those with higher socioeconomic status [42]. In a large sample drawn from a general Danish population, Shnohr et al. [43] found that individuals with low education were more frequently classified as heavy drinkers, compared to individuals with higher education. The association between educational attainment and risky drinking among employees should be subject to further research.

In line with Halkjelsvik and Moan [17], we found that the majority of risky drinkers (both within the overall sample and within identified at-risk groups) scored within the lowest risk category (moderate risk), where simple advice is the recommended intervention strategy. Studies have in general revealed higher estimates of alcohol consumption and risky drinking among primarily non-working populations, e.g., unemployed and students [14, 18, 36, 37], compared to working populations [19–24]. Alcohol consumption corresponding to higher risk levels may be largely incompatible with functioning in a workplace over time. Heavy drinkers may, to a large extent, have been excluded from the working community due to alcohol problems. This may contribute to explain why we found that the majority of risky drinkers among employees can be characterised by moderate risk of developing alcohol problems rather than being heavy drinkers.

Methodological considerations

The present study has some limitations. Conducted within a cross-sectional design, we have identified associations between sociodemographic variables and risky drinking. It is, however, not possible to draw causal conclusions from these associations. Moreover, risky drinking may be influenced by a great variety of variables not measured and included in this study.

The present study was based on a relatively large sample ($n = 3571$) from the Norwegian working community. The final response rate, however, was low (24.9%). Comparisons between the study sample and the invited sample (see Table 1) did, however, reveal very small differences regarding gender and age distributions. Distribution of gender in the study sample was not significantly different from the true distribution in the invited sample. Distribution of age was significantly different ($p < .001$), with a 4.2 percentage point overrepresentation of employees aged 40 and older. Generalisations should therefore be done with caution. Low response rates may contribute to prevalence estimates biased by non-response, and non-response bias may be a greater threat to prevalence estimates than to

associations between variables [44]. Although evidence is somewhat inconclusive, it has been proposed that heavy drinkers, males and individuals with low socioeconomic status tend to be overrepresented among non-responders in health surveys [41–46]. Hence, non-response bias may have contributed to an underestimation of risky drinking in the present study.

The study benefited from utilising the AUDIT as a measure of alcohol consumption, a widely validated tool [33, 35], designed for international use across gender, age and cultures [8]. Moreover, the AUDIT did demonstrate satisfactory psychometric properties in the present study. The AUDIT does, however, suffer from limitations as a result of being a self-reported measure, and in the present study we were not able to compare AUDIT scores with a more objective measure of alcohol consumption. Self-reported alcohol consumption has been found to be considerably lower than estimates of actual alcohol sales [47]. Individuals who responded on the AUDIT questions may have underreported their actual alcohol consumption, possibly contributing to an underestimation of risky drinking in the present study.

Implications

Sociodemographic associations identified in this study do imply that in some groups, a much larger proportion, (up to one in three) may be particularly exposed to risky drinking, i.e., males, young employees, employees with low education, unmarried employees and those without children. However, identified sociodemographic correlates may not be conceived of as a check list that can inform employers about each employee's level of alcohol risk. Knowledge of a set of significant correlates of risky drinking may, on the other hand, be directive in determining which and to what extent companies should make alcohol-preventive measures an overall priority, and for early identification purposes.

In the present study, more than nine out of ten risky drinkers scored within the lowest risk category, implying that low-cost interventions (such as simple advice) on an individual and/or collective level may be serviceable and sufficient for the majority of risky drinkers. On an individual level, such interventions may be administered by the occupational health services or primary health care services. A stepped-care approach [8, 48] may be utilised, i.e., employees are first managed by means of the lowest intervention level according to their AUDIT score and referred to the next level if they do not respond to the initial intervention. On a collective level, companies may benefit from developing and implementing specific guidelines regarding work-related alcohol use, as well as establishing alcohol prevention as an integrated part of the continuous work on health safety and environment in the workplace.

The present study carries some implications for future research. In the research literature, it is evident that a variety of measures of alcohol consumption and thresholds for risky drinking are employed and few studies have ulitised internationally validated instruments. Such diversity and lack of standardisation makes it difficult to compare studies and assess whether observed differences are due to actual variation within populations or differences in measurement and conceptualisation. Future research should attempt at establishing more consensus on how to measure and conceptualise risky drinking.

In this study we found that lower education was associated with risky drinking. This finding contradicts previous findings that generally suggests an association in the opposite direction. Hence, future research would benefit from engaging in a more thorough exploration of the association between educational level and risky drinking, e.g., by means of longitudinal studies and studies investigating possible moderators and mediators of this relationship.

Conclusions

A considerable amount of employees (between one and three out of ten) were identified as potential risky drinkers. Being male, young, having low education, being unmarried and not having children seem to characterise employees at particular risk. However, as many as nine out of ten risky drinking employees scored within the lowest risk level. Potentially, low-cost workplace-based interventions may be a cost-effective measure to meet a major challenge that faces individual employees, employers as well as larger society.

Abbreviations

AUDIT: The Alcohol Use Disorders Identification Test; CI: Confidence interval; OR: Odds ratio; REK: Regional Committees for Medical and Health Research in Norway; S.E.: Standard error; WHO: World Health Organization; WIRUS: Workplace Interventions preventing Risky Use of alcohol and Sick leave

Funding

The study was supported by the Norwegian Directorate of Health and the Research Council of Norway. The funding bodies had no role in the design of study nor in data collection, analysis and data interpretation.

Availability of data and materials

The dataset used and analysed during the current study is available from the corresponding author on reasonable request.

Authors' contributions

RWA is the principal investigator and project manager of the WIRUS-project, and has designed and developed the WIRUS-screening study. MMT analysed that data and drafted the manuscript. JCS and RWA provided scientific input to the different drafts and provided data interpretation. All authors made critical revisions and provided intellectual content to the manuscript, approved the final version to be published, and agreed to be accountable for all aspects of this work. All authors read and approved the final manuscript.

Ethics approval and consent to participate
The study was approved by the Regional Committee for Medical and Health Research in Norway (REK) (approval no. 2014/647). Participants provided written informed consent.

Competing interests
The authors declare that they have no competing interests.

Publisher's Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Author details
[1]Faculty of Health Sciences, Department of Occupational Therapy, Prosthetics and Orthotics, OsloMet - Oslo Metropolitan University, St. Olavs plass, NO-0130 Oslo, Norway. [2]Department of Health Promotion, Norwegian Institute of Public Health, Bergen, Norway. [3]Center for Alcohol & Drug Research Stavanger University Hospital, Stavanger, Norway. [4]Faculty of Health Sciences, University of Stavanger, Stavanger, Norway. [5]Presenter – Making Sense of Science, Stavanger, Norway.

Received: 17 October 2017 Accepted: 1 June 2018
Published online: 14 June 2018

References
1. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the global burden of disease study 2010. Lancet. 2012;380(9859):2224–60.
2. World Health Organization. Global status report on alcohol and health, 2014. Geneva: World Health Organization; 2014.
3. Frone MR. Prevalence and distribution of alcohol use and impairment in the workplace: a US national survey. J Stud Alcohol. 2006;67(1):147–56.
4. Schou L, Moan IS. Alcohol use–sickness absence association and the moderating role of gender and socioeconomic status: a literature review. Drug Alcohol Rev. 2016;35(2):158–69.
5. Kirkham HS, Clark BL, Bolas CA, Lewis GH, Jackson AS, Fisher D, et al. Which modifiable health risks are associated with changes in productivity costs? Popul Health Manag. 2015;18(1):30–8.
6. Mangione TW, Howland J, Amick B, Cote J, Lee M, Bell N, et al. Employee drinking practices and work performance. J Stud Alcohol. 1999;60(2):261–70.
7. Schultz AB, Edington DW. Employee health and presenteeism: a systematic review. J Occup Rehabil. 2007;17(3):547–79.
8. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. AUDIT: The alcohol use disorders identification test: guidelines for use in primary health care. Geneva: World Health Organization; 2001.
9. Taylor SE. Health psychology. 7th ed. New York: McGraw-Hill; 2009.
10. Skogen JC. Alkohol og permanent arbeidsuførhet. Høyt forbruk av alkohol eller alkoholproblemer - hva er forskjellen? [alcohol and permanent work disability. High consumption of alcohol or alcohol problems - what is the difference?]. In: Sagvaag H, Sikveland B, editors. Alkohol + arbeidsliv = sant? En vitenskapelig antologi [alcohol + employment = true? A scientific anthology]. Oslo: Gyldendal; 2014. p. 215–25.
11. Fleming MF, Manwell LB, Barry KL, Johnson K. At-risk drinking in an HMO primary care sample: prevalence and health policy implications. Am J Public Health. 1998;88(1):90–3.
12. Levola J, Aalto M. Screening for at-risk drinking in a population reporting symptoms of depression: a validation of the AUDIT, AUDIT-C, and AUDIT-3. Alcohol Clin Exp Res. 2015;39(7):1186–92.
13. Rumpf H-J, Hapke U, Meyer C, John U. Screening for alcohol use disorders and at-risk drinking in the general population: psychometric performance of three questionnaires. Alcohol Alcoholism. 2002;37(3):261–8.
14. Shah AA, Bazargan-Hejazi S, Lindstrom RW, Wolf KE. Prevalence of at-risk drinking among a national sample of medical students. Subst Abus. 2009;30(2):141–9.
15. Waern M, Marlow T, Morin J, Östling S, Skoog I. Secular changes in at-risk drinking in Sweden: birth cohort comparisons in 75-year-old men and women 1976–2006. Age Ageing. 2013;43(2):228–34.
16. Yan T, Xu H, Ettner SL, Barnes AJ, Moore AA. At-risk drinking and outpatient healthcare expenditures in older adults. J Am Geriatr Soc. 2014;62(2):325–8.
17. Halkjelsvik T, Storvoll EE. Andel av befolkningen i Norge med et risikofylt alkoholkonsum målt gjennom alcohol use disorders identification test (AUDIT) [proportion of the population in Norway with an at-risk alcohol consumption measured by alcohol use disorders identification test (AUDIT)]. Nord Stud Alcohol Dr. 2014;32(1):61–7.
18. Myrtveit SM, Askeland KG, Knudsen AK, Knapstad M, Olsen R, Nedregård T, et al. Risky drinking among Norwegian students: associations with participation in the introductory week, academic performance and alcohol-related attitudes. Nord Stud Alcohol Dr. 2016;33(4):361–80.
19. Webb GR, Redman S, Hennrikus D, Rostas JA, Sanson-Fisher RW. The prevalence and sociodemographic correlates of high-risk and problem drinking at an industrial worksite. Addiction. 1990;85(4):495–507.
20. Howland J, Mangione TW, Kuhlthau K, Bell N, Heeren T, Lee M, et al. Work-site variation in managerial drinking. Addiction. 1996;91(7):1007–17.
21. Kjaerheim K, Mykletun R, Aasland OG, Haldorsen T, Andersen A. Heavy drinking in the restaurant business: the role of social modelling and structural factors of the work-place. Addiction. 1995;90(11):1487–95.
22. Nesvåg S, Lie T. Rusmiddelbruk blant ansatte i norsk privat arbeidsliv arbeidsliv [Drug use among employees in Norwegian private sector]. Nordisk Alkohol- og Narkotikatidsskrift. 2004;21(2):91–109.
23. Marchand A, Parent-Lamarche A, Blanc M-È. Work and high-risk alcohol consumption in the Canadian workforce. Int J Env Res Pub He. 2011;8(7):2692–705.
24. Kawakami N, Harantani T, Hemmi T, Araki S. Prevalence and demographic correlates of alcohol-related problems in Japanese employees. Soc Psych Psych Epid. 1992;27(4):198–202.
25. Ames GM, Bennett JB. Prevention interventions of alcohol problems in the workplace: a review and guiding framework. Alc Res Health. 2011;34(2):175.
26. Frone MR. Predictors of overall and on-the-job substance use among young workers. J Occup Health Psych. 2003;8(1):39–54.
27. Mäkelä P, Tigerstedt C, Mustonen H. The Finnish drinking culture: change and continuity in the past 40 years. Drug Alcohol Rev. 2012;31(7):831–40.
28. Allamani A, Beccaria F, Voller F. The puzzle of Italian drinking. Trends in alcohol consumption, harms and policy: Italy 1990–2010. Nord Stud Alcohol Dr. 2010;27(5):465–78.
29. Nordaune K, Skarpaas LS, Sagvaag H, Haveraaen L, Rimstad S, Kinn LG, et al. Who initiates and organises situations for work-related alcohol use? The WIRUS culture study. Scand J Public Healt. 2017;45(8):749–756.
30. Aas RW, Haveraaen L, Sagvaag H, Thørrisen MM. The influence of alcohol consumption on sickness presenteeism and impaired daily activities. The WIRUS screening study. PLoS One. 2017;12(10):e0186503.
31. Norwegian Institute of Public Health. Rusmidler i Norge 2016 [Drugs in Norway 2016]. Oslo: Norwegian Institute of Public Health; 2016.
32. Sagvaag H, Sikveland B. Alkohol + arbeidsliv = sant? En vitenskapelig antologi [Alcohol + employment = true? A scientific anthology]. Oslo: Gyldendal; 2014.
33. de Meneses-Gaya C, Zuardi AW, Loureiro SR, Crippa JAS. Alcohol use disorders identification test (AUDIT): an updated systematic review of psychometric properties. Psychol Neurosci. 2009;2(1):83.
34. Centers for Disease Control and Prevention. Planning and implementing screening and brief intervention for risky alcohol use: a step-by-step guide for primary care practices. Atlanta: Centers for Disease Control and Prevention; 2014.
35. Reinert DF, Allen JP. The alcohol use disorders identification test: an update of research findings. Alcohol Clin Exp Res. 2007;31(2):185–99.
36. Janlert U, Hammarström A. Alcohol consumption among unemployed youths: results from a prospective study. Addiction. 1992;87(5):703–14.
37. Reine I, Novo M, Hammarström A. Unemployment and ill health–a gender analysis: results from a 14-year follow-up of the northern Swedish cohort. Public Health. 2013;127(3):214–22.
38. Wilsnack RW, Wilsnack SC, Kristjanson AF, Vogeltanz-Holm ND, Gmel G. Gender and alcohol consumption: patterns from the multinational GENACIS project. Addiction. 2009;104(9):1487–500.
39. Eigenbrodt ML, Mosley TH Jr, Hutchinson RG, Watson RL, Chambless LE, Szklo M. Alcohol consumption with age: a cross-sectional and longitudinal study of the atherosclerosis risk in communities (ARIC) study, 1987–1995. Am J Epidemiol. 2001;153(11):1102–11.
40. Andersson A, Mårdby A-C, Holmgren K, Hensing G. Associations between leisure activities and binge drinking in adults: findings from a Swedish newly sick-listed sample. Work. 2014;48(2):143–53.
41. Crum RM, Helzer JE, Anthony JC. Level of education and alcohol abuse and dependence in adulthood: a further inquiry. Am J Public Health. 1993;83(6):830–7.

42. Lynch JW, Kaplan GA, Salonen JT. Why do poor people behave poorly? Variation in adult health behaviours and psychosocial characteristics by stages of the socioeconomic lifecourse. Soc Sci Med. 1997;44(6):809–19.
43. Schnohr C, Højbjerre L, Riegels M, Ledet L, Larsen T, Schultz-Larsen K, et al. Does educational level influence the effects of smoking, alcohol, physical activity, and obesity on mortality? A prospective population study. Scand J Soc Med. 2004;32(4):250–6.
44. Knudsen AK, Hotopf M, Skogen JC, Øverland S, Mykletun A. The health status of nonparticipants in a population-based health study: the Hordaland health study. Am J Epidemiol. 2010;172(11):1306–14.
45. Boniface S, Scholes S, Shelton N, Connor J. Assessment of non-response bias in estimates of alcohol consumption: applying the continuum of resistance model in a general population survey in England. PLoS One. 2017;12(1):e0170892.
46. Korkeila K, Suominen S, Ahvenainen J, Ojanlatva A, Rautava P, Helenius H, et al. Non-response and related factors in a nation-wide health survey. Eur J Epidemiol. 2001;17(11):991–9.
47. Boniface S, Kneale J, Shelton N. Drinking pattern is more strongly associated with under-reporting of alcohol consumption than socio-demographic factors: evidence from a mixed-methods study. BMC Public Health. 2014; 14(1):1297.
48. Babor TF, Higgins-Biddle JC. Brief intervention for hazardous and harmful drinking: a manual for use in primary care. Geneva: World Health Organization; 2001.
49. Eurostat. NACE rev. 2. Statistical classification of economic activities in the European community. Luxembourg: Eurostat; 2008.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

Paper II

Thørrisen, M. M., Bonsaksen, T., Hashemi, N., Kjeken, I., van Mechelen, W., & Aas, R. W. (2019). Association between alcohol consumption and impaired work performance (presenteeism): A systematic review. BMJ Open, 9(7).
DOI: **https://dx.doi.org/10.1136/bmjopen-2019-029184**

BMJ Open

Association between alcohol consumption and impaired work performance (presenteeism): a systematic review

Mikkel Magnus Thørrisen,[1] Tore Bonsaksen,[1,2] Neda Hashemi,[3] Ingvild Kjeken,[1,4] Willem van Mechelen,[5,6,7,8,9] Randi Wågø Aas[1,3,10]

To cite: Thørrisen MM, Bonsaksen T, Hashemi N, *et al*. Association between alcohol consumption and impaired work performance (presenteeism): a systematic review. *BMJ Open* 2019;**9**:e029184. doi:10.1136/bmjopen-2019-029184

► Prepublication history and additional material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2019-029184).

Received 16 January 2019
Revised 20 March 2019
Accepted 19 June 2019

Check for updates

© Author(s) (or their employer(s)) 2019. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to
Mikkel Magnus Thørrisen; mikkel-magnus.thorrisen@oslomet.no

ABSTRACT

Objectives The aim of this review was to explore the notion of alcohol-related presenteeism; that is, whether evidence in the research literature supports an association between employee alcohol consumption and impaired work performance.

Design Systematic review of observational studies.

Data sources MEDLINE, Web of Science, PsycINFO, CINAHL, AMED, Embase and Swemed+ were searched through October 2018. Reference lists in included studies were hand searched for potential relevant studies.

Eligibility criteria We included observational studies, published 1990 or later as full-text empirical articles in peer-reviewed journals in English or a Scandinavian language, containing one or more statistical tests regarding a relationship between a measure of alcohol consumption and a measure of work performance.

Data extraction and synthesis Two independent reviewers extracted data. Tested associations between alcohol consumption and work performance within the included studies were quality assessed and analysed with frequency tables, cross-tabulations and χ^2 tests of independence.

Results Twenty-six studies were included, containing 132 tested associations. The vast majority of associations (77%) indicated that higher levels of alcohol consumption were associated with higher levels of impaired work performance, and these positive associations were considerably more likely than negative associations to be statistically significant (OR=14.00, *phi*=0.37, p<0.001). Alcohol exposure measured by hangover episodes and composite instruments were over-represented among significant positive associations of moderate and high quality (15 of 17 associations). Overall, 61% of the associations were characterised by low quality.

Conclusions Evidence does provide some support for the notion of alcohol-related presenteeism. However, due to low research quality and lack of longitudinal designs, evidence should be characterised as somewhat inconclusive. More robust and less heterogeneous research is warranted. This review, however, does provide support for targeting alcohol consumption within the frame of workplace interventions aimed at improving employee health and productivity.

PROSPERO registration number CRD42017059620.

Strengths and limitations of this study

- This systematic review is, to the best of our knowledge, the first to exclusively explore evidence for the notion of alcohol-related presenteeism.
- The review was based on comprehensive searches in seven scientific databases as well as in reference lists and included studies containing data from more than 92 000 employees across 15 countries.
- As a result of included studies often being characterised by exploring broader aims related to health and productivity, and by testing several relevant associations between alcohol consumption and work performance, associations were chosen as the unit of analysis.
- Due to the heterogeneous nature of the included data, meta-analyses were deemed inappropriate, in particular since measures of alcohol consumption were difficult to compare across studies/associations (eg, abstainer vs drinker, frequency, volume, hangovers, binge drinking, composite instruments and dependence/abuse diagnoses).
- Included data were quality assessed on an association level by means of a parsimonious and conservative assessment system developed specifically for this review.

INTRODUCTION

Alcohol consumption

Excessive alcohol consumption is a major risk factor for disease, disability and mortality and has been identified as a causal agent in more than 200 disease and injury conditions.[1] Higher alcohol consumption has been found to be associated with lowered life expectancy,[2] and according to the WHO,[3] harmful alcohol consumption is related to approximately 3 million annual deaths globally. Among the population aged 15–49 years, alcohol has been identified as the leading risk factor for death and disability-adjusted life-years.[4] Alcohol is by far the most used and misused psychoactive substance in the workforce,[5] and 1–3 out

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

of 10 employees can be characterised as risky drinkers in need for interventions,[6–9] that is, having a consumption pattern that increases the risk for social, legal, medical, occupational, domestic and economic problems.[10] Even though adverse consequences of alcohol tend to accumulate in concordance with increased consumption,[2 4] it is far from straightforward to establish an appropriate threshold distinguishing between no/low-risk and risky drinking. Whether a particular drinking pattern or consumption level can be conceived of as risky, depends on several factors, such as: (1) effects of alcohol consumption interact with other individual characteristics, such as general health, sociodemographic, physiological and other lifestyle factors[11] and (2) any level of drinking may be risky given certain circumstances, such as when being pregnant, operating heavy machinery and taking medications known to interact with alcohol.[12] International drinking guidelines, often expressed in terms of a number of alcohol units during a specific time frame, vary considerably across countries, and moreover, even standard drink sizes vary internationally.[12] In both research and clinical practice, thresholds for risky drinking are often applied based on scores on composite instruments, assuming a more complex relationship between alcohol and health, such as a score of 8 or higher on the Alcohol Use Disorders Identification Test (AUDIT).[10 13]

Alcohol can affect mood as well as cognitive and psychomotor performance. Psychopharmacological and experimental workplace simulation studies have explored effects of alcohol intoxication on performance, generally suggesting little consistent impairment at low to moderate intoxication levels (blood alcohol content (BAC) 0.01%–0.08%), while at higher BAC levels (≥0.09%) impairment seems to increase quite linearly with task complexity.[14–17] For comparison, one standard UK drink approximates a BAC of 0.02% for a male (age: 40 years; body weight: 80 kg) or 0.04% for a female (age: 40 years; body weight: 60 kg).[18] For both, a BAC of ≥0.09% would be surpassed after three drinks. In a 6-hour time window, a BAC of ≥0.09% would be present after nine (male) or six (female) drinks. Hangover episodes, defined as an adverse mental and physical state experienced after heavy drinking when the BAC level returns to zero (p.85)[5] include symptoms that may be related to performance decrements, such as headache, nausea, drowsiness and sensitivity to light/sound.[15 19 20]

Alcohol consumption may influence activity performance in a variety of domains, including the occupational sphere. Regarding employees' alcohol consumption, one may distinguish between workforce overall alcohol consumption (consumption regardless of context) and work-related alcohol consumption (consumption prior to or during the workday, as well as in contexts directly related to the work environment or the employment relationship).[5 21–23] According to Frone's integrative conceptual model of employee substance use and productivity, not showing up at work (absenteeism) and arriving late at work (tardiness) are primarily believed to be affected by off-the-job drinking, while leaving work early and reduced work performance are thought mainly to be due to on-the-job drinking, that is, drinking within 2 hours before work, during breaks or while performing the job.[5 24] However, the model does allow for possible cross-over effects between contexts. Off-the-job drinking 'may indirectly affect performance outcomes to the extent that it causes off-the-job substance impairment, which when carried into the workplace becomes workplace impairment' (p. 134).[5] An association between employees' alcohol consumption and absenteeism is quite well established in the literature,[25] while alcohol-related presenteeism stands out as a far more under-researched topic.

Presenteeism

Presenteeism has been defined in a variety of ways and the concept somewhat suffers from a 'definitional creep' (p. 521).[26] Two distinct traditions in presenteeism research have been identified.[26 27] The first tradition has primarily emphasised the exploration of presenteeism determinants and studied presenteeism as a chosen behaviour or personal choice. In this perspective, presenteeism is defined as the act of 'showing up for work even when one is ill' (p. 519)[26], or 'the phenomenon of people who, despite complaints and ill health that should prompt rest and absence from work, are still turning up at their jobs' (p. 503).[28] Hence, presenteeism may be conceived as an alternative to absenteeism and, as such, even as a health-promoting measure within a return-to-work framework.[29] The second tradition has been more oriented towards consequences of this behaviour, in particular related to productivity loss. Researchers in this tradition have defined presenteeism as 'decreased on-the-job performance due to the presence of health problems' (p. 548)[30], 'the health-related productivity loss while at paid work' (p. 351)[31], or 'the measurable extent to which health symptoms, conditions and diseases adversely affect the work productivity of individuals who choose to remain at work'(p. 2).[32] Evidently, the first tradition treats presenteeism as a behaviour, regardless of its consequences, while the second tradition claims that adverse performance outcomes are inherent in the conceptualisation of presenteeism.

It is plausible to conceive that a variety of health conditions do not result in productivity impairment, and from an organisational perspective, it may be argued that situations in which employees attend work while sick become of interest primarily when performance decrements are involved. In this systematic review, we consider presenteeism as reduced on-the-job performance due to health problems.[30] As such, presenteeism constitutes a link between on-the-job productivity and employee health,[30] addressing the grey area between optimal work performance and the absence of productivity (ie, absenteeism).[26] Within this frame, alcohol-related presenteeism can be conceptualised as the presence of a positive association between alcohol consumption and impaired work performance (or conversely as a negative association

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

between alcohol consumption and work performance). Alcohol-related presenteeism is thus operationalised as the product of a relationship between two variables (exposure: alcohol consumption; outcome: work performance) rather than a single variable (attending work while sick), rendering it possible to retain the notion of work performance as inherent in the phenomenon of presenteeism without conflating cause and effect.

Performance outcomes at work comprise several phenomena related to productivity. The concept of presenteeism is most directly associated with task performance. However, performance may as well be related to contextual performance (such as working extra hours and helping coworkers), counterproductive behaviour (such as workplace aggression and property damage) and issues related to job safety, such as injuries resulting from accidents (p. 132).[5] A recent Norwegian study revealed that employees' alcohol consumption was a major concern relating to safety issues,[33] and several studies support an association between alcohol and occupational injuries.[34–36] However, in the context of the present review, we focused on work performance related to task performance, which can be conceived of as most directly related to on-the-job productivity.

Absenteeism and presenteeism have been found to be moderately correlated and related by baseline presenteeism being a risk factor for future absenteeism.[37] Several authors have argued that presenteeism may carry more substantial societal costs than absenteeism. Hemp stated that 'the illnesses people take with them to work (…) usually account for a greater loss in productivity because they are so prevalent, so often go untreated, and typically occur during peak working years. Those indirect costs have long been largely invisible to employers' (p. 2).[38]

Known predictors of presenteeism include diseases and disorders (eg, musculoskeletal problems, depression and anxiety), certain individual characteristics (eg, gender, age, job satisfaction, stress and family status) and factors related to the organisational environment (eg, employment security, work schedules, workload, managerial support, corporate culture and leadership style).[27] Knowledge of mechanisms underlying presenteeism is, however, still quite limited. In particular, the impact of individual health risks or combinations of risks should be researched more extensively.[30]

Rationale and aim

Some studies have explored alcohol-related presenteeism, either directly or indirectly. There is, however, a lack of synthesised knowledge, rendering it difficult to assess the evidence of a possible association between employee alcohol consumption and work performance. In their review of relationships between psychological, physical and behavioural health and work performance, Ford *et al* found alcohol consumption to be weakly associated with work performance problems.[39] However, this conclusion was based solely on 12 studies identified in two scientific databases in 2011. It seems imperative to generate new accumulated knowledge in order to aid in deciding whether and how workplace interventions and Workplace Health Promotion Programs (WHPP) should include an emphasis on alcohol consumption.

The aim of this review was to explore whether evidence in the research literature supports the notion of alcohol-related presenteeism, that is, whether evidence supports an association between employee alcohol consumption (overall, as well as work related) and impaired work performance.

METHODS

Protocol and registration

This review is registered in the International prospective register of systematic reviews and is part of the Norwegian national Workplace Interventions preventing Risky Use of alcohol and Sick leave (WIRUS) project. Original research from the WIRUS project is published elsewhere.[9 23 40]

Eligibility criteria

Studies exploring alcohol-related presenteeism, that is, the relationship between alcohol consumption (exposure) and work performance (outcome) among employees (population), were included in this review. Included studies had to satisfy the following criteria: (1) *type of study* (observational study, eg, case–control, prospective cohort or cross-sectional study); (2) *type of participants* (the study reported results from a sample of employees, defined as all salaried persons between 16 and 70 years of age, both workers and managers, regardless of employment sector or branch); (3) *type of measures/tests* (the study reported one or more statistical test(s) of a relationship between a measure of alcohol consumption and a measure of work performance); (4) *type of publication and language* (the study was reported as a full-text empirical research article published in English or a Scandinavian language in a peer-reviewed scientific journal); and (5) *time* (the study was published year 1990 or later).

Studies were excluded if they (1) reported results from samples in which employees were mixed with other groups (eg, full-time students and unemployed), unless results were reported independently for each group and/or (2) reported tests where alcohol and/or work performance were analysed in combination with other factors (eg, if on-the-job performance was analysed in combination with absenteeism within a wider productivity variable). Time restrictions were set a priori due to drinking behaviour, in particular, resulting from complex and interacting antecedents that are susceptible to changes over time.[24 41 42] Hence, very old studies may suffer from low external validity.

Literature search

A primary database search strategy (based on a MEDLINE structure; see online supplementary file 1) was developed and applied in seven scientific databases (MEDLINE,

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

Web of Science, PsycINFO, CINAHL, AMED, Embase and Swemed+). Where necessary, the search strategy was adapted to each database. The primary (MEDLINE) strategy comprised a total of 31 steps, of which 20 were abstract-level text searches, 7 were based on Medical Subject Headings (MeSH) terms (Medical Subject Headings, topics or similar terms), and the remaining were combinations of results applying Boolean operators (OR; AND). First, studies relating to the population (employees) were searched for (employee*; employed; worker*; workforce; work [MeSH]; employment [MeSH]), followed by studies relating to the exposure (alcohol consumption) (alcohol*; drink*; drunk*; hangover; "hang over"; alcohol drinking [MeSH]; binge drinking [MeSH]; drinking behaviour [MeSH]) and the outcome (work performance) (presenteeism; "job productiv*"; "work productiv*"; "job capacity"; "work capacity"; "job ability"; "work ability"; "job impair*"; "work impair*"; "job performance"; "work performance"; presenteeism [MeSH]; work performance [MeSH]). Finally, search blocks for population, exposure and outcome were combined. Database search results were transferred to EndNote.

No restrictions were imposed at the search stage. The primary search strategy was pilot tested by three reviewers prior to conducting the main searches. Databases were initially searched in September 2017. An updated search was conducted in October 2018. Additionally, reference lists in included studies were hand searched for potential relevant studies.

Study and data selection

After searching the seven databases, hand searching in reference lists in included studies and removing duplicates, identified studies were screened for relevance on a title/abstract level. Study selection was based on the results of combining the three main search blocks in the database search strategy (population, exposure and outcome). For quality assurance of the search strategy and eligibility criteria, the first 20 studies were independently screened by three reviewers. The remaining studies were independently screened by two reviewers. Initial disagreements on eligibility were resolved through discussion. The reviewers reached consensus. Hence, it was not necessary to consult with a third reviewer. Potentially relevant studies were independently assessed in full-text format for eligibility by two reviewers. Initial disagreements were resolved through discussion, without the need for consulting a third reviewer.

Data extraction

Data from the included studies were extracted independently by two reviewers. Disagreements were resolved through discussion, without the need to consult a third reviewer. We were unable to locate standardised extraction forms appropriate for this review. Therefore, we developed and applied two extraction forms.

First, on a study characteristics extraction form, the following pieces of information were extracted from each included article: title, author(s), year of publication, characteristics of study sample, study setting, number of participants included in the study (study sample size), gender and age distribution, study design, data collection method(s), information on the measures of exposure and outcome and the number of tested associations relevant to the review research question. Second, on an association characteristics extraction form, the following pieces of information were extracted about each relevant association: type of statistical test, number of participants included in association (association sample size), effect size, p value and/or CI and information on the measures of exposure and outcome. Extracted data were entered in spreadsheets for further analysis.

Quality assessment

Searches indicated that studies fulfilling the inclusion criteria were characterised by different designs and by containing several statistical associations between alcohol consumption and presenteeism. Included studies were characterised by exploring broader aims related to health and productivity, while this review emphasises the relationship between alcohol and work performance in particular. Hence, it was deemed inappropriate to conduct overall quality assessment of each study. Instead, relevant tested associations in the included studies were assessed on two key domains: (1) sample size (low quality=<500; moderate quality=500–999; high quality=≥1000) and (2) risk of confounding (level of adjustment, the extent to which associations between exposure and outcome were controlled for possible confounding variables: low quality=unadjusted or unclear; moderate quality=adjusted for individual *or* work-related/environmental factor(s); high quality=adjusted for individual *and* work-related/environmental factors). The sample size thresholds were based on the assumption that alcohol-related presenteeism is a relatively low-prevalent phenomenon in the workforce. The study of rare events requires greater statistical strength than the study of frequent events.[43] Samples consisting of less than 500 observations were defined as small. Sample size categorisations were similar to thresholds applied in a recent association-based review of alcohol-related absenteeism.[25] Each association was ascribed an overall quality judgement (low, moderate or high) based on the assessment of the two key domains, according to the 'worst score counts' algorithm recommended by the COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) guidelines.[44] Hence, an association's overall score was equal to its lowest domain assessment. High-quality associations were thus characterised by being based on at least 1000 observations and being adjusted for individual (eg, gender, age, personality, disease conditions and drug use) as well as work-related/environmental factors (eg, work position, work schedule and job characteristics).

The quality assessment procedure was pilot tested on a random sample of 10 associations. Quality assessments were performed independently by two reviewers.

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

Consensus was reached, and initial disagreements were resolved through discussion, without the need for consulting a third reviewer.

Analysis

Measures of exposure (alcohol consumption) as well as measures of outcome (work performance) displayed considerable heterogeneity between the included studies. As a result of the heterogeneous nature of the included data, meta-analyses were deemed inappropriate. Included data (associations) were instead analysed with frequency tables and cross-tabulations. First, associations were sorted into a frequency table by quality level and overall association characteristics. Next, four contingency tables were constructed in order to explore properties of the identified associations more thoroughly: (1) direction and significance, (2) quality and direction, (3) publication year and quality and (4) significance and quality. The four 2×2 tables were analysed by means of ORs (with 95% CIs) and χ^2 tests of independence (with phi coefficients). Finally, measurements of alcohol consumption and work performance applied in the included studies were categorised into subgroups.

Patient and public involvement

No patients or public were involved in this review study.

RESULTS

Overview of the evidence

Searches in the seven databases resulted in 540 articles (MEDLINE: n=135; Web of Science: n=128; PsycINFO: n=63; CINAHL: n=22; AMED: n=3; Embase: n=189; Swemed+: n=0). Hand searching in reference lists resulted in an additional nine articles. After duplicate removal (n=282), a total of 267 unique articles remained. Application of the eligibility criteria resulted in exclusion of 158 studies, leaving 109 potentially relevant articles.

Eighty-three studies were excluded after being subjected to full-text assessment. The vast majority of these were excluded as a result of not reporting a statistical test of an association between alcohol consumption and work performance (n=52) or because of publication type (n=24). Articles not reporting tests of associations were typically characterised by: (1) not studying variables that conceptually could be defined as alcohol consumption and/or work performance and (2) analysing alcohol consumption and/or work performance in combination with other factors, rendering it impossible to isolate the association of interest. Alcohol being analysed in combination with smoking/other lifestyle factors and work performance being analysed in combination with absenteeism constitute typical examples. Articles excluded on the basis of publication type were typically conference papers. The study selection process resulted in 26 studies satisfying all inclusion criteria and is presented in figure 1.

The 26 included studies were based on data from 92 730 employees from a total of 15 countries (Australia, China, Czech republic, Denmark, Finland, Greece, Ireland, Japan, the Netherlands, Norway, Portugal, Slovenia, Sweden, Switzerland and the USA). Employees in the USA constituted the samples in half of the studies

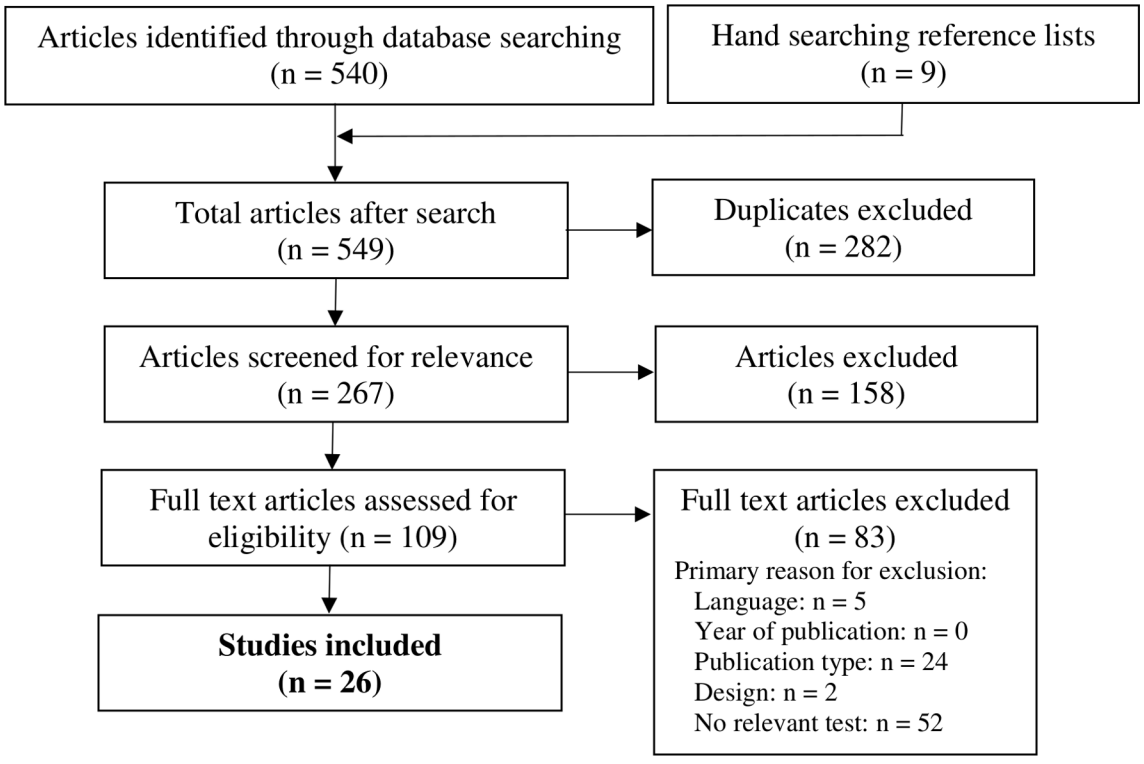


Figure 1 PRISMA flow chart of the study selection process. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

(13 of 26). The vast majority of studies (21 of 26) were based on cross-sectional research designs. A total of 132 associations between alcohol consumption and work performance were tested in the 26 included studies. Characteristics of the included studies are presented in table 1. Characteristics of the included associations are presented in online supplementary file 2.

Quality of the included data

Ninety-three of the 132 associations (71%) were based on samples smaller than 1000 employees. Approximately half of the associations were unadjusted (n=63; 48%), while 29 associations (22%) were adjusted for individual factors as well as for work-related/environmental factors. By applying the 'worst score counts' algorithm, 80 associations (61%) were judged as being of low quality, 38 associations (29%) were of moderate quality, while 14 associations (11%) were characterised by high quality. Results from quality assessment of the included associations are presented in online supplementary file 3.

Direction, significance, quality and time

One hundred and two of the 132 tested associations (77%) indicated a positive relationship between alcohol consumption and work performance, that is, implying that higher levels of consumption were associated with higher levels of performance impairment. Approximately half of these (n=56, 55%) were statistically significant. The majority of positive associations was judged to be of low quality (n=70, 69%), followed by moderate (n=23, 22%) and high quality (n=9, 9%). For instance, in a sample of employees in the USA, Kirkham *et al*[45] found that risky drinking, as measured with the CAGE questionnaire,[46] was associated with impaired work performance, measured with the Work Limitations Questionnaire,[47] both overall (ID36, β=0.20, p<0.001) as well as among those aged <45 years (ID37, β=0.22, p<0.001) and ≥45 years (ID38, β=0.20, p<0.001). Among Finnish employees, Pensola *et al*[48] found that high hangover frequency (at least six hangovers during the past 12 months), compared with low frequency (no alcohol or less than six hangovers during the past 12 months), was associated with moderate or poor self-reported work ability (ID41, PRR (prevalence rate ratio)=1.15, 95% CI: 1.0 to 1.3). In a study of Norwegian employees, Aas *et al*[40] found that higher binge drinking frequency (measured with a single item from the AUDIT)[10 13] was positively related to the experienced degree of impaired work performance (measured with a single item from the Work Productivity and Activity Impairment questionnaire)[49] during the past 7 days (ID127, β=0.06, p<0.01).

Twenty-five of the 132 tested associations (19%) indicated a negative relationship, that is, implying that higher levels of alcohol consumption were associated with lower performance impairment (higher work performance). Only two of these associations were statistically significant, and both of these were of low quality. These two associations (ID66, *r*=0.10, p<0.01, and ID68, *r*=0.09, p<0.01, in Friedman *et al*[50]) tested the relationship between duration of alcohol use and overall work performance and found that longer duration, as opposed to shorter duration, was associated with higher work performance.

Five associations (4%) were not possible to classify as either positive or negative. They were characterised by: (1) finding no differences in work performance between compared alcohol consumption groups (ID102, M_{diff}=0.0, p=0.68, in Moore *et al*[51]; ID130, OR=1.00, p=ns, in van den Berg *et al*[52]); (2) by finding significant differences between multiple consumption groups but without a consistent positive/negative pattern (ID28, unclear effect size, p<0.001), and ID29, unclear effect size, p=0.03, in Kim *et al*[53]); or (3) by finding a J-shaped pattern where abstainers scored comparable with moderate-level drinkers on impaired performance (ie, higher than low-level drinkers) but still lower than heavy drinkers (ID98, unclear effect size, p<0.05, in Moore *et al*[51]). The identified associations, sorted by quality level and overall association characteristics, are presented in table 2.

Positive associations were considerably more likely than negative associations to be statistically significant (OR=14.00, 95% CI 3.1 to 65.5; χ^2 (1, n=127)=17.80, p=0.000, phi=0.37). However, negative associations were less likely than positive associations to be of low quality (OR=0.22, 95% CI 0.1 to 0.6; χ^2 (1, n=127)=11.37, p=0.001, phi=−0.30). Furthermore, recent studies (≥year 2000) were more likely than older studies (<year 2000) to be of moderate or high quality (OR=2.95, 95% CI 1.30 to 6.79; χ^2 (1, n=132)=6.96, p=0.008, phi=0.23). There was no significant relationship between whether associations were significant and whether they were of moderate/high or low quality. The four 2×2 contingency tables are presented in table 3.

Measurements of alcohol consumption and work performance

Categorisation of the applied measurements of alcohol consumption in the 26 included studies revealed eight subgroups: (1) consumption status (eg, current alcohol drinker (yes/no), applied in Yu *et al*[54]); (2) drinking frequency (eg, number of times drunk during past 3 months, applied in Ames *et al*[21]; typical frequency of alcohol consumption during past year, applied in Aas *et al*[40]); (3) drinking intensity (eg, average number of alcohol drinks during the past week, applied in Adler *et al*[55]); (4) drinking volume (eg, monthly frequency × typical quantity during past 30 days, applied in Blum *et al*[56]); (5) binge drinking (eg, binge drinking (six or more drinks on a single occasion) frequency during past year, applied in Aas *et al*[40]); (6) hangover (eg, frequency of hangover episodes at work during past year, applied in Ames *et al*[21]); and (7) composite instruments comprising several aspects of consumption, such as frequency, intensity and alcohol problems (eg, the AUDIT,[10 13] applied in Richmond *et al*[57]); and (8) alcohol-related diagnosis (eg, DSM-IV diagnosis of alcohol abuse, applied in Lim *et al*[58]).

The 26 included studies contained a total of six work performance measurement categories: (1) overall

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

Table 1 Characteristics of the included studies (n=26) with measurements and included associations (n=132)

Article/study (author, reference, year)	Sample	Design	Alcohol measures	Presenteeism measures	Included association(s) (n, ID)
Adler *et al*,[55] 2011	USA: military veterans (n=473).	Cross-sectional.	Binge drinking episodes past 3 months.	WLQ.	n=10 ((1–10)).
Airilia *et al*,[80] 2012	Finland: fire fighters (n=403).	Longitudinal.	Drinking frequency.	Work Ability Index, subdimensions.	n=6 ([11–16]).
Fisher *et al*,[61] 2000	USA: military personnel (n=5389).	Cross-sectional.	Drinking frequency and quantity during past year.	Number of impaired work ability days during past year.	n=7 ((17–23)).
Karlsson *et al*,[64] 2010	Sweden: various occupations (n=341).	Longitudinal.	Weekly alcohol intake (grams).	Prognosis of work ability, 6 months.	n=2 ((24, 25)).
Kessler and Frank,[66] 1997	USA: various occupations (n=4091).	Cross-sectional.	DSM-III-R diagnosis (alcohol abuse/ dependence).	Number of work cutback days during past 30 days.	n=2 ((26, 27)).
Kim *et al*,[53] 2013	USA: patients with fibromyalgia in various occupations (n=946).	Cross-sectional.	Number of drinks per week.	Fibromyalgia Impact Questionnaire, item job ability.	n=8 ((28–35)).
Kirkham *et al*,[45] 2015	USA: computer manufacturer employees (n=17 089).	Longitudinal.	CAGE questionnaire, at risk versus not at risk.	WLQ.	n=3 ((36–38))
Odlaug *et al*,[81] 2016	8 European countries: patients with alcohol dependence, various occupations (n=2979).	Cross-sectional.	Drinking amount, past 12 months.	WPAI, presenteeism item.	n=1 ((39)).
Pensola *et al*,[48] 2016	Finland: people with multisite pain, various occupations (n=3884).	Cross-sectional.	Hangover frequency, past 12 months.	Current work ability (0–10).	n=8 ((40–47)).
Richmond *et al*,[57] 2016	USA: government employees (n=344).	Quasiexperimental.	AUDIT.	Workplace Outcome Suite, presenteeism scale.	n=1 ((48)).
Schou *et al*,[63] 2017	Norway: various occupations (n=1407).	Cross-sectional.	Drinking frequency.	Number of presenteeism episodes, past 12 months.	n=1 ((49)).
Steegmann *et al*,[82] 1997	China: cycle haulers (n=45).	Cross-sectional.	Alcohol intake/intensity (mL).	Supervisor's estimate of worker's contribution.	n=1 ((50)).
Tsuchiya *et al*,[67] 2012	Japan: community workers (n=530).	Cross-sectional.	DSM-IV diagnosis (alcohol abuse/dependence).	WHO Health and Work Performance Questionnaire (HPQ).	n=2 ((51, 52)).
van Scheppingen *et al*,[83] 2014	Netherlands: dairy company employees (n=629).	Cross-sectional.	Weekly alcohol intake.	Presenteeism frequency.	n=1 ((53))
Yu *et al*,[54] 2015	China: petrochemical corporation employees (n=1506).	Cross-sectional.	Current alcohol drinker (yes/no).	Presenteeism during past 4 weeks (yes/no).	n=2 ((54, 55)).
Friedman *et al*,[50] 1992	USA: supermarket employees (n=860).	Cross-sectional.	DSM-III diagnosis alcohol abuse.	Overall job performance (supervisor ratings).	n=14 ((56–69)).

Continued

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

Table 1 Continued

Article/study (author, reference, year)	Sample	Design	Alcohol measures	Presenteeism measures	Included association(s) (n, ID)
Boles *et al*,[62] 2004	USA: employees in a large national employer (n=2264).	Cross-sectional.	CAGE questionnaire, at risk versus not at risk.	WPAI; % presenteeism during past week.	n=3 ((70–72)).
Blum *et al*,[56] 1993	USA: employees, various occupations (n=136).	Cross-sectional.	Monthly frequency x typical quantity (past 30 days)	Technical job performance	n=12 ((73–84)).
Burton *et al*,[84] 2005	USA: financial services employees (n=28 375).	Cross-sectional.	At-risk (>14/week) versus no-risk drinking.	WLQ, short version.	n=5 ((85–89)).
Lim *et al*,[58] 2000	Australia: employees, various occupations (n=4579).	Cross-sectional.	DSM-IV diagnosis alcohol abuse.	Number of work cutback days past month.	n=2 ((90, 91)).
Lowmaster *et al*,[59] 2012	USA: police officers (n=85).	Cross-sectional.	Personality Assessment Inventory, subscale Alcohol Problems Scale (ALC)	Supervisor ratings of overall job performance.	n=3 ((92–94))
Moore *et al*,[51] 2000	USA: manufacturing company employees (n=2279).	Cross-sectional.	CAGE questionnaire, at risk versus not at risk.	Time at work spent goofing off.	n=13 ((95–107)).
Ames *et al*,[21] 1997	USA: manufacturing plant employees (n=832).	Longitudinal.	Frequency drinking before/during work and hangovers past year.	Frequency sleeping on the job and task/coworker problems past year.	n=14 ((108–121)).
Furu *et al*,[60] 2018	Finland: workers in solvent-exposed fields (n=1622).	Cross-sectional.	Excessive drinking (AUDIT-C, scores 7–12).	Current work ability compared with lifetime best (0–10).	n=2 ((122, 123)).
Aas *et al*,[40] 2017	Norway: employees, various occupations (n=3278).	Cross-sectional.	Drinking frequency and binge drinking past year (AUDIT 1, 3).	Quantity presenteeism during past 7 days (degree 0–10).	n=4 ((124–127)).
van den Berg *et al*,[52] 2017	The Netherlands: healthcare workers.	Cross-sectional.	Excessive alcohol intake (>10 drinks a week).	Current work ability compared with lifetime best (0–10).	n=5 ((128–132)).

AUDIT, Alcohol Use Disorders Identification Test; DSM, Diagnostic and Statistical manual of Mental disorders; WLQ, Work Limitations Questionnaire; WPAI, Work Productivity and Activity Impairment Questionnaire.

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

Table 2 Identified associations (n=132) according to direction/significance and assessed quality level

	Direction and significance of associations				
Quality level	Significant positive* association	Significant negative† association	Non-significant positive association	Non-significant negative association	Other‡
Low	[1], [2], [3], [4], [5], [10], [12], [17], [19], [26], [39], [49], [51], [54], [55], [56], [58], [59], [60], [62], [64], [67], [69], [77], [78], [81], [82], [83], [84], [95], [96], [97], [118], [119], [120], [121], [124] and [125].	[66] and [68].	[6], [7], [8], [9], [11], [13], [14], [16], [18], [20], [21], [23], [25], [27], [48], [50], [53], [57], [61], [63], [65], [73], [74], [75], [76], [79], [80], [104], [107], [122], [131] and [132].	[15], [22], [24], [92], [93] and[94].	[28] and [130].
Moderate	[40], [42], [43], [44], [46], [47], [52], [101], [106], [109], [110], [115] and [123].		[34], [35], [45], [91], [100], [103], [105], [117], [128] and [129].	[30], [31], [32], [33], [90], [99], [108], [111], [112], [113], [114] and [116].	[29], [98] and [102].
High	[36], [37], [38], [41] and [127].		[70], [71], [72] and [126].	[85], [86], [87], [88] and [89].	

Note: number in brackets=association ID.
*Higher level of alcohol associated with higher level of presenteeism.
†Lower level of alcohol associated with higher level of presenteeism or higher level of alcohol associated with lower level of presenteeism.
‡Inconsistent direction, no relationship or J-shaped relationship between alcohol and presenteeism.

work performance/impairment (eg, supervisor ratings of overall work performance, applied in Lowmaster and Morey[59]; self-reported current work performance compared with lifetime best, applied in Furu *et al*[60]; Work Limitations Questionnaire sum score,[47] applied in Kirkham *et al*[45]); (2) domain-specific work performance/impairment (eg, Work Limitations Questionnaire subscale Time management,[47] applied in Adler *et al*[55]); (3) impaired performance quantity (eg, number of days working below a normal level of performance during past 12 months, applied in Fisher *et al*[61]; estimated per cent impaired performance during past week, applied in Boles *et al*[62]); (4) impaired performance frequency (eg, frequency of impaired performance episodes during past 12 months, applied in Schou *et al*[63]); (5) prognosis of work performance (eg, self-assessed probability of good work performance within frame of 6 months, applied in Karlsson *et al*[64]); and (6) work performance status (eg, impaired work performance during past 4 weeks (yes/no), applied in Yu *et al*[54]). The identified associations, sorted according to measurements of alcohol consumption and work performance, are presented in table 4.

In the 132 included associations, the most frequently applied alcohol measurement was drinking intensity (n=28, 21%) and composite instruments (n=27, 20%). Overall work performance/impairment (n=67, 51%) and

Table 3 Cross-tabulations of included associations according to direction, significance, quality and publication year

	Direction			Direction	
Significance	Positive % (n)	Negative % (n)	Quality	Positive % (n)	Negative % (n)
Significant	54.9 (56)	8.0 (2)	Moderate/high	31.4 (32)	68.0 (17)
Non-significant	45.1 (46)	92.0 (23)	Low	68.6 (70)	32.0 (8)
	OR=14.00*** (3.130 to 65.53)			OR=0.22** (0.08 to 0.55)	
	χ^2 (1, n=127)=17.80, p=0.000, phi=0.37			χ^2 (1, n=127)=11.37, p=0.001, phi=−0.30	
	Publication year			**Significance**	
Quality	≥Year 2000 % (n)	<Year 2000 % (n)	Quality	Significant % (n)	Non-significant % (n)
Moderate/high	47.2 (42)	23.3 (10)	Moderate/high	32.8 (20)	44.9 (31)
Low	52.8 (47)	76.7 (33)	Low	67.2 (41)	55.1 (38)
	OR=2.95** (1.30 to 6.70)			OR= 0.60^{ns} (0.29 to 1.22)	
	χ^2 (1, n=132)=6.96, p=0.008, phi=0.23			χ^2 (1, n=130)=2.00, p=0.157^{ns}, phi=−0.12	

OR, with 95% CI; χ^2=chi square test of independence, with phi coefficient.
**P<0.01; ***p<0.001.
ns, non-significant.

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

Table 4 Identified associations (n=132) according to measurements of alcohol consumption and work performance

	Work performance measure					
Alcohol measure	**Overall work performance/impairment**	**Domain-specific work performance/impairment**	**Impaired performance, quantity**	**Impaired performance, frequency**	**Prognosis work performance**	**Work performance status**
Consumption status	*[66↓*]* and *[67↑*]*					*[54↑*]* and *[55↑*]*
Frequency	*[11↓ns]*, *[12↑*]*, *[14↑ns]*, *[15↓ns]*, *[58↑*]* and *[59↑*]*		[108↓ns], [109↑*], *[124↑*]* and **[126↑ns]**	*[49↑*]*, [113↓ns] and [114↓ns]	*[13↑ns]* and *[16↑ns]*	
Quantity	*[10↑*]*, *[28|*]*, [29|ns], [30↓ns], [31↓ns], [32↓ns], [33↓ns], [34↑ns], [35↑ns], *[39↑*]*, *[50↑ns]*, **[85↓ns]**, [128↑ns], [129↑ns], *[130|ns]*, *[131↑ns]* and *[132↑ns]*	*[6↑ns]*, *[7↑ns]*, *[8↑ns]*,*[9↑ns]*, **[86↓ns]**, **[87↓ns]**, **[88↓ns]** and **[89↓ns]**		*[53↑ns]*	*[24↓ns]*,*[25↑ns]*	
Volume	*[62↑*]*, *[63↑ns]*, *[68↓*]*, *[69↑*]*, *[73↑ns]*, *[74↑ns]*, *[75↑ns]*, *[76↑ns]*, *[77↑*]*, *[78↑*]*, *[79↑ns]*, *[80↑ns]*, *[81↑*]*, *[82↑*]*, *[83↑*]* and *[84↑*]*		*[17↑*]*, *[18↑ns]*, *[19↑*]*, *[20↑ns]*, *[21↑ns]*, *[22↓ns]*, *[23↑ns]* and [111↓ns]	[116↓ns]		
Heavy episodic/binge drinking	*[5↑*]*	*[1↑*]*, *[2↑*]*, *[3↑*]* and *[4↑*]*	[112↓ns], *[125↑*]* and **[127↑*]**	[117↑ns]		*[118↑*]*
Hangover episodes	[40↑*], **[41↑*]**, [42↑*], [43↑*], [44↑*], [45↑ns], [46↑*] and [47↑*]		[110↑*]	[115↑*]		*[119↑*]*, *[120↑*]* and *[121↑*]*
Composite instruments	**[36↑*]**, **[37↑*]**, **[38↑*]**, *[48↑ns]*, *[64↑*]*, *[65↑ns]*, *[92↓ns]*, *[93↓ns]*, *[94↓ns]*, *[122↑ns]* and [123↑*]		**[70↑ns]**, **[72↑ns]**, *[95↑*]*, *[96↑*]*, *[97↑*]*, [98|*], [99↓ns], [100↑ns], [101↑*], [102|ns], [103↑ns], *[104↑ns]*, [105↑ns], [106↑*] and *[107↑ns]*			**[71↑ns]**
Diagnosis	*[51↑*]*, [52↑*], *[56↑*]*, *[57↑ns]*, *[60↑*]* and *[61↑ns]*		*[26↑*]*, *[27↑ns]*, [90↓ns] and [91↑ns]			

Number in brackets=association ID; assessed quality level indicated by typeface: italic=low, regular=moderate, bold=high; ↑=positive association; ↓=negative association; |=association in non-consistent direction.
*Significant association.
ns, non-significant association.

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

quantity of impaired performance (n=35, 27%) were the most frequently utilised work performance measures. When exploring the group of associations characterised by being significant positive and of moderate or high quality (n=18), the vast majority of these (n=15) applied either hangover (n=9) or composite instruments (n=6) as alcohol consumption measures.

DISCUSSION

The aim of this review was to explore whether evidence in the research literature supports the notion of alcohol-related presenteeism, that is, whether evidence supports an association between employee alcohol consumption and work performance. Twenty-six studies met the eligibility criteria, containing a total of 132 tested associations between alcohol consumption and presenteeism, based on data from 92 730 employees in 15 countries.

The vast majority of the associations (102 of 132, 77%) indicated a positive relationship between alcohol consumption and impaired work performance, implying that higher levels of alcohol consumption were associated with higher levels of impaired performance. Furthermore, positive associations were considerably more likely than negative associations to be statistically significant.

Alcohol use has the potential for influencing cognitive and psychomotor performance, which may explain why employees' alcohol consumption is associated with work performance. In particular, hangover episodes are characterised by symptoms that can induce work impairments (headache, nausea, drowsiness and so on),[15 19 20] and alcohol intoxication, at least at higher BAC, may produce work impairments that increase linearly with task complexity.[14–17] Positive associations between alcohol consumption and performance impairments are not so surprising in light of knowledge on the relationship between alcohol consumption and absenteeism. In their review, Schou and Moan[25] found that employees' consumption was positively associated with both short-term and long-term sick leave. The complementary hypothesis of the relationship between absenteeism and presenteeism claims that these behaviours are both related to employees' overall health status and that they are positively associated.[27] Research has demonstrated moderate positive correlations between absenteeism and presenteeism and that presenteeism may be a risk factor for future absenteeism.[27 37]

Alcohol measurements based on hangovers and composite instruments were over-represented in associations characterised by being significant positive and of moderate or high quality. Hangovers tend to result from binge drinking episodes, or drinking shortly before work. Such short-term impairment-producing consumption may be more predictive of work impairments than for instance typical drinking frequency, which instead may be more predictive of long-term ill-health consequences.[65] Composite instruments, such as the AUDIT,[10 13] tend to assume a more complex relationship between alcohol, health and performance than what may be the case for more basic measurements (eg, drinking frequency or intensity). Hence, a composite instrument measuring both consumption and experienced alcohol problems may be more predictive of productivity outcomes such as work performance.

While most alcohol measures in the included studies can be said to capture somewhat different aspects of alcohol consumption (eg, frequency, intensity, volume, binge episodes and hangovers), four studies did report abuse/dependence diagnoses (diagnosis vs no diagnosis) as measure of exposure.[50 58 66 67] One may argue that an alcohol-related diagnosis, focusing on harms and consequences as well as on use, is conceptually different from more direct measures of consumption. These studies are thus difficult to compare with other studies in this review, even though they do not differ considerable in terms of overall conclusions regarding the relationship between exposure and outcome. Moreover, these studies are difficult to interpret in the context of the present review's research question. One may assume that individuals satisfying the criteria for an alcohol-related diagnosis are indeed characterised by having high consumption levels. However, the consumption levels of those not satisfying the diagnostic criteria in these studies remain unknown.

The majority of positive associations were judged to be of low quality, and 25 of 132 associations (19%) even indicated a negative relationship, that is, implying that higher levels of alcohol consumption were associated with lower performance impairments (higher performance). Moreover, five associations were inconsistent, that is, not possible to classify as positive or negative, or did not reveal any association between alcohol consumption and work performance at all. Negative associations were less likely than positive associations to be of low quality.

Only two associations categorised as negative reported statistically significant findings. These associations, both reported in Friedman *et al*,[50] tested the relationship between duration of alcohol use and overall work performance and found that longer duration (higher exposure) was associated with lower work impairment. Basically, these results may imply that more experienced drinkers report lower levels of work impairment than less experienced drinkers. As such, rather than implying that higher consumption could be related to lower impairments, they may reflect that experienced drinkers have developed higher tolerance levels and more sophisticated coping strategies than less experienced drinkers.

The relationship between alcohol consumption and health outcomes has, in some studies, been described as a J-shaped curve where low to moderate consumption is associated with better health outcomes than non-drinking.[68] In their study of manufacturing company employees in the USA, Moore *et al*[51] found a J-shaped relationship between alcohol consumption and percentage of time at work spent 'goofing off'. In this study, abstainers scored higher on 'goof-off time' than low-moderate drinkers, but lower than heavy drinkers. J-shaped relationships

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

have also been found between alcohol consumption and cognitive outcomes.[69] It is, however, somewhat unclear whether low-moderate levels of alcohol consumption in fact have some protective effects or whether such findings are products of confounding.[4 68 70] For instance, studies have demonstrated that heavy drinking is associated with cognitive deficits that endure long after abstinence.[71] Such deficits, due to former heavy drinking, may impair work performance, even though the employee is currently categorised as an abstainer. A recent review found no mortality benefits for low-volume drinking compared with lifetime abstention or occasional drinking, when adjusting for study design and characteristics.[72] Nevertheless, potential curvilinear relationships between alcohol consumption and health outcomes may contribute to explain why a considerable proportion of associations failed to demonstrate significant positive relationships. Moreover, on-the-job performance outcomes may be more directly affected by on-the-job drinking (within 2 hours before work, during breaks or while performing the job) than by off-the-job drinking, even though off-the-job consumption may translate into workplace impairment.[5] Among the studies included in this review, only one (Ames *et al*[21]) contained explicit measures of on-the-job drinking, while the remaining studies measured overall consumption (consumption regardless of context). Moreover, overall consumption may have differential impact on different domains. In a study of employees in Norway, Aas *et al*[40] found that overall consumption demonstrated stronger associations with performance impairments outside the workplace compared with work performance, which may be due to employees moderating (self-regulating) their behaviour at work as a result of potential sanctions from employers. Self-regulatory motivations and mechanisms may contribute to hide alcohol-related presenteeism, which may complicate the exploration of associations between alcohol consumption and work performance.

Implications

Overall, this review provides support for the notion of alcohol-related presenteeism, that is, that employee alcohol consumption may be associated with performance decrements at work. Research has, although often demonstrating somewhat mixed results, shown that employees' alcohol consumption is related to occupational outcomes, including absenteeism and occupational injuries.[25 34–36] The results of this review on alcohol-related presenteeism imply that impaired work performance may be an additional detrimental occupational outcome related to alcohol consumption. As such, this review provides further support for targeting alcohol consumption within workplace interventions aimed at improving employee health and productivity, rather than implying that interventions should specifically target presenteeism behaviour. Further research is necessary for determining whether and how presenteeism should be targeted directly in interventions.

It is not possible to draw firm conclusions regarding the relationship between alcohol consumption and work performance. The majority of identified evidence was of low quality as a result of low power (small sample sizes) and/or risk of confounding. Moreover, the majority of identified studies were cross-sectional, and thereby unable to draw causal inferences about the relationship between exposure and outcome. Above all, this review implies the need for further research. First, future research would benefit from studying alcohol-related presenteeism by means of more robust study designs that better enable exploration of causal mechanisms and development over time. A more thorough exploration of alcohol as a risk factor for impaired work performance could be done by means of retrospective case–control studies, where historical data sources containing information on alcohol consumption (such as medical records) are used in order to compare work impaired (cases) with non-impaired employees (controls). How the relationship between alcohol and work performance develops over time can be explored with prospective cohort studies, where researchers can follow and compare risky and non-risky drinkers with repeated measurements of work performance.

Second, both alcohol consumption and work performance are conceptualised and measured very differently across current studies. Such heterogeneity makes it difficult to explore findings in the literature by means of meta-analyses. Progress in the field seems to hinge on researchers' ability to reach more agreement on how to conceptualise these variables and measure them using instruments with satisfactory psychometric properties. This seems particularly true for the concept of presenteeism. According to an expert panel from the American College of Occupational and Environmental Medicine (p. 351),[31] productivity instruments should be supported by scientific evidence, be applicable to the specific work setting, support decision making and be practical. Ospina *et al*[73] concluded that the following three instruments were most strongly supported by evidence: The Stanford Presenteeism Scale (six-item version),[74] the Endicott Work Productivity Scale[75] and the Health and Work Questionnaire.[76] Regardless of design, future research would benefit from measurement triangulation. For instance, alcohol consumption could be measured with a validated self-report composite measure (eg, the AUDIT measuring both consumption and alcohol-related harm, or the abbreviated AUDIT-C measuring only consumption),[10 13] items separating off-the-job and on-the-job drinking and hangovers, and an alcohol biomarker test (such as the carbohydrate-deficient transferrin test). Work performance could be measured with a validated self-report composite instrument (eg, the Stanford Presenteeism Scale),[74] as well as with supervisors' ratings of employee work performance and, where possible, register data on task performance. Measurement triangulation may provide more valid measures as well as enabling exploration of a potential correspondence

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

between consumption contexts, impairment contexts and performance outcomes.

Third, future research would benefit from taking possible mediators and moderators of the relationship between alcohol and work performance into account, such as sociodemographic, general health, work related and other lifestyle factors.

Methodological considerations

This review has some limitations. First and foremost, due to the heterogeneous nature of the identified data, we were unable to perform meta-analyses on the included data.

Second, it may be considered a limitation that this review used associations and not studies as the unit of interest. Associations were deemed the appropriate unit of interest in this review for two reasons: (1) included studies were characterised by exploring broader aims related to health and productivity, while this review specifically aimed at exploring the relationship between alcohol consumption and work performance and (2) in several studies, multiple associations between alcohol consumption and work performance were tested (often with different measures and subgroups within each study).

Third, this review did not use a previously validated critical appraisal tool (CAT) for assessment of included primary research. One reason for this is that studies based on different study designs were included in the review. At present, there exists no generic gold standard CAT for application across study designs.[77 78] A second reason is that the current review emphasised associations rather than studies as the unit of interest. Hence, it was deemed more appropriate to develop a parsimonious and conservative quality assessment system in which each association was evaluated based on power (sample size) and risk of confounding (level of adjustment). Deliberately, we chose a conservative approach to quality assessment by ascribing each association an overall score in accordance with the 'worst score counts' algorithm. Such an approach is in line with the COSMIN guidelines.[44]

Fourth, articles published before 1990 were not eligible for inclusion in this review. This exclusion criterion was set a priori as a result of old studies having limited external validity due to changes in drinking behaviour over time. Time restrictions were imposed at the study selection stage, not in the literature search phase of the review. This decision was made in order to be able to assess the magnitude of potentially relevant research published prior to 1990. Seventeen articles from the 1980s were excluded in the title/abstract screening. However, these articles did not satisfy all the other inclusion criteria and were, thus, not exclusively excluded based on year of publication. Hence, we do not find it very likely that relevant studies published before 1990 have been missed.

Fifth, we chose to use the concept of presenteeism in line with researchers who define it in terms of decreased on-the-job productivity due to health problems.[30] Such an understanding does ascribe valence to the phenomenon, that is, a behaviour contributing to lost productivity that may carry negative influence on the overall work environment.[79] We are, however, aware of differing opinions among scholars regarding conceptualisations of presenteeism. Different definitions have different strengths and weaknesses. According to Johns,[26] a proper definition should: (1) neither ascribe motives nor consequences to presenteeism and (2) avoid conflating cause and effect by perceiving productivity loss itself as presenteeism. To some extent, we do agree with such objections against a productivity-based definition. A more open understanding, such as simply 'showing up for work even when one is ill' (p. 519),[26] does not ascribe a certain valence to the phenomenon, nor does it presuppose or exclude any particular consequence. We believe, however, that in a socioeconomic and organisational perspective, situations in which employees attend work while ill become of interest primarily when performance decrements are in fact involved. In order to avoid conflating cause and effect, we operationalised alcohol-related presenteeism as the product of a relationship between two measurable variables, that is, alcohol consumption (predictor/exposure) and work performance (outcome).

CONCLUSIONS

Alcohol-related presenteeism (impaired work performance associated with alcohol consumption) stands out as an important but under-researched topic in the research literature. According to this review, evidence provides support for the notion that employee alcohol consumption may be associated with impaired work performance. However, due to low research quality and lack of longitudinal designs, existing evidence should still be characterised as inconclusive regarding the prevalence, nature and impact of alcohol-related presenteeism in the workforce. More robust and less heterogeneous research is warranted.

Author affiliations
[1]Department of Occupational Therapy, Prosthetics and Orthotics, Faculty of Health Sciences, OsloMet – Oslo Metropolitan University, Oslo, Norway
[2]Faculty of Health Sciences, VID Specialized University, Sandnes, Norway
[3]Department of Public Health, Faculty of Health Sciences, University of Stavanger, Stavanger, Norway
[4]National Advisory Unit on Rehabilitation in Rheumatology, Diakonhjemmet Hospital, Oslo, Norway
[5]Amsterdam University Medical Centers, Department of Public and Occupational Health and Amsterdam Public Health Research Institute, Vrije University Medical Center, Amsterdam, The Netherlands
[6]Center of Human Movement Sciences, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands
[7]School of Human Movement and Nutrition Sciences, Faculty of Health and Behavioural Sciences, University of Queensland, Brisbane, Australia
[8]Department of Human Biology, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa
[9]School of Public Health, Physiotherapy and Population Sciences, University College Dublin, Dublin, Ireland
[10]Presenter - Making Sense of Science, Stavanger, Norway

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

Contributors RWA is the principal investigator and project manager of the WIRUS project (Workplace Interventions preventing Risky Use of alcohol and Sick leave). This review study was designed by MMT and RWA. MMT analysed the data and drafted the manuscript. Data selection was performed by MMT, NH and RWA; data extraction by MMT and TB; and quality assessment by MMT and IK. TB, NH, IK, WvM and RWA provided scientific input to the different drafts and provided data interpretation. All authors made critical revisions and provided intellectual content to the manuscript, approved the final version to be published and agreed to be accountable for all aspects of this work.

Funding The review study is funded by the Norwegian Directorate of Health and the Research Council of Norway.

Disclaimer The funding bodies had no role in the design of the review or in data analysis or interpretation.

Competing interests For the avoidance of doubt, WVM wishes to declare that he is director-shareholder of Vrije University Medical Center (VUmc) spin-off company Evalua Nederland B.V. and non-executive board member of Arbo Unie B.V. Both companies operate in the Dutch occupational healthcare market.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Data are available on reasonable request.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

REFERENCES

1. Lim SS, Vos T, Flaxman AD, *et al*. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2224–60.
2. Wood AM, Kaptoge S, Butterworth AS, *et al*. Risk thresholds for alcohol consumption: combined analysis of individual-participant data for 599 912 current drinkers in 83 prospective studies. *Lancet* 2018;391:1513–23.
3. World Health Organization. *Global status report on alcohol and health 2018*. Geneva, Switzerland: World Health Organization, 2018.
4. Griswold MG, Fullman N, Hawley C, *et al*. Alcohol use and burden for 195 countries and territories, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2018;392:1015–35.
5. Frone MR. *Alcohol and illicit drug use in the workforce and workplace*. Washington, DC: American Psychological Association, 2013.
6. Howland J, Mangione TW, Kuhlthau K, *et al*. Work-site variation in managerial drinking. *Addiction* 1996;91:1007–17.
7. Kawakami N, Haratani T, Hemmi T, *et al*. Prevalence and demographic correlates of alcohol-related problems in Japanese employees. *Soc Psych Psych Epid* 1992;27:198–202.
8. Marchand A, Parent-Lamarche A, Blanc MÈ. Work and high-risk alcohol consumption in the Canadian workforce. *Int J Environ Res Public Health* 2011;8:2692–705.
9. Thørrisen MM, Skogen JC, Aas RW. The associations between employees' risky drinking and sociodemographics, and implications for intervention needs. *BMC Public Health* 2018;18:735.
10. Babor TF, Higgins-Biddle JC, Saunders JB, *et al*. *AUDIT: The Alcohol Use Disorders Identification Test. Guidelines for use in primary health care*. Geneva, Switzerland: World Health Organization, 2001.
11. Taylor SE. *Health psychology*. 7th edn. New York, NY: McGraw-Hill, 2009.
12. Dawson DA. Defining risk drinking. *Alcohol Res Health* 2011;34:144–56.
13. Saunders JB, Aasland OG, Babor TF, *et al*. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction* 1993;88:791–804.
14. Glencross DJ. Alcohol and human performance. *Drug Alcohol Rev* 1990;9:111–8.
15. Martin CS. Measuring acute alcohol impairment. In: Karch SB, ed. *Drug abuse handbook*. 2nd edn. New York, NY: CRC Press, 2007:316–33.
16. Price DL, Liddle RJ. The effect of alcohol on a manual arc welding task. *Weld J* 1982;61:15–19.
17. Streufert S, Pogash R, Roache J, *et al*. Alcohol and managerial performance. *J Stud Alcohol* 1994;55:230–8.
18. Blood Alcohol Content calculator. https://www.drinkdriving.org/drink_driving_information_bloodalcoholcontentcalculator.php (cited 8 March 2019).
19. Prat G, Adan A, Pérez-Pàmies M, *et al*. Neurocognitive effects of alcohol hangover. *Addict Behav* 2008;33:15–23.
20. Verster JC. The alcohol hangover: A puzzling phenomenon. *Alcohol Alcohol* 2008;43:124–6.
21. Ames GM, Grube JW, Moore RS. The relationship of drinking and hangovers to workplace problems: an empirical study. *J Stud Alcohol* 1997;58:37–47.
22. Mangione TW, Howland J, Amick B, *et al*. Employee drinking practices and work performance. *J Stud Alcohol* 1999;60:261–70.
23. Nordaune K, Skarpaas LS, Sagvaag H, *et al*. Who initiates and organises situations for work-related alcohol use? The WIRUS culture study. *Scand J Public Health* 2017;45:749–56.
24. Frone MR. Alcohol, drugs, and workplace safety outcomes: A view from a general model of employee substance use and productivity. In: Barling J, Frone MR, eds. *The psychology of workplace safety*. Washington, DC: American Psychological Association, 2004:127–56.
25. Schou L, Moan IS. Alcohol use-sickness absence association and the moderating role of gender and socioeconomic status: A literature review. *Drug Alcohol Rev* 2016;35:158–69.
26. Johns G. Presenteeism in the workplace: A review and research agenda. *J Organ Behav* 2010;31:519–42.
27. Gosselin E, Lemyre L, Corneil W, *et al*. Presenteeism and absenteeism: differentiated understanding of related phenomena. *J Occup Health Psychol* 2013;18:75–86.
28. Aronsson G, Gustafsson K, Dallner M. Sick but yet at work. An empirical study of sickness presenteeism. *J Epidemiol Community Health* 2000;54:502–9.
29. Lau B, Dye AH, Aarseth S. Lederes erfaringer med oppfølging av sykmeldte [Managers' experiences with follow-up of employees on sick leave]. *Tidsskrift for Norsk psykologforening* 2018;56:586–97.
30. Schultz AB, Edington DW. Employee health and presenteeism: a systematic review. *J Occup Rehabil* 2007;17:547–79.
31. Loeppke R, Hymel PA, Lofland JH, *et al*. Health-related workplace productivity measurement: general and migraine-specific recommendations from the ACOEM Expert Panel. *J Occup Environ Med* 2003;45:349–59.
32. Chapman LS. Presenteeism and its role in worksite health promotion. *Am J Health Promot* 2005;19:1–8.
33. Buvik K, Moan IS, Halkjelsvik T. Alcohol-related absence and presenteeism: Beyond productivity loss. *Int J Drug Policy* 2018;58:71–7.
34. Jurek T, Rorat M. Fatal accidents at work in agriculture associated with alcohol intoxication in Lower Silesia in Poland. *Med Pr* 2017;68:23–30.
35. Smith GS, Kraus JF. Alcohol and residential, recreational, and occupational injuries: a review of the epidemiologic evidence. *Annu Rev Public Health* 1988;9:99–121.
36. Zwerling C. Current practice and experience in drug and alcohol testing in the workplace. *Bull Narc* 1993;45:155–96.
37. Skagen K, Collins AM. The consequences of sickness presenteeism on health and wellbeing over time: A systematic review. *Soc Sci Med* 2016;161:169–77.
38. Hemp P. Presenteeism: at work–but out of it. *Harv Bus Rev* 2004;82:49–58.
39. Ford MT, Cerasoli CP, Higgins JA, *et al*. Relationships between psychological, physical, and behavioural health and work performance: A review and meta-analysis. *Work Stress* 2011;25:185–204.
40. Aas RW, Haveraaen L, Sagvaag H, *et al*. The influence of alcohol consumption on sickness presenteeism and impaired daily activities. The WIRUS screening study. *PLoS One* 2017;12:e0186503.
41. Allamani A, Beccaria F, Voller F. The puzzle of Italian drinking. Trends in alcohol consumption, harms and policy: Italy 1990-2010. *Nord Stud Alcohol Dr* 2010;27:465–78.
42. Mäkelä P, Tigerstedt C, Mustonen H. The Finnish drinking culture: change and continuity in the past 40 years. *Drug Alcohol Rev* 2012;31:831–40.
43. Kaplan RM, Chambers DA, Glasgow RE. Big data and large sample size: a cautionary note on the potential for bias. *Clin Transl Sci* 2014;7:342–6.
44. Terwee CB, Mokkink LB, Knol DL, *et al*. Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist. *Qual Life Res* 2012;21:651–7.

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

45. Kirkham HS, Clark BL, Bolas CA, *et al*. Which modifiable health risks are associated with changes in productivity costs? *Popul Health Manag* 2015;18:30–8.
46. Ewing JA. Detecting alcoholism. The CAGE questionnaire. *JAMA* 1984;252:1905–7.
47. Lerner D, Amick BC, Rogers WH, *et al*. The Work Limitations Questionnaire. *Med Care* 2001;39:72–85.
48. Pensola T, Haukka E, Kaila-Kangas L, *et al*. Good work ability despite multisite musculoskeletal pain? A study among occupationally active Finns. *Scand J Public Health* 2016;44:300–10.
49. Reilly MC, Zbrozek AS, Dukes EM. The validity and reproducibility of a work productivity and activity impairment instrument. *Pharmacoeconomics* 1993;4:353–65.
50. Friedman AS, Granick S, Utada A, *et al*. Drug use/abuse and supermarket workers' job performance. *Employee Assistance Quarterly* 1992;7:17–34.
51. Moore S, Grunberg L, Greenberg E. The relationships between alcohol problems and well-being, work attitudes, and performance: are they monotonic? *J Subst Abuse* 2000;11:183–204.
52. van den Berg S, Burdorf A, Robroek SJW. Associations between common diseases and work ability and sick leave among health care workers. *Int Arch Occup Environ Health* 2017;90:685–93.
53. Kim CH, Vincent A, Clauw DJ, *et al*. Association between alcohol consumption and symptom severity and quality of life in patients with fibromyalgia. *Arthritis Res Ther* 2013;15:R42.
54. Yu J, Wang S, Yu X. Health risk factors associated with presenteeism in a Chinese enterprise. *Occup Med-C* 2015;65:732–8.
55. Adler DA, Possemato K, Mavandadi S, *et al*. Psychiatric status and work performance of veterans of Operations Enduring Freedom and Iraqi Freedom. *Psychiatr Serv* 2011;62:39–46.
56. Blum TC, Roman PM, Martin JK. Alcohol consumption and work performance. *J Stud Alcohol* 1993;54:61–70.
57. Richmond MK, Pampel FC, Wood RC, *et al*. Impact of employee assistance services on depression, anxiety, and risky alcohol use a quasi-experimental study. *J Occup Environ Med* 2016;58:641–50.
58. Lim D, Sanderson K, Andrews G. Lost productivity among full-time workers with mental disorders. *J Ment Health Policy Econ* 2000;3:139–46.
59. Lowmaster SE, Morey LC. Predicting law enforcement officer job performance with the Personality Assessment Inventory. *J Pers Assess* 2012;94:254–61.
60. Furu H, Sainio M, Hyvärinen HK, *et al*. Work ability score of solvent-exposed workers. *Int Arch Occup Environ Health* 2018;91:559–69.
61. Fisher CA, Hoffman KJ, Austin-Lane J, *et al*. The relationship between heavy alcohol use and work productivity loss in active duty military personnel: a secondary analysis of the 1995 Department of Defense Worldwide Survey. *Mil Med* 2000;165:355–61.
62. Boles M, Pelletier B, Lynch W. The relationship between health risks and work productivity. *J Occup Environ Med* 2004;46:737–45.
63. Schou L, Moan IS, Storvoll E. Attitudes toward alcohol-related sickness absence and presenteeism: differences across subgroups of the population? *J Subst Use* 2017;22:225–31.
64. Karlsson N, Skargren E, Kristenson M. Emotional support predicts more sickness absence and poorer self assessed work ability: a two-year prospective cohort study. *BMC Public Health* 2010;10:648.
65. Bacharach SB, Bamberger P, Biron M. Alcohol consumption and workplace absenteeism: the moderating effect of social support. *J Appl Psychol* 2010;95:334–48.
66. Kessler RC, Frank RG. The impact of psychiatric disorders on work loss days. *Psychol Med* 1997;27:861–73.
67. Tsuchiya M, Kawakami N, Ono Y, *et al*. Impact of mental disorders on work performance in a community sample of workers in Japan: The World Mental Health Japan Survey 2002–2005. *Psychiatry Res* 2012;198:140–5.
68. Grønbaek M. The positive and negative health effects of alcohol- and the public health implications. *J Intern Med* 2009;265:407–20.
69. Neafsey EJ, Collins MA. Moderate alcohol consumption and cognitive risk. *Neuropsychiatr Dis Treat* 2011;7:465–84.
70. Skog OJ. Public health consequences of the J-curve hypothesis of alcohol problems. *Addiction* 1996;91:325–37.
71. Stavro K, Pelletier J, Potvin S. Widespread and sustained cognitive deficits in alcoholism: a meta-analysis. *Addict Biol* 2013;18:203–13.
72. Stockwell T, Zhao J, Panwar S, *et al*. Do "moderate" drinkers have reduced mortality risk? A systematic review and meta-analysis of alcohol consumption and all-cause mortality. *J Stud Alcohol Drugs* 2016;77:185–98.
73. Ospina MB, Dennett L, Waye A, *et al*. A systematic review of measurement properties of instruments assessing presenteeism. *Am J Manag Care* 2015;21:171–85.
74. Koopman C, Pelletier KR, Murray JF, *et al*. Stanford presenteeism scale: health status and employee productivity. *J Occup Environ Med* 2002;44:14–20.
75. Endicott J, Nee J. Endicott Work Productivity Scale (EWPS): a new measure to assess treatment effects. *Psychopharmacol Bull* 1997;33:13–16.
76. Shikiar R, Halpern MT, Rentz AM, *et al*. Development of the Health and Work Questionnaire (HWQ): an instrument for assessing workplace productivity in relation to worker health. *Work* 2004;22:219–29.
77. Crowe M, Sheppard L. A review of critical appraisal tools show they lack rigor: Alternative tool structure is proposed. *J Clin Epidemiol* 2011;64:79–89.
78. Sanderson S, Tatt ID, Higgins JP. Tools for assessing quality and susceptibility to bias in observational studies in epidemiology: a systematic review and annotated bibliography. *Int J Epidemiol* 2007;36:666–76.
79. Lack DM. Presenteeism revisited. A complete review. *Aaohn J* 2011;59:77–89.
80. Airila A, Hakanen J, Punakallio A, *et al*. Is work engagement related to work ability beyond working conditions and lifestyle factors? *Int Arch Occup Environ Health* 2012;85:915–25.
81. Odlaug BL, Gual A, DeCourcy J, *et al*. Alcohol dependence, co-occurring conditions and attributable burden. *Alcohol Alcohol* 2016;51:201–9.
82. Steegmann AT, Li TL, Hewner SJ, *et al*. The China productivity project: results and conclusions. *Am J Phys Anthropol* 1997;103:295–313.
83. van Scheppingen AR, de Vroome EM, ten Have KC, *et al*. Motivations for health and their associations with lifestyle, work style, health, vitality, and employee productivity. *J Occup Environ Med* 2014;56:540–6.
84. Burton WN, Chen CY, Conti DJ, *et al*. The association of health risks with on-the-job productivity. *J Occup Environ Med* 2005;47:769–77.

BMJ Open: first published as 10.1136/bmjopen-2019-029184 on 16 July 2019. Downloaded from http://bmjopen.bmj.com/ on 17 July 2019 by guest. Protected by copyright.

Supplementary File 1. Primary database search strategy (based on search in Medline)

		Search#	Query	Search type	Search level
Population	*Employees*	1	employee*	Text	Abstract
		2	employed	Text	Abstract
		3	worker*	Text	Abstract
		4	workforce	Text	Abstract
		5	work	MeSH	-
		6	employment	MeSH	-
		7	**1 OR 2 OR 3 OR 4 OR 5 OR 6**		
Exposure	*Alcohol consumption*	8	alcohol*	Text	Abstract
		9	drink*	Text	Abstract
		10	drunk*	Text	Abstract
		11	hangover	Text	Abstract
		12	"hang over"	Text	Abstract
		13	alcohol drinking	MeSH	-
		14	binge drinking	MeSH	-
		15	drinking behavior	MeSH	-
		16	**8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15**		
Outcome	*Work performance*	17	presenteeism	Text	Abstract
		18	"job productiv*"	Text	Abstract
		19	"work productiv*"	Text	Abstract
		20	"job capacity"	Text	Abstract
		21	"work capacity"	Text	Abstract
		22	"job ability"	Text	Abstract
		23	"work ability"	Text	Abstract
		24	"job impair*"	Text	Abstract
		25	"work impair*"	Text	Abstract
		26	"job performance"	Text	Abstract
		27	"work performance"	Text	Abstract
		28	presenteeism	MeSH	-
		29	work performance	MeSH	-
		30	**17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29**		
		31	**7 AND 16 AND 30**		

Note. This primary database search strategy was applied in Medline. When applied in the other databases (Web of Science, PsycINFO, Cinahl, Amed, Embase and Swemed+), the strategy was adapted to each database.

Supplementary File 2. Overview of tested associations (n = 132) in the included studies (n = 26)

Association ID	Study (author, year, reference)	Effect size[a]	Significance	Sample size	Adjustment	Classification in review[b]
1	Adler *et al.*, 2011 [45]	*r* = .11	*p* = .01	473	Unadjusted	↑ * L
2	"	*r* = .10	*p* = .03	473	Unadjusted	↑ * L
3	"	*r* = .14	*p* = .002	473	Unadjusted	↑ * L
4	"	*r* = .14	*p* = .002	473	Unadjusted	↑ * L
5	"	*r* = .16	*p* <.001	473	Unadjusted	↑ * L
6	"	*r* = .07	*p* = .16	473	Unadjusted	↑ ns L
7	"	*r* = .08	*p* = .08	473	Unadjusted	↑ ns L
8	"	*r* = .09	*p* = .50	473	Unadjusted	↑ ns L
9	"	*r* = .07	*p* = .11	473	Unadjusted	↑ ns L
10	"	*r* = .10	*p* = .04	473	Unadjusted	↑ * L
11	Airila *et al.*, 2012 [46]	*r* = -.05	ns	403	Unadjusted	↑ ns L
12	"	*r* = -.10	*p* <.05	403	Unadjusted	↑ * L
13	"	*r* = -.05	ns	403	Unadjusted	↑ ns L
14	"	b = -.07	95% CI: -.18, .05	403	Age; work ability at baseline	↑ ns L
15	"	b = .01	95% CI: -.07, .09	403	Age; work ability at baseline	↓ ns L
16	"	b = -.06	95% CI: -.16, .05	403	Age; work ability at baseline	↑ ns L
17	Fisher *et al.*, 2000 [47]	RR = 1.52	*p* <.05; 95% CI: 1.36, 1.70	Unclear	Age	↑ * L

18	"	RR = 1.18	95% CI: 0.88, 1.60	Unclear	Age	↑ ns L
19	"	RR = 1.76	*p* <.05; 95% CI: 1.34, 2.33	Unclear	Age	↑ * L
20	"	RR = 1.38	95% CI: 0.72, 2.61	Unclear	Age	↑ ns L
21	"	RR = 1.25	95% CI: 0.96, 1.62	Unclear	Age	↑ ns L
22	"	RR = 0.58	95% CI: 0.26, 1.30	Unclear	Age	↓ ns L
23	"	RR = 1.39	95% CI: 0.62, 3.12	Unclear	Age	↑ ns L
24	Karlsson *et al.*, 2010 [48]	OR = 0.91	95% CI: 0.33, 2.55	300	Gender; age	↓ ns L
25	"	OR = 2.33	95% CI: 0.84, 6.51	289	Gender; age	↑ ns L
26	Kessler & Frank, 1997 [49]	b = .88	*p* <.05	4091	Unadjusted	↑ * L
27	"	b = .17	ns	4091	Unadjusted	↑ ns L
28	Kim *et al*., 2013 [50]	unclear	*p* <.001	946	Unadjusted	| * L
29	"	unclear	*p* = .03	946	Age; employment; education; body mass index; drug use	| * M
30	"	unclear	*p* = .10	884	Age; employment; education; body mass index; drug use	↓ ns M
31	"	unclear	*p* = .11	577	Age; employment; education; body mass index; drug use	↓ ns M
32	"	unclear	*p* = .98	577	Age; employment; education; body mass index; drug use	↓ ns M

33	"	unclear	p = .51	577	Age; employment; education; body mass index; drug use	↓ ns M
34	"	unclear	p = .97	369	Age; employment; education; body mass index; drug use	↑ ns M
35	"	unclear	p = .53	62	Age; employment; education; body mass index; drug use	↑ ns M
36	Kirkham *et al.*, 2015 [51]	β = .20	p <.001; 95% CI: .14, .27	27459	Age; gender; region of residence; misc. work-related factors	↑ * H
37	"	β = .22	p <.001; 95% CI: .13, .32	10639	Age; gender; region of residence; misc. work-related factors	↑ * H
38	"	β = .20	p <.001; 95% CI: .10, .29	16820	Age; gender; region of residence; misc. work-related factors	↑ * H
39	Odlaug *et al.*, 2016 [52]	unclear	p <.05	1373	Unadjusted	↑ * L
40	Pensola *et al.*, 2016 [53]	PRR = 1.22	95% CI: 1.1, 1.4	1351	Age; gender	↑ * M
41	"	PRR = 1.15	95% CI: 1.0, 1.3	1351	Age; gender; misc. work-related, physical and psychosocial factors	↑ * H
42	"	PRR = 1.30	95% CI: 1.1, 1.6	546	Age	↑ * M
43	"	PRR = 1.21	95% CI: 1.0, 1.5	546	Age; gender; misc. work-related, physical and psychosocial factors	↑ * M

44	"	PRR = 1.15	95% CI: 1.0, 1.4	805	Age	↑ * M
45	"	PRR = 1.01	95% CI: 0.9, 1.2	573	Age; gender	↑ ns M
46	"	PRR = 1.92	95% CI: 1.4, 2.7	778	Age; gender	↑ * M
47	"	PRR = 1.80	95% CI: 1.3, 2.6	778	Age; gender; misc. work-related, physical and psychosocial factors	↑ * M
48	Richmond *et al.*, 2016 [54]	b = 0.017; β = .057	ns	338	Baseline presenteeism	↑ ns L
49	Schou *et al.*, 2017 [55]	r = .458	p <.01	1406	Unadjusted	↑ * L
50	Steegmann *et al.*, 1997 [56]	r = .073	ns	45	Unadjusted	↑ ns L
51	Tsuchiya *et al.*, 2012 [57]	b = -1.1	95% CI: -2.1, -0.0	530	Unadjusted	↑ * L
52	"	b = -1.1	95% CI: -2.1, -0.1	530	Gender; age; education; job category; work time	↑ * M
53	van Scheppingen *et al.*, 2014 [58]	r = .01	ns	629	Unadjusted	↑ ns L
54	Yu *et al.*, 2015 [59]	χ^2 = 4.6	p <.05	1506	Unadjusted	↑ * L
55	"	OR = 1.76	95% CI: 1.02, 3.03	1506	unclear	↑ * L
56	Friedman *et al.*, 1992 [60]	r = -.09	p <.01	860	Unadjusted	↑ * L
57	"	r = .02	ns	860	Unadjusted	↑ ns L
58	"	r = -.14	p <.01	973	Unadjusted	↑ * L

59	"	r = .09	p <.01	973	Unadjusted	↑ * L
60	"	r = -.12	p <.01	886	Unadjusted	↑ * L
61	"	r = .05	ns	886	Unadjusted	↑ ns L
62	"	r = -.13	p <.01	852	Unadjusted	↑ * L
63	"	r = .06	ns	852	Unadjusted	↑ ns L
64	"	r = 09	p <.01	863	Unadjusted	↑ * L
65	"	r = .03	ns	863	Unadjusted	↑ ns L
66	"	r = .10	p <.01	1229	Unadjusted	↓ ns L
67	"	r = .06	p <.05	1229	Unadjusted	↑ * L
68	"	r = .09	p <.01	1229	Unadjusted	↓ * L
69	"	r = .07	p <.05	1229	Unadjusted	↑ * L
70	Boles *et al.*, 2004 [61]	unclear	ns	2264	Age; gender; misc. risk factors	↑ ns H
71	"	OR = 3.74	p = .115	2264	Age; gender; misc. risk factors	↑ ns H
72	"	b = 0.901	p = .930	2264	Age; gender; misc. risk factors	↑ ns H
73	Blum *et al.*, 1993 [62]	r = -.016	ns	136	Unadjusted	↑ ns L
74	"	M_{diff} = 0.01	ns	136	Unadjusted	↑ ns L
75	"	M_{diff} = 0.21	ns	136	Unadjusted	↑ ns L
76	"	M_{diff} = 0.05	ns	136	Unadjusted	↑ ns L

77	"	r = -.185	p <.05	136	Unadjusted	↑ * L
78	"	M_{diff} = 0.19	p <.05	136	Unadjusted	↑ * L
79	"	M_{diff} = 0.16	ns	136	Unadjusted	↑ ns L
80	"	M_{diff} = 0.03	ns	136	Unadjusted	↑ ns L
81	"	r = -.233	p <.01	136	Unadjusted	↑ * L
82	"	M_{diff} = 0.28	p <.01	136	Unadjusted	↑ * L
83	"	M_{diff} = 0.35	p <.01	136	Unadjusted	↑ * L
84	"	M_{diff} = 0.03	p <.05	136	Unadjusted	↑ * L
85	Burton *et al.*, 2005 [63]	M_{diff} = -0.0748	ns	28375	Age; gender; diseases; misc. risk factors	↓ ns H
86	"	M_{diff} = -0.0447	ns	28375	Age; gender; diseases; misc. risk factors	↓ ns H
87	"	M_{diff} = -0.0833	ns	28375	Age; gender; diseases; misc. risk factors	↓ ns H
88	"	M_{diff} = -0.0853	ns	28375	Age; gender; diseases; misc. risk factors	↓ ns H
89	"	M_{diff} = -0.0865	ns	28375	Age; gender; diseases; misc. risk factors	↓ ns H
90	Lim *et al.*, 2000 [64]	b = -0.92	ns	4579	Physical and mental disorders	↓ ns M
91	"	b = 0.18	ns	4579	Physical and mental disorders	↑ ns M
92	Lowmaster *et al.*, 2012 [65]	r = .21	ns	85	Unadjusted	↓ ns L
93	"	r = .12	ns	29	Unadjusted	↓ ns L

94	"	r = .23	ns	56	Unadjusted	↓ ns L
95	Moore *et al.*, 2000 [66]	unclear	p <.05	1521	Unadjusted	↑ * L
96	"	unclear	p <.05	1378	Unadjusted	↑ * L
97	"	unclear	p <.05	520	Unadjusted	↑ * L
98	"	unclear	p <.05	2256	Demographic variables	| * M
99	"	M_{diff} = 0.1	p = .65	1780	Demographic variables	↓ ns M
100	"	M_{diff} = 0.2	p = .10	520	Demographic variables	↑ ns M
101	"	M_{diff} = 0.3	p <.01	1378	Demographic variables	↑ * M
102	"	M_{diff} = 0.0	p = .68	676	Demographic variables	| ns M
103	"	M_{diff} = 0.1	p = .09	1534	Demographic variables	↑ ns M
104	"	M_{diff} = 0.2	p = .10	274	Demographic variables	↑ ns L
105	"	M_{diff} = 0.1	p =.42	663	Demographic variables	↑ ns M
106	"	M_{diff} = 0.2	p <.05	1521	Demographic variables	↑ * M
107	"	M_{diff} = 0.1	p = .22	261	Demographic variables	↑ ns L
108	Ames *et al.*, 1997 [21]	b = -0.02; β = -.02	ns	832	Drinking variables; job characteristics	↓ ns M
109	"	b = 0.08; β = .08	p <.05	832	Drinking variables; job characteristics	↑ * M
110	"	b = 0.08; β = .08	p <.05	832	Drinking variables; job characteristics	↑ * M
111	"	b = -0.01; β = -.01	ns	832	Drinking variables; job characteristics	↓ ns M

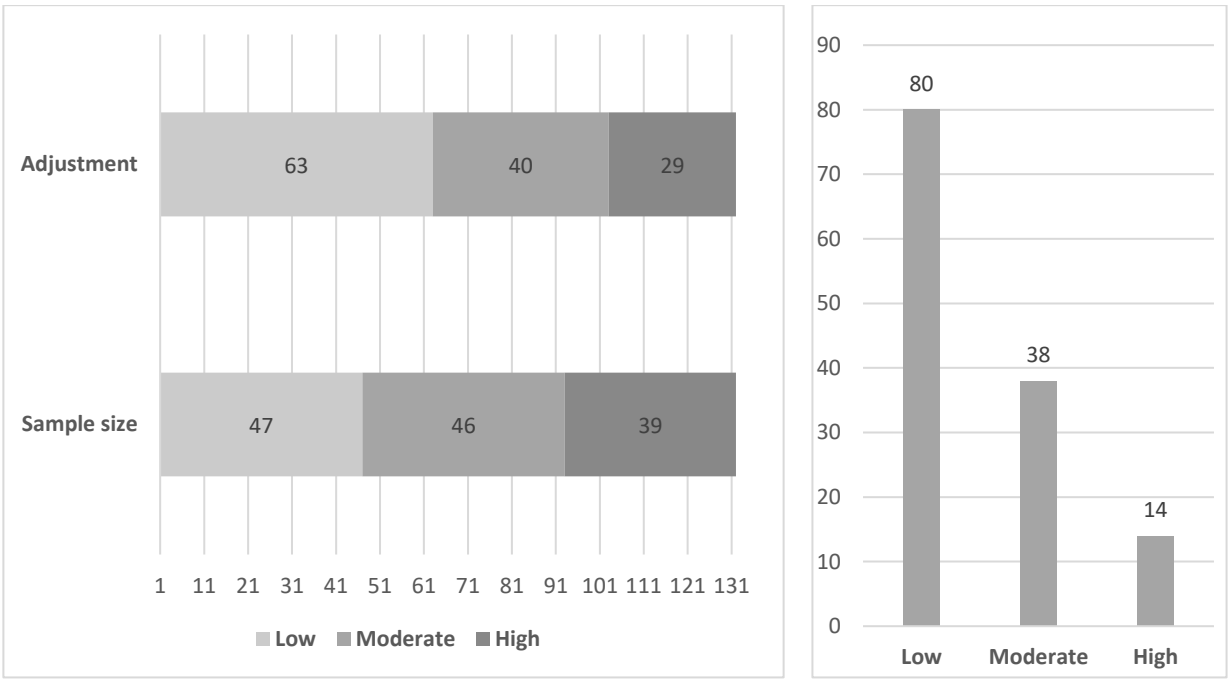
112	"	b = -0.03; β = -.03	ns	832	Drinking variables; job characteristics	↓ ns M
113	"	b = -0.02; β = -.02	ns	832	Drinking variables; sociodemographics	↓ ns M
114	"	b = -0.01; β = -.01	ns	832	Drinking variables; sociodemographics	↓ ns M
115	"	b = 0.21; β = .21	*p* <.001	832	Drinking variables; sociodemographics	↑ * M
116	"	b = -0.01; β = -.01	ns	832	Drinking variables; sociodemographics	↓ ns M
117	"	b = 0.00; β = .00	ns	832	Drinking variables; sociodemographics	↑ ns M
118	"	η^2 = .01	*p* <.02	832	Unadjusted	↑ * L
119	"	η^2 = .01	*p* <.05	832	Unadjusted	↑ * L
120	"	η^2 = .02	*p* <.01	832	Unadjusted	↑ * L
121	"	η^2 = .01	*p* <.05	832	Unadjusted	↑ * L
122	Furu *et al.*, 2018 [67]	OR = 1.25	95% CI: 0.98, 1.61	1622	Unadjusted	↑ ns L
123	"	OR = 1.36	95% CI: 1.05, 1.77	1622	Age	↑ * M
124	Aas *et al.*, 2017 [40]	*r* = .049	*p* <.01	3278	Unadjusted	↑ * L
125	"	*r* = .076	*p* <.001	3278	Unadjusted	↑ * L
126	"	b = 0.016; β = .028	ns	3278	Gender; age; education; living status; employment sector; binge drinking	↑ ns H

127	"	b = 0.040; β = .057	*p* <.01	3278	Gender; age; education; living status; employment sector; drinking frequency	↑ * H
128	van den Berg *et al.*, 2017 [68]	OR = 1.23	95% CI: 0.87, 1.74	509	Gender; age; education	↑ ns M
129	"	OR = 1.28	95% CI: 0.99, 1.65	1267	Gender; age; education	↑ ns M
130	"	OR = 1.00	ns	410	Gender; age; education	| ns L
131	"	OR = 1.18	95% CI: 0.66, 3.11	413	Gender; age; education	↑ ns L
132	"	OR = 1.52	95% CI: 0.96, 2.41	335	Gender; age; education	↑ ns L

[a] *r* = correlation coefficient; b = unstandardised regression coefficient; RR = relative risk; OR = odds ratio; β = standardised regression coefficient; PRR = prevalence risk ratio; χ^2 = chi square; M_{diff} = mean difference; η^2 = eta squared

[b] ↑ = positive association; ↓ = negative association; | = inconsistent direction; * = significant association; ns = non-significant association; L = low quality association; M = moderate quality association; H = high quality association

Supplementary File 3. Results of quality assessments of included associations (n = 132)



Panel A **Panel B**

Panel A displays quality assessments separately on two key domains (sample size and level of adjustment). Panel B displays overall assessments according to the "worst score counts" algorithm.

Paper III

Aas, R. W., Haveraaen, L., Sagvaag, H., & Thørrisen, M. M. (2017). The influence of alcohol consumption on sickness presenteeism and impaired daily activities. The WIRUS screening study. PLoS ONE, 12(10). DOI: **https://dx.doi.org/10.1371/journal.pone.0186503**

PLOS ONE

RESEARCH ARTICLE

The influence of alcohol consumption on sickness presenteeism and impaired daily activities. The WIRUS screening study

Randi Wågø Aas[1,2,3]*, Lise Haveraaen[2], Hildegunn Sagvaag[1], Mikkel Magnus Thørrisen[3]

1 Department of Health Studies, University of Stavanger, Stavanger, Norway, **2** Presenter - Making Sense of Science, Stavanger, Norway, **3** Department of Occupational Therapy, Prosthetics and Orthotics, Oslo and Akershus University College of Applied Sciences, Oslo, Norway

* randi.w.aas@uis.no

Check for updates

OPEN ACCESS

Citation: Aas RW, Haveraaen L, Sagvaag H, Thørrisen MM (2017) The influence of alcohol consumption on sickness presenteeism and impaired daily activities. The WIRUS screening study. PLoS ONE 12(10): e0186503. https://doi.org/10.1371/journal.pone.0186503

Editor: John E Mendelson, California Pacific Medical Center Research Institute, UNITED STATES

Received: April 11, 2017

Accepted: October 3, 2017

Published: October 17, 2017

Copyright: © 2017 Aas et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: The data from the study contain potentially sensitive information. In accordance with restrictions imposed by the Regional Committees for Medical and Health Research in Norway (approval no. 2014/647), data must be stored on a secure server at the University of Stavanger. The contents of the ethics committee's approval resolution as well as the wording of participants' written consent do not render open public data access possible. Access to the study's minimal and depersonalized data set

Abstract

Background

Alcohol use is a global health issue and may influence activity performance in a variety of domains, including the occupational and domestic spheres. The aim of the study was to examine the influence of annual drinking frequency and binge drinking (≥6 units at one occasion) on activity impairments both at work (sickness presenteeism) and outside the workplace.

Methods

Employees (n = 3278), recruited from 14 Norwegian private and public companies, responded to a questionnaire containing questions from the Alcohol Use Disorders Identification Test (AUDIT) and the Workplace Productivity and Activity Impairment questionnaire (WPAI).

Results

Multiple hierarchical regression analyses revealed that binge drinking was associated with both sickness presenteeism and impaired daily activities, even after controlling for gender, age, educational level, living status and employment sector. Annual drinking frequency was associated with impaired daily activities, but not sickness presenteeism.

Conclusions

Binge drinking seems to have a stronger influence on activity performance both at work and outside the workplace than drinking frequency. Interventions targeting alcohol consumption should benefit from focusing on binge drinking behavior.

Introduction

Alcohol use constitutes a global health issue. Harmful use of alcohol has been found to be involved in more than 200 different injury and disease conditions [1]. The World Health

may be requested by contacting the Faculty of Health Sciences at University of Stavanger (post@uis.no).

Funding: The study was funded by the Norwegian Directorate of Health and Research Council of Norway. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests: The authors have declared that no competing interests exist.

Organization estimates that 3.3 million annual deaths worldwide; i.e., 5.9% of all global mortality are related to alcohol use [2]. Alcohol consumption levels tend to be highest in the developed world, and alcohol is the most used psychoactive substance in the workforce [3]. Studies have demonstrated that between 10 and 35% of employees can be characterized as risky drinkers [4], i.e., that they have a pattern of alcohol consumption that increases the risk of social, legal, medical, occupational, domestic, and economical problems [5].

Alcohol consumption may influence activity performance in a variety of domains, including the occupational and domestic spheres. In his general model of employee substance use and productivity outcomes, Frone [3] proposes that both on-the-job and off-the-job substance use may lead to impaired performance outcomes. Furthermore, a recent systematic review reported that alcohol consumption is associated with both short- and long-term sickness absence [6]. Reporting to work and performing sub-optimally due to alcohol use, however, has received somewhat less attention in the research literature. This phenomenon, reduced on-the-job productivity, is termed sickness presenteeism. In a longitudinal study, Kirkham and colleagues [7] found that alcohol was associated with a higher number of presenteeism days among both younger and older workers. Similarly, others have discovered positive relationships between drinking behavior and the frequency of reported work problems [8] as well as alcohol consumption and productivity loss [9]. Moreover, sickness presenteeism has been found to be a risk factor for future sickness absence [10].

Alcohol consumption are often associated with impaired daily activities, such as difficulties in carrying out daily routines [11] and mobility problems [12]. Difficulties in economic self-sufficiency (inadequate access to financial resources to support everyday life), restriction of participation in activities associated with leading a meaningful life, and impaired social relationships have also been associated with alcohol consumption [13].

Different drinking patterns can have dissimilar effects on outcome measures. One may distinguish between (a) drinking frequency, i.e., the typical frequency of drinking in a given period of time, and (b) episodic heavy drinking (binge drinking). Binge drinking is often operationalized as consuming five drinks or more on one occasion [14, 15]. However, the Alcohol Use Disorders Identification Test defines binge drinking as six or more alcohol units on a single occasion [5].

In line with Bacharach and colleagues [16], it may be reasonable to assume that impairment-producing episodes of binge drinking would be more predictive of both sickness presenteeism and impaired daily activities than drinking frequency. Effects captured by drinking frequency may be linked to rather long-term ill-health consequences while binge drinking tends to have explicit short-term impairment-related consequences (e.g., hangover symptoms) [17].

The present study was conducted in Norway, a country in which alcohol is a legal and widely used drug. Traditionally, Norway has been characterized as a spirit-drinking country with binge drinking during the weekends and abstinence during weekdays, i.e., a dry drinking culture [18]. However, it has been emphasized that the Norwegian drinking culture has developed during the last decades in the direction of more drinking during weekdays in addition to weekend binge drinking [19]. Nevertheless, Norwegian youths are consuming less alcohol than most of their Western counterparts [20], and alcohol use per person per year in the general Norwegian population (7.7 litres) is somewhat lower than in the rest of Europe (10.9 litres) and in the United States (9.2 litres) [2].

Based on a public health perspective and justified by the total consumption model [21], Norway has restrictive alcohol policies regulated by means of a licence system, alcohol sale monopoly, advertising ban, age limits and taxation on products containing alcohol [20]. Use of alcohol at work is forbidden and infringement may result in resignation. Scandinavian studies on alcohol consumption in the working community have primarily focused on drinking

outside the workplace [22]. Although representing a quite uninvestigated issue in Norwegian studies, alcohol-related sickness presenteeism has, in a recent study [23], been reported by 11.0% of employees.

Knowledge on the relationship between alcohol consumption on one hand and sickness presenteeism and impaired daily activities on the other, is limited within working populations that are not in clinical treatment for alcohol abuse or -dependence. To be able to provide early identification and public health programs targeting risky drinking, such knowledge might be crucial. Moreover, there seems to be a shortage of studies that have explored and compared activity restrictions both within and outside the workplace.

The aim of the present study was therefore to explore the influence of annual drinking frequency and binge drinking on sickness presenteeism and impaired daily activities in a sample of Norwegian employees.

Materials and methods

Design

This study is part of the Norwegian national WIRUS project (Workplace Interventions preventing Risky Use of alcohol and Sick leave), where one of the studies are the WIRUS-Screening study. Other results from WIRUS are published elsewhere [24]. The study was designed as a cross-sectional study among private (n = 5) and public (n = 9) companies, employing a total of 14,353 individuals.

Sample

The employees were invited to participate in a web-based alcohol screening study, where they answered questionnaires designed to measure alcohol consumption, sickness presenteeism and impaired daily activities. A total of 4,275 employees (29.8%) responded to the questionnaire. However, 997 employees were excluded because of missing values on key variables or as a result of being abstainers, leaving a final sample of 3,278 individuals. Characteristics of the study sample, the invited sample and the Norwegian workforce are presented in Table 1.

The study sample consisted of 32.6% males and 67.4% females. 68.5% of employees were aged $\geq$40 and 75.3% had completed a university or college education. 10.0% of the respondents were employed within the five private sector companies (production, transport, hotel/restaurant and health care), while 90.0% were employed within the nine public sector companies (public administration and health care).

Alcohol measures

Two questions were used to measure alcohol consumption. Both items were taken from the Norwegian translation of the Alcohol Use Disorders Identification Test (AUDIT), developed by the World Health Organization [5]. Annual drinking frequency (AUDIT 1), was measured by one item: "How often, during the last year, did you have a drink containing alcohol?". Answers were scored on a five-point Likert scale ranging from "never", "monthly or less", "two or four times a month", "two to three times a week" to "four or more times a week". Employees who responded "never" on the AUDIT-1 were treated as abstainers and consequently excluded from the final sample. Hence, the measure of annual drinking frequency consisted of response categories that comprised any consumption during the last year, i.e., from "monthly or less" to "four or more times a week". Annual drinking frequency was treated as a categorical variable with four levels in correlation and regression analyses, and was collapsed into two categories (frequent/infrequent drinking) for crosstabulation. Frequent drinking consisted of the

Table 1. Study sample, invited sample and national workforce characteristics.

Variable	Study sample % (n)	Invited sample % (n)	Difference % (*p-value*)[a]	Norwegian workforce %[b]
Gender			1.6 (.081)	
Male	32.6 (1067)	34.2 (4908)		52.7
Female	67.4 (2211)	65.8 (9445)		47.3
Age			4.0 (< .001)	
≤ 39	31.5 (1032)	35.5 (5102)		45.0
≥ 40	68.5 (2246)	64.5 (9251)		55.0
Educational level				
Primary/lower secondary	2.5 (81)	-		16.3
Upper secondary	22.2 (728)	-		42.3
University/college	75.3 (2469)	-		41.4
Living status				
Living alone	13.7 (448)	-		-
Living with others	86.3 (2830)	-		-
Employment sector				
Private	10.0 (328)	-		-
Public	90.0 (2950)	-		-
Industry				
Transport	1.8 (60)	-		-
Production	5.6 (184)	-		-
Publ. administration	75.3 (2468)	-		-
Health care	16.5 (542)	-		-
Hotel/restaurant	0.7 (24)	-		-

[a]Difference between study sample and invited sample.

[b]Characteristics of the Norwegian national workforce in 2016, obtained from Statistics Norway (http://www.ssb.no)

https://doi.org/10.1371/journal.pone.0186503.t001

responses "2–3 times a week" and "≥4 times a week", while infrequent drinking included the response categories "monthly or less" and "2–4 times a month". Binge drinking episodes (AUDIT-3) were measured with the question: "How often, during the last year, did you have six or more drinks on one occasion?". The question was rated on a five-point Likert scale, ranging from "never", "less than monthly", "monthly" and "weekly" to "almost daily". Binge drinking was entered as a categorical variable with five levels in correlation and regression analyses, and was collapsed into two categories (recurrent/never or rarely) for crosstabulation. Recurrent binge drinking included the response categories "monthly", "weekly" and "almost daily", while the responses "never" and "rarely" were combined into a never/rarely caregory. The AUDIT has demonstrated satisfactory psychometric properties and is a recommended alcohol screening instrument [25, 26].

Measures of sickness presenteeism and impaired daily activities

Sickness presenteeism and impaired daily activities were measured by one item each taken from a Norwegian translation of the Work Productivity and Activity Impairment questionnaire (WPAI). Sickness presenteeism was measured on a visual analogue scale ranging from zero (no influence on productivity) to ten (obstructed productivity completely), where respondents answered the following question: "During the past seven days, how much did alcohol consumption affect your productivity while you were working?". The WPAI has demonstrated satisfactory psychometric properties [27] and measures work productivity in a manner that is

in accordance with measures of sickness presenteeism [28], and not only productivity loss in general. Sickness presenteeism was thus found to be a good concept in the context of the present study.

Similarly, impaired daily activities were measured by asking respondents: "During the past seven days, how much did alcohol consumption affect your ability to do regular daily activities, other than work at a job?". Responses were given on a visual analogue scale from zero (no influence on activities) to ten (obstructed activities completely).

Sickness presenteeism and impaired daily activities were entered as continuous variables in correlation and regression analyses, and collapsed into two categories (impairment/no impairment) for utilization in crosstabulation. No impairment reflected a score of zero, while impairment included scores ranging from one to ten on the visual analogue scale.

Control measures

Earlier studies have found variables such as gender, age, educational level and family life to be associated with activity performance in working populations [29, 30]. Therefore, gender, age, educational level and living status (living alone or living with others) were considered potential confounders and accordingly included as control variables. Additionally, employment sector (private/public) was included as a control measure.

Analysis

All statistical analyses were performed with IBM SPSS version 24. Bivariate correlation analyses (Pearson *r*) were performed to explore the strength and direction of the unadjusted relationships between the variables. Contingency tables were constructed to estimate the odds and risks of impairment given low or high levels of annual drinking frequency and binge drinking, respectively. Adjusted multiple hierarchical regression analyses were applied to investigate the influence of annual drinking frequency and binge drinking episodes on sickness presenteeism and impaired daily activities. Control measures were entered at stage 1 and alcohol measures were entered in stage 2 to evaluate the model as a whole, as well as the influence of each independent variable. Significant results were defined as $p < .05$.

Ethics

The study was approved by the Regional Committees for Medical and Health Research in Norway (approval no. 2014/647). Respondents were informed about the study's aim and confidentiality, assured that participation was voluntary and provided written informed consent.

Results

Correlations between the variables

As seen in Table 2, correlations between the study variables were generally small, but most were statistically significant.

Drinking frequency and binge drinking

Almost two out of ten (19.7%) employees reported "frequent drinking" during last year, i.e., consumption on a weekly or almost daily basis, while the majority (80.3%) reported "infrequent drinking" (maximum four times a month). Approximately one out of ten (11.0%) employees reported "recurrent binge drinking" during the last year (binge drinking episodes on a monthly, weekly or almost daily basis), while 89.0% reported "never or rarely binge drinking".

Table 2. Correlations between the study variables.

	Presenteeism	Daily activ.	Frequency	Binge	Gender	Age	Education	Sector	Living status
Presenteeism	-								
Daily activ.	.712***	-							
Frequency	.049**	.107***	-						
Binge	.076***	.177***	.341***	-					
Gender	-.037*	-.080***	-.109***	-.210***	-				
Age	-.029	-.069***	.177***	.,203***	-.051**	-			
Education	.019	.023	.131***	-.074***	.023	-.067***	-		
Sector	-.031	-.053**	.020	-.139***	.217***	.084***	.300***	-	
Living status	-.014	-.051**	.020	-.055**	-.007	-.006	.029	.006	-

Sickness presenteeism and impaired daily activities: Higher scores indicate higher levels of impairment. Gender: Lower score is male, higher score is female; Sector: Lower score is private, higher score is public; Living status: Lower score is living alone, higher score is living with others; For all other variables, higher scores indicate higher levels.

*$p < .05$

** $p < .01$

*** $p < .001$

https://doi.org/10.1371/journal.pone.0186503.t002

As seen in Table 3, 4.2% of employees who consumed alcohol monthly or less reported sickness presenteeism, compared to 7.4% among those who consumed alcohol 2–4 times a month, 9.7% among those who drank 2–3 times a week, and 12.9% among those who consumed alcohol ≥4 times a week. Thus, a higher proportion of frequent drinkers (consumption on a weekly or almost daily basis;10.1%) reported sickness presenteeism compared to infrequent

Table 3. Crosstabulation of annual drinking frequency and activity performance.

	Drinking frequency							
	Monthly or less		2–4 times a month		2–3 times a week		≥4 times a week	
	n	%	n	%	n	%	n	%
Presenteeism								
Impairment	53	4.2	101	7.4	54	9.7	11	12.9
No impairment	1212	95.8	1268	92.6	505	90.3	74	87.1
Daily activities								
Impairment	64	5.1	150	11.0	93	16.6	16	18.8
No impairment	1201	94.9	1219	89.0	466	83.4	69	81.2
Total n (%)	1265 (38.6)		1369 (41.8)		559 (17.1)		85 (2.6)	
	Frequent[a]				**Infrequent[b]**			
	n	%	OR	RR	n	%	Total n (%)	
Presenteeism								
Impairment	65	10.1	1.81	1.71	154	5.8	219 (6.7)	
No impairment	579	89.9			2480	94.2	3059 (93.3)	
Daily activities								
Impairment	109	16.9	2.32	2.09	214	8.1	323 (9.9)	
No impairment	535	83.1			2420	91.9	2955 (90.1)	
Total n (%)	644 (19.7)				2634 (80.3)			

[a]Consumption on a weekly or almost daily basis.

[b]Consumption maximum 4 times a month.

https://doi.org/10.1371/journal.pone.0186503.t003

Table 4. Crosstabulation of binge drinking and activity performance.

	Binge drinking episodes									
	Never		Rarely		Monthly		Weekly		Almost daily	
	n	%	n	%	n	%	n	%	n	%
Presenteeism										
Impairment	63	5.3	120	6.9	29	8.6	7	30.4	0	0.0
No impairment	1123	94.7	1610	93.1	308	91.4	16	69.6	2	100.0
Daily activities										
Impairment	70	5.9	163	9.4	82	24.3	8	34.8	0	0.0
No impairment	1116	94.1	1567	90.6	255	75.7	15	65.2	2	100.0
Total n (%)	1186 (36.2)		1730 (52.8)		337 (10.3)		23 (0.7)		2 (0.1)	

	Recurrent[a]				Never/ rarely[b]			
	n	**%**	**OR**	**RR**	**n**	**%**	**Total n (%)**	
Presenteeism								
Impairment	36	9.9	1.64	1.59	183	6.3	219 (6.7)	
No impairment	326	90.1			2733	93.7	3059 (93.3)	
Daily activities								
Impairment	90	24.9	3.81	3.11	233	8.0	323 (9.9)	
No impairment	272	75.1			2683	92.0	2955 (90.1)	
Total n (%)	362 (11.0)				2916 (89.0)			

[a]Binge drinking episodes on a monthly, weekly or almost daily basis.

[b]Never or rarely binge drinking episodes

https://doi.org/10.1371/journal.pone.0186503.t004

drinkers (consumption maximum 4 times a month; 5.8%). 5.1% of employees who consumed alcohol monthly or less reported impaired daily activities, compared to 11.0% of those who consumed alcohol 2–4 times a month, 16.6% among those who drank 2–3 times a week, and 18.8% among those who consumed alcohol $\leq$4 times a week. Hence, compared to infrequent drinkers, a higher percentage of frequent drinkers reported impaired daily activities (16.9% versus 8.1%). The odds of sickness presenteeism for frequent drinkers were 1.81 times higher than for infrequent drinkers, while the odds of impaired daily activities for frequent drinkers were 2.32 times higher than for their infrequent counterparts.

As shown in Table 4, 5.3% of employees who had no binge drinking episodes reported sickness presenteeism, compared to 6.9% among those who rarely binge drank, 8.6% among those who binge drank on a monthly basis, and 30.4% among those who had binge drinking episodes on a weekly basis. Consequently, a higher proportion of recurrent binge drinkers (binge drinking on a monthly, weekly or almost daily basis) reported sickness presenteeism (9.9%) compared to those who never or rarely had binge drinking episodes (6.3%). 5.9% of employees who had no binge drinking episodes reported impaired daily activities, compared to 9.4% among those who rarely binge drank, 24.3% among those who binge drank on a monthly basis, and 34.8% of those who had binge drinking episodes on a weekly basis. Hence, impaired daily activities was indicated by a higher percentage of recurrent binge drinkers (24.9%) than by those who never or rarely had binge drinking episodes (8.0%). The odds of sickness presenteeism for recurrent binge drinkers were 1.64 times higher than for those who never or rarely had binge drinking episodes, while the odds of impaired daily activities were 3.81 times higher for recurrent compared to those who never or rarely had binge drinking episodes.

Table 5. Sickness presenteeism hierarchical regression model.

				95% CI	
Variable	**b**	***SE***	**β**	**Lower**	**Upper**
Stage 1					
Gender	-.033	.018	-.033	-.068	.002
Age	-.001	.001	-.026	-.003	.000
Educational level	.015	.010	.028	-.005	.035
Sector	-.046	.029	-.030	-.103	.011
Living status	-.020	.024	-.015	-.066	.026
R^2	.004				
Stage 2					
Gender	-.018	.018	-.019	-.054	.017
Age	-.001	.001	-.019	-.002	.001
Educational level	.015	.010	.027	-.005	.035
Sector	-.040	.029	-.026	-.097	.017
Living status	-.016	.024	-.012	-.062	.030
Drinking frequency	.016	.011	.028	-.006	.039
Binge drinking	.040**	.014	.057**	.012	.067
R^2	.008				
ΔR^2	.005***				

** $p <$ .01

*** $p <$ .001

https://doi.org/10.1371/journal.pone.0186503.t005

Sickness presenteeism

The sickness presenteeism hierarchical regression model is presented in Table 5. The overall model explained 0.8% of the variance in sickness presenteeism. The control variables (gender, age, educational level, living status and employment sector), entered at stage 1, explained 0.4% of the variance in the model. After entering the alcohol consumption variables at stage 2, the total variance explained by the model increased to 0.8%, F (7, 3270 = 5.926, $p < .001$), ΔR^2 = .005, $p < .001$. In the fully adjusted model, binge drinking was the only independent predictor associated with sickness presenteeism (b = .040, β = .057, $p < .01$, 95% CI = [.012, .067]). Annual drinking frequency did not display a statistically significant contribution to the model (b = .016, β = .028, p = .156, 95% CI = [-.006, .039]).

Impaired daily activities

The impaired daily activities hierarchical regression model is presented in Table 6. The overall model explained 4.2% of the variance in impaired daily activities. The control variables, entered, at stage 1 explained 1.7% of the variance in the model. By including the alcohol measures, the total variance explained increased significantly to 4.2%, F (7, 3270 = 50.645, $p <$ .001), ΔR^2 = .025, $p < .001$. After controlling for gender, age, educational level, employment sector and living status, both annual drinking frequency and binge drinking were significantly associated with impaired daily activities. Binge drinking (b = .120, β = .131, $p < .001$, 95% CI = [.085, .155]) displayed a stronger influence on daily activity impairment than annual drinking frequency (b = .049, β = .064, $p < .01$, 95% CI = [.020, .078]).

Table 6. Impaired daily activities hierarchical regression model.

				95% CI	
Variable	**b**	***SE***	**β**	**Lower**	**Upper**
Stage 1					
Gender	-.098***	.023	-.076***	-.143	-.053
Age	-.004***	.001	-.068***	-.006	-.002
Educational level	.025	.013	.034	-.001	.050
Sector	-.083*	.038	-.041*	-.158	-.009
Living status	-.094**	.031	-.053**	-.154	-.034
R^2	.017				
Stage 2					
Gender	-.055*	.023	-.042*	-.101	-.009
Age	-.003*	.001	-.052*	-.005	-.001
Educational level	.024	.013	.033	-.002	.050
Sector	-.066	.038	-.032	-.139	.008
Living status	-.083**	.030	-.047**	-.142	-.023
Drinking frequency	.049**	.015	.064**	.020	.078
Binge drinking	.120***	.018	.131***	.085	.155
R^2	.042				
ΔR^2	.025***				

*$p < .05$
**$p < .01$
***$p < .001$

https://doi.org/10.1371/journal.pone.0186503.t006

Discussion

The aim of the present study was to explore the influence of annual drinking frequency and binge drinking on activity impairments both at work (sickness presenteeism) and outside the workplace. Results showed that (a) binge drinking was associated with higher levels of sickness presenteeism and impaired daily activities, (b) binge drinking had a stronger influence on daily activities than on sickness presenteeism, and (c) annual drinking frequency significantly influenced the employees' daily activities but it did not affect sickness presenteeism.

Binge drinking was associated with both higher levels of sickness presenteeism and impaired daily activities outside the workplace. Binge drinking is known to have several short-term effects such as hangovers, decreased attention and reduced concentration, as well as other temporary physical, cognitive and psychological disturbances [31]. These consequences can severely impact the individual's ability to perform regular daily activities and reduce their work performance [32, 33]. Reduced on-the-job performance due to alcohol consumption seems to be fairly common amongst the workforce, and the findings from this study are comparable to other studies on the Norwegian working community [23].

Somewhat surprisingly, the association between binge drinking and impaired daily activities was stronger the association between binge drinking and sickness presenteeism. Similarly, annual drinking frequency displayed an influence on impaired daily activities but not on sickness presenteeism. An explanation for these findings could be that (heavy) drinking usually occurs on days preceding weekends and holidays, when the employees have a day off from work [34].

Studies on drinking patterns have found that people drink less before conducting "serious" activities that require long-term commitment and focus, such as work activities, due to the

impact heavy drinking can have on performance [35]. Another related explanation could therefore be that the employees moderate their behavior because of a fear of sanctions as a consequence of reduced performance due to alcohol. In Norway, alcohol in the workplace is considered inappropriate [36]. Behavior that deviates from these norms may lead to marginalization, social exclusion [37], formal admonitions from employers and in some cases even resignation [22]. It is therefore possible that fear of such sanctions might contribute to self-regulation and suppression of impairments while at work, whereas similar self-regulation is not considered necessary outside the workplace. These findings seem to be in line with Frone's [3] general model of employee substance use and productivity outcomes that postulates that reduced on-the-job productivity primarily is a result of on-the-job substance use.

By comparing standardized regression coefficients and probability values, the present study found that annual drinking frequency had less influence on both activity performance measures compared to binge drinking. It is possible that, whereas binge drinking episodes result in more short-term disability and impairments, a pattern of frequent consumption can have more long-term consequences which do not immediately influence employees' activity performance in a short-term perspective [16]. Individuals who have a pattern of frequent drinking often experience more serious health-related problems in the long-term [38], and it is therefore likely that frequent drinkers might have more sickness absence compared to employees who engage in infrequent binge drinking. Research on the relationship between alcohol consumption and sickness absence has found that a larger number of drinks consumed per week is associated with a higher number of sickness absence days during a year [39]. Employees who drink frequently do not necessarily consume large amounts of alcohol on each occasion. Hangovers and other impairments due to alcohol usually result from episodes of heavy consumption, whereas low-risk drinking is not associated with next-day impairments [40].

Implications

Findings from the present study might indicate that binge drinking has a stronger influence on activity performance than annual drinking frequency, both at work and outside the workplace. Hence, individual and collective interventions aimed at preventing the development of alcohol-related problems may benefit from specifically targeting alcohol consumption behavior characterized by high levels of binge drinking. The findings from this study may in particular have implications for public sector employees, as a result of well educated female employees above age 40 and employed within public administration constituting a large proportion of the study sample.

Methodological issues

The present study has some limitations. It was based on a cross-sectional design and, hence, it is not possible to draw causal inferences from the associations identified. The relationship between alcohol consumption and activity performance may, as emphasized by Frone [3], be moderated and influenced by a variety of variables not included in the present study, such as various pharmacological, dispositional, situational and motivational factors. Such presumed complexity may be a pivotal reason for why the present study's included variables were not able to explain a large proportion of variance in the outcome measures.

This study was based on a relatively large sample (n = 3,278). The final response rate, however, was low (22.8%). Moreover, comparisons between our study sample and characteristics of the entire Norwegian workforce did reveal that older, highly educated and female employees were somewhat overrepresented in this study. On the other hand, our study sample was to a

much lesser degree different from our invited sample regarding gender and age distributions. Gender distribution in the study was not significantly different from the invited sample. Age distribution, however, was significantly different ($p < .001$), with a 4.0% underrepresentation of employees younger than 40 years old. Although non-response is a less prominent threat to associations between variables than to prevalence estimates [41], the low response rate may have somewhat biased our findings. Some studies suggest that males, individuals with low socioeconomic status and heavy drinkers tend to be underrepresented in health surveys [41–43]. Furthermore, actual alcohol sales have been found to be considerably higher than self-reported alcohol consumption [44]. Non-response bias and the application of self-reported alcohol measures suggest that alcohol consumption may be underestimated in this study. As such, findings must be interpreted with some caution.

We measured our four main variables with only one item on each, which could be a limitation in how we were able to grasp the concept under study. However, all four items were taken from validated instruments using psychometric accepted scales, and single-item measurements have been demonstrated to be reliable when exploring health behaviors, especially when inquiring about rather objective facts [45]. Our independent and dependent variables were measured within different time frames, i.e., consumption during the last year and impairment during the last seven days. Measuring consumption within a large time frame may have rendered it possible to capture a presumably representative drinking pattern, although it may have increased the risk for recall bias. Conversely, the activity performance measures may have had a limited ability to grasp a representative impairment pattern due to the restricted time frame, although minimizing the risk for recall bias.

We chose to interpret work productivity as sickness presenteeism, even though we are aware of the differing opinions on how presenteeism should or could be measured. Some argue that combining "showing up at work feeling ill" with "productivity loss" provides a complex outcome element that is both difficult to define and to measure. Therefore, some propose that presenteeism should only involve "showing up for work when one is ill" [46]. Given the employers' perspective and the socioeconomic perspectives on presenteeism, it may be conversely claimed that it is when this situation results in productivity loss that it becomes of interest. Being at work, not feeling well, but performing as normal is a phenomenon with less impact. Believing that all who feel unwell will have reduced productivity may involve overestimating the effect of illness. Therefore, in this study presenteeism is clearly linked to the consequences of alcohol use on illness and productivity. Furthermore, in this study we conceptualized frequent drinking as consuming alcohol at least two times a week, while recurrent binge drinking was operationalized as binge drinking episodes occurring on a monthly basis or more. These thresholds were chosen to reflect the dry drinking culture in Norway, a culture characterized by binge drinking during the weekends and abstinence during weekdays [22]. What constitute appropriate cut-off values may vary considerably between countries and cultures [47].

Our outcome measures did not allow us to estimate the number of lost hours or days of productivity associated with increased alcohol consumption. However, the aim of the present study was not to provide such estimations but rather to compare the relative influences of two alcohol measures on two activity performance arenas. The wording of the WPAI-statements may be considered to measure a relationship as well as a construct, e.g., by asking respondents to indicate whether they have experienced productivity loss due to alcohol consumption. Hence, participants are asked to attribute their behavior to a specific cause, and such attributions may not be accurate. However, the WPAI is considered to be a valid instrument [20] and was, despite some inherent limitations, deemed serviceable in the context of this study.

Conclusions

Alcohol consumption constitutes a global health issue. The present study found that employees' alcohol consumption were associated with their activity performance both at work (sickness presenteeism) and outside the workplace. Binge drinking was stronger associated with activity impairments than annual drinking frequency, and binge drinking was stronger associated with daily activities than with workplace performance. Although further longitudinal research is needed, the findings of the present study implicate that interventions targeting alcohol consumption should place large emphasis on binge drinking behavior.

Author Contributions

Conceptualization: Randi Wågø Aas, Lise Haveraaen, Hildegunn Sagvaag, Mikkel Magnus Thørrisen.

Data curation: Mikkel Magnus Thørrisen.

Formal analysis: Mikkel Magnus Thørrisen.

Funding acquisition: Randi Wågø Aas.

Methodology: Randi Wågø Aas, Mikkel Magnus Thørrisen.

Project administration: Randi Wågø Aas.

Supervision: Randi Wågø Aas.

Writing – original draft: Randi Wågø Aas, Lise Haveraaen, Hildegunn Sagvaag, Mikkel Magnus Thørrisen.

Writing – review & editing: Randi Wågø Aas, Lise Haveraaen, Hildegunn Sagvaag, Mikkel Magnus Thørrisen.

References

1. Lim SS, Vos T, Flaxman AD, Danaei G, Adair-Rohani H. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: A systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012; 380(9859): 2224–2260. https://doi.org/10.1016/S0140-6736(12)61766-8 PMID: 23245609
2. World Health Organization. Global status report on alcohol and health 2014. Geneva, Switzerland: World Health Organization; 2014.
3. Frone MR. Alcohol, drugs, and workplace safety outcomes: A view from a general model of employee substance use and productivity. In: Barling J, Frone MR, eds. The psychology of workplace safety. Washington, DC: American Psychological Association; 2004. p. 127–156.
4. Nesvåg S, Lie T. Rusmiddelbruk blant ansatte i norsk privat arbeidsliv [Drug use among employees in Norwegian private sector]. Nordisk Alkohol- og Narkotikatidsskrift. 2004; 21(2): 91–109.
5. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. AUDIT: The Alcohol Use Disorders Identification Test. Guidelines for use in primary care. 2nd ed. Geneva, Switzerland: World Health Organization; 2001.
6. Schou L, Moan IS. Alcohol use-sickness absence association and the moderating role of gender and socioeconomic status: A literature review. Drug and Alcohol Review. 2016; 35(2): 158–169. https://doi.org/10.1111/dar.12278 PMID: 26331574
7. Kirkham HS, Clark BL, Bolas CA, Lewis GH, Jackson AS, Fisher D, et al. Which modifiable health risks are associated with changes in productivity costs? Population Health Management. 2015; 18(1): 30. https://doi.org/10.1089/pop.2014.0033 PMID: 25375893
8. Mangione TW, Howland J, Amick B, Cote J, Lee M, Bell N, et al. Employee drinking practices and work performance. Journal of Studies on Alcohol. 1999; 60(2): 261–270. https://doi.org/10.15288/jsa.1999.60.261 PMID: 10091965
9. Riedel EJ, Grossmeier RJ, Haglund-Howieson EL, Buraglio EC, Anderson ED, Terry EP. Use of a normal impairment factor in quantifying avoidable productivity loss because of poor health. Journal of

Occupational and Environmental Medicine. 2009; 51(3): 283–295. https://doi.org/10.1097/JOM.0b013e31819eaac0 PMID: 19240649

10. Bergström G, Bodin L, Hagberg J, Aronsson G, Josephson M. Sickness presenteeism today, sickness absenteeism tomorrow? A prospective study on sickness presenteeism and future sickness absenteeism. Journal of Occupational and Environmental Medicine. 2009; 51(6): 629–638. PMID: 19448572
11. McKechnie J. Hill E. Alcoholism in older women religious. Substance Abuse. 2009; 30(2): 107–117. https://doi.org/10.1080/08897070902802026 PMID: 19347750
12. Saarni SI, Suvisaari J, Sintonen H, Pirkola S, Koskinen S, Aromaa A, et al. Impact of psychiatric disorders on health-related quality of life: General population survey. British Journal of Psychiatry. 2007; 190(4): 326–332. https://doi.org/10.1192/bjp.bp.106.025106 PMID: 17401039
13. Rodriguez LM, Dibello AM, Neighbors C. Perceptions of partner drinking problems, regulation strategies and relationship outcomes. Addictive Behaviors. 2013; 38(12): 2949–2957. https://doi.org/10.1016/j.addbeh.2013.08.028 PMID: 24070719
14. Naimi TS, Brewer RD, Mokdad A, Denny C, Serdula MK, Marks JS. Binge drinking among US adults. Jama. 2003; 289(1): 70–75. PMID: 12503979
15. Wechsler H, Nelson TF. Binge drinking and the American college students: What's five drinks? Psychology of Addictive Behaviors. 2001; 15(4): 287–291. PMID: 11767258
16. Bacharach SB, Bamberger P, Biron M. Alcohol consumption and workplace absenteeism: The moderating effect of social support. Journal of Applied Psychology. 2010; 95(2): 334–348. https://doi.org/10.1037/a0018018 PMID: 20230073
17. Blum TC, Roman PM, Martin JK. Alcohol-consumption and work performance. Journal of Studies on Alcohol. 1993; 54(1): 61–70. https://doi.org/10.15288/jsa.1993.54.61 PMID: 8355501
18. Simpura J, Karlsson T. Trends in drinking patterns among adult population in 15 European countries, 1950 to 2000: A review. Nordic Studies on Alcohol and Drugs. 2001; 18(1): 31–53.
19. Room R, Mäkelä K. Typologies of the cultural position of drinking. Journal of Studies on Alcohol. 2000; 61(3): 475–483. https://doi.org/10.15288/jsa.2000.61.475 PMID: 10807222
20. Norwegian Institute of Public Health. Rusmidler i Norge 2016 [Drugs in Norway 2016]. Oslo, Norway: Norwegian Institute of Public Health; 2016.
21. Room R, Livingston M. The distribution of customary behavior in a population: The total consumption model and alcohol policy. Sociological Perspectives. 2017; 60(1): 10–22. https://doi.org/10.1177/0731121416683278
22. Frøyland K. Arbeidsliv, rusmiddelbruk og forebygging—tendenser og funn i nyere forskning [Work life, drug use and prevention—tendencies and findings in recent research]. In Sagvaag H, Sikveland B, eds. Alkohol + arbeid = sant? [Alcohol + work = true?]. Oslo, Norway: Gyldendal Akademisk.
23. Moan IS, Halkjelsvik T. Alkohol og arbeidsliv. En undersøkelse blant norske arbeidstakere [Alcohol and working community. A study among Norwegian employees]. Oslo, Norway: Norwegian Institute of Public Health; 2016.
24. Nordaune K, Skarpaas LS, Sagvaag H, Haveraaen L, Rimstad S, Kinn LG, et al. Who initiates and organises situations for work-related alcohol use? The WIRUS culture study. Scandinavian Journal of Public Health. https://doi.org/10.1177/1403494817704109 PMID: 28666393
25. Reinert DF, Allen JP. The Alcohol Use Disorders Identification Test: An update of research findings. Alcoholism: Clinical and Experimental Research. 2007; 31(2): 185–199.
26. de Meneses-Gaya C, Zuardi AW, Loureiro SR, Crippa JAS. Alcohol Use Disorders Identification Test (AUDIT): An updated systematic review of psychometric properties. Psychology & Neuroscience. 2009; 2(1): 83–97.
27. Reilly MC, Zbrozek AS, Dukes EM. The validity and reproducibility of a work productivity and activity impairment instrument. Pharmaco Economics. 1993; 4(5): 353–365. https://doi.org/10.2165/00019053-199304050-00006
28. Koopman RC, Pelletier FK, Murrway EJ, Sharda LC, Berger SM, Turpin MR, et al. Stanford Presenteeism Scale: Health status and employee productivity. Journal of Occupational and Environmental Medicine. 2002; 44(1): 14–20. PMID: 11802460
29. Aronsson G, Gustafsson K. Sickness presenteeism: Prevalence, attendance-pressure factors, and an outline of a model for research. Journal of Occupational and Environmental Medicine. 2005; 47(9): 958–966. https://doi.org/10.1097/01.jom.0000177219.75677.17 PMID: 16155481
30. Hansen CD, Andersen JH. Going ill to work—What personal circumstances, attitudes and work-related factors are associated with sickness presenteeism?. Social Science & Medicine. 2008; 67(6) 956–964. https://doi.org/10.1016/j.socscimed.2008.05.022 PMID: 18571821

31. Verster JC. The alcohol hangover—A puzzling phenomenon. Alcohol and Alcoholism. 2008; 43(2): 124–126. https://doi.org/10.1093/alcalc/agm163 PMID: 18182417

32. Fisher CA, Hoffman KJ, Austin-Lane J, Kao TC. The relationship between heavy alcohol use and work productivity loss in active duty military personnel: A secondary analysis of the 1995 Department of Defense Worldwide Survey. Military Medicine. 2000; 165(5): 355–361. PMID: 10826382

33. Verster JC, van der Maarel M, McKinney A, Olivier B, de Haan L. Driving during alcohol hangover among Dutch professional truck drivers. Traffic Injury Prevention. 2014; 15(5): 434–438. https://doi.org/10.1080/15389588.2013.833329 PMID: 24678564

34. Horverak Ø, Bye EK. Det norske drikkemønsteret. En studie basert på intervjudata fra 1973 til 2004 [The Norwegian drinking pattern. A study based on interview data from 1973 to 2004]. Oslo, Norway: Norwegian Institute for Alcohol and Drug Research; 2007.

35. Finlay AK, Ram N, Maggs JL, Caldwell LL. Leisure activities, the social weekend, and alcohol use: Evidence from a daily study of first-year college students. Journal of Studies on Alcohol and Drugs. 2012; 73(2): 250–259. https://doi.org/10.15288/jsad.2012.73.250 PMID: 22333332

36. Skutle A, Buvik K, Iversen E. "Et glass vin etter jobben?" Rusmiddelvaner i det kvinnedominerte arbeidslivet ["A glass of wine after work?" Drug habits in the female-dominated working community]. Bergen, Norway: Stiftelsen Bergensklinikkene; 2009.

37. Nesvåg S, Duckert F. Work-related drinking and processes of social integration and marginalization in two Norwegian workplaces. Culture and Organization. 2015: 1–20. https://doi.org/10.1080/14759551.2015.1021800

38. Russell M, Cooper ML, Frone MR, Welte JW. Alcohol drinking patterns and blood pressure. American Journal of Public Health. 1991; 81(4): 452–457. https://doi.org/10.2105/AJPH.81.4.452 PMID: 2003623

39. Johansson E, Böckerman A, Uutela A. Alcohol consumption and sickness absence: Evidence from microdata. European Journal of Public Health. 2009; 19(1): 19–22. https://doi.org/10.1093/eurpub/ckn116 PMID: 19033355

40. Polak MA, Conner TS. Impairments in daily functioning after heavy and extreme episodic drinking in university students. Drug and Alcohol Review. 2012; 31(6): 763–769. https://doi.org/10.1111/j.1465-3362.2012.00429.x PMID: 22414263

41. Knudsen AK, Hotopf M, Skogen JC Øverland S, Mykletun A. The health status of nonparticipants in a population-based health study: The Hordaland Health Study. American Journal of Epidemiology. 2010; 172(11): 1306–1314. https://doi.org/10.1093/aje/kwq257 PMID: 20843863

42. Boniface S, Scholes S, Shelton N, Connor J. Assessment of non-response bias in estimates of alcohol consumption: Applying the continuum of resistance model in a general population survey in England. PLOS ONE. 2017; 12(1). https://doi.org/10.1371/journal.pone.0170892 PMID: 28141834

43. Korkeila K, Souminen S, Ahvenainen A, Ojanlatva A, Rautava P, Helenius H, et al. Non-response and related factors in a nation-wide health survey. European Journal of Epidemiology. 2001; 17(11): 991–999. https://doi.org/10.1023/A:1020016922473 PMID: 12380710

44. Boniface S, Kneale K, Shelton N. Drinking pattern is more strongly associated with under-reporting of alcohol consumption than socio-demographic factors: Evidence from a mixed-methods study. BMC Public Health. 2014; 14(1297). https://doi.org/10.1186/1471-2458-14-1297 PMID: 25519144

45. Dollinger S, Malmquist D. Reliability and validity of single-item self-reports: With special relevance to college students' alcohol use, religiousity, study, and social life. Journal of General Psychology. 2009; 136(3): 231–242. https://doi.org/10.3200/GENP.136.3.231-242 PMID: 19650519

46. Garrow V. Presenteeism: A review of current thinking. Brighton, United Kingdom: Institute of Employment Studies; 2016

47. Dawson DA. Defining risk drinking. Alcohol Research & Health. 2011; 34(2): 144–156.

Paper IV

Thørrisen, M. M., Skogen, J. C., Kjeken, I., Jensen, I., & Aas, R. W. (2019). Current practices and perceived implementation barriers for working with alcohol prevention in occupational health services. The WIRUS OHS study. Substance Abuse Treatment, Prevention, and Policy, 14(1). DOI: **https://dx.doi.org/10.1186/s13011-019-0217-2**

Thørrisen et al. Substance Abuse Treatment, Prevention, and Policy (2019) 14:30
https://doi.org/10.1186/s13011-019-0217-2

Substance Abuse Treatment, Prevention, and Policy

RESEARCH Open Access

Current practices and perceived implementation barriers for working with alcohol prevention in occupational health services: the WIRUS OHS study

Mikkel Magnus Thørrisen[1,2*], Jens Christoffer Skogen[3,4,5], Ingvild Kjeken[1,6], Irene Jensen[7] and Randi Wågø Aas[1,2,5]

Abstract

Background: Alcohol is associated with detrimental health and work performance outcomes, and one to three out of ten employees may benefit from interventions. The role of occupational health services (OHS) in alcohol prevention has received little attention in research. The primary aims of this study were to explore current practices of alcohol prevention targeting employees in occupational health settings, and examine whether and which perceived implementation barriers were associated with alcohol prevention activity. The secondary aim was to explore whether barriers were differentially associated with primary, secondary and tertiary prevention activities.

Methods: In this cross-sectional study, survey data were collected from 295 OHS professionals in Norway in 2018. Data were analysed by means of descriptive statistics, one-way analysis of variance, paired samples t-tests, and multivariate linear regression analyses.

Results: Overall, seven out of ten OHS professionals worked with alcohol-related cases less than monthly, while only one out of ten did so on a weekly basis. Their activities were more focused on tertiary prevention than on primary and secondary prevention. Physicians, psychologists and nurses reported to handle alcohol-related issues more often than occupational therapists and physical therapists. Higher levels of implementation barriers internal to the OHS' organisation (competence, time and resources) were associated with lower alcohol prevention activity. Barriers external to the OHS' organisation (barriers concerning employers and employees) were not. This pattern was evident for primary, secondary and tertiary prevention activities. A majority of OHS professionals agreed that employees' alcohol consumption constitute a public health challenge, and that OHS' should focus more on alcohol prevention targeting employees.

(Continued on next page)

* Correspondence: mikkel-magnus.thorrisen@oslomet.no
[1]Department of Occupational Therapy, Prosthetics and Orthotics, Faculty of Health Sciences, OsloMet – Oslo Metropolitan University, PO box 4 St. Olavs plass, NO-0130 Oslo, Norway
[2]Presenter – Making Sense of Science, PO box 8118, NO-4068 Stavanger, Norway
Full list of author information is available at the end of the article

© The Author(s). 2019 **Open Access** This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.

(Continued from previous page)
Conclusions: Occupational health settings at workplaces may be particularly serviceable for alcohol prevention programmes since the majority of the population is employed and the majority of employees consume alcohol. An increase in overall prevention activity, and a shift from mainly focusing on tertiary prevention to an increased emphasis on primary and secondary prevention, may both hinge on increased training of OHS professionals, emphasising knowledge on the importance of working with alcohol prevention, and training in administering alcohol prevention programmes. Making alcohol prevention a priority may also require increased allocation of time and resources.

Keywords: Alcohol consumption, Occupational health services, Workplace interventions, Workforce, Implementation, Prevention

Background

Occupational health services (OHS) aim to protect and promote employees' safety and health, as well as to improve the work environment and working conditions [1–3]. The majority of the population is employed and the majority of employees consume alcohol. Therefore, several researchers have argued that the OHS should be more actively involved in alcohol prevention targeting employees [1, 4–6]. It has proved feasible to conduct brief alcohol prevention programmes as an integrated part of regular health examinations routinely performed within the OHS [7, 8], and early identification and interventions targeting problem drinking may even be considered more appropriate in OHS as compared to specialised health care [9]. In a Swedish study [1], it was discovered that OHS professionals were generally interested in gaining further training and knowledge regarding alcohol prevention.

Harmful alcohol consumption is a major risk factor for disease, disability and mortality, and has been identified as a causal agent in more than 200 disease and injury conditions [10, 11]. According to the World Health Organization (WHO) [12], harmful alcohol consumption is related to approximately three million annual deaths globally. A recent study from the Global Burden of Disease project [13], based on data from 694 individual/population-level sources and 592 prospective and retrospective studies, found that alcohol consumption is the leading risk factor for deaths and disability-adjusted life-years among the population aged 15 to 49 years (accounting for 3.8% of female deaths and 12.2% of male deaths). Despite robust evidence for adverse health consequences attributable to alcohol consumption, some studies have found a J-shaped relationship between alcohol and health, indicating that low to moderate consumption levels may carry certain health benefits. Moderate consumption has been inversely related to risk for certain cardiovascular diseases [14], diabetes type 2 [15] and certain mental health outcomes [16]. Such findings suggest that potential health benefits should be weighted against risks [17]. It is, however, somewhat unclear whether such results reflect true protective effects of alcohol or is a result of confounding [18, 19]. Nevertheless, decades of evidence implies that potential health benefits from alcohol will be outweighed by adverse consequences [11–13, 20]. Hence, efforts to reduce overall population-level alcohol consumption should be emphasised [13].

Alcohol is by far the most used psychoactive substance in the workforce [21]. One may discriminate between workforce alcohol consumption (overall consumption, regardless of context; [21]) and work-related alcohol consumption (consumption during working hours, shortly prior to work, or in contexts related to the work environment; [21–24]). Three out of four employees have been found to be overall regular drinkers, while approximately one out of ten has consumed alcohol during working hours [21]. In a Norwegian study, it was found that 43% of regular drinkers' consumption occurred in work-related settings [25]. Studies have estimated that one to three out of ten employees may benefit from alcohol prevention programmes [25–30]. Both in research and in policy guidelines, attempts have been made to distinguish between low-risk and risky drinking. Risky drinking has been defined as a pattern of drinking that increases the risk of social, legal, medical, occupational, domestic and economic problems [31]. Figure 1 presents a conceptual model for the relationships between alcohol consumption, drinking categories, prevention levels, risk levels and intervention recommendations.

Based on WHOs Alcohol Use Disorders Identification Test (AUDIT), an individual's drinking pattern may be measured on a scale ranging from 0 to 40 [31, 34]. A sum score of eight or higher is generally considered the threshold for risky drinking [31, 35]. Moreover, risky drinking is categorised into three risk levels (moderate risk: scores 8–15; high risk: scores 16–19; and dependence likely risk: scores 20–40) [31]. According to WHOs international intervention guidelines [33], low-risk drinkers should receive information about alcohol use and potential negative consequences, moderate-risk drinkers may benefit from low-cost interventions such

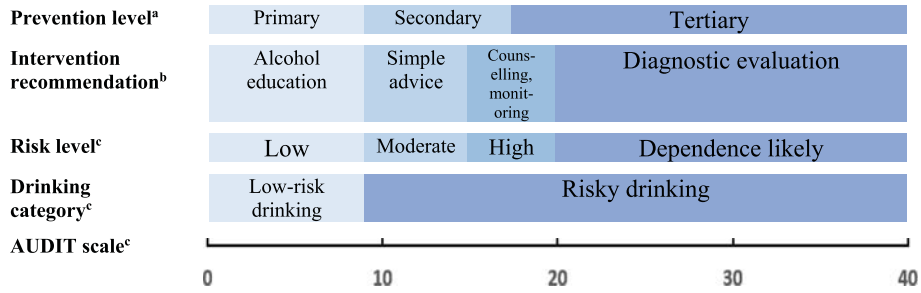


Fig. 1 Conceptual model of the relationships between alcohol consumption, drinking categories, risk levels, intervention recommendations and prevention levels. [a]Based on [32]; [b]Based on [31, 33]; [c]Based on [31]

as simple advice, high-risk drinkers should receive brief counselling and consecutive monitoring, while those with likely alcohol dependence should be referred to further diagnostic evaluation. In accordance with Coohey and Marsh's [32] conceptualisations of prevention levels, low-risk drinking employees constitute the target group for primary prevention activities, i.e., activities aimed at preventing an undesirable end-state (alcohol-related problems) before it occurs (or aimed at maintaining low-risk drinking as a desirable state). Secondary prevention activities target individuals experiencing the early phases of the undesirable end-state (employees with moderate to high risk), while tertiary prevention is focused on employees with high to dependence likely risk [32].

Employees' alcohol consumption carries substantial societal costs. Productivity impairments associated with alcohol consumption comprise both not being at work (sick leave/absenteeism) as well as being at work but functioning sub-optimally (presenteeism). A recent literature review [36] found evidence to support an association between employees' alcohol consumption and short-term as well as long-term sick leave, across socioeconomic status and gender. On a population level, Scandinavian time-series studies have linked increased alcohol consumption to increased sick leave. Based on alcohol sales in Sweden, it was estimated that a monthly increase of one decilitre pure alcohol per inhabitant was associated with 2–2.5 more long-term sick leave spells per 10,000 inhabitants [37], while an annual increase of 3.5 decilitres pure alcohol per inhabitant has been linked to an annual increase of 1.6 million sick leave days in the Swedish population [38]. A relationship between employees' alcohol consumption and presenteeism (reduced on-the-job performance) has been demonstrated in several studies, e.g., in samples of American manufacturer employees [39], Finnish employees with multisite pain [40], Japanese community workers [41], and Norwegian employees in various occupations [42], implying that higher levels of alcohol consumption are associated with higher levels of work impairments. A Norwegian study [43] suggested that negative workplace consequences (e.g., safety and psychosocial issues) may occur even though the overall prevalence of alcohol-related absenteeism and presenteeism may be quite low.

In addiction diseases, prevention is always of benefit. Alcohol prevention programmes targeting employees comprise a variety of intervention approaches on individual as well as an organisational level. According to Frone [21], they can be described as "interventions aimed at changing environmental, cultural, social, or personal factors in an effort (a) to keep individuals from abusing alcohol (…) and (b) to avert adverse work outcomes" (p. 143), for instance in the form of workplace health promotion programmes or drug testing. Although evidence is somewhat mixed, certain intervention approaches (e.g., brief interventions consisting of one to four consultations) have demonstrated promising results [44–47]. Implementation of alcohol prevention programmes has, however, proved difficult [48], suggesting that providing health professionals with research evidence and/or clinical guidelines may not be sufficient. Rather, evidence must be combined with implementation strategies aimed at providing health care professionals with encouragement and skills necessary to change established routines [49].

Implementation of brief alcohol prevention programmes has mainly been studied in primary care settings. Barry et al. [48] found that lack of time was the most important barrier to implementation. In a review of qualitative evidence [50], it was concluded that successful implementation is dependent on adequate financial and managerial support combined with workload reduction and training opportunities for health care professionals. In a sample of nurses working with hospitalised patients, lack of alcohol-related knowledge and skills, concerns about negative patient reactions and logistic issues (e.g., lack of time) were found to be salient anticipated barriers to implementation of alcohol prevention programmes [51]. Similarly, Babor et al. [52] concluded that lack of time, staff turnover and competing priorities were associated with lower alcohol prevention activity.

Research related to OHS practice is limited, and research on alcohol prevention in the OHS is particularly sparse [1, 9, 53–55]. There is a need for further research on alcohol prevention in the OHS and on OHS professionals' potential role in increased prevention of alcohol problems [1]. In order to develop strategies aimed at enabling implementation of alcohol prevention programmes in the OHS, it is pivotal to gain knowledge about which barrier domains should be targeted. Implementation barriers may originate from and reside within different domains or contexts, such as the OHS' organisation itself (e.g., resources, time, workload, and competence/training), or factors external to the OHS' organisation (e.g., employers'/clients' interest in focusing on employees' alcohol consumption, individual factors relating to OHS professionals' or employers'/clients' personal attitudes). Different barrier domains may require different implementation strategies and, moreover, different barrier domains may relate dissimilarly to working with different alcohol risk groups (e.g., primary, secondary and tertiary prevention activities). Hence, there is a need for studies investigating relationships between alcohol prevention activity and implementation barriers, i.e., for studies that explore associations beyond merely asking OHS professionals to rate which implementation barriers they perceive to be most salient. The present study adds to existing literature by providing updated knowledge on a rather under-researched topic, by generating knowledge on associations between implementation barriers and alcohol prevention activity, not merely on which and to what extent professionals perceive barriers, and by recognising that relationships between implementation barriers and prevention activity may vary according to alcohol risk level.

The primary aims of this study were to explore current practices of alcohol prevention targeting employees in occupational health settings, and examine whether and which perceived implementation barriers were associated with alcohol prevention activity. The secondary aim was to explore whether implementation barriers were differentially associated with primary, secondary and tertiary prevention activities.

Methods

Design and setting

The present study was designed as a cross-sectional survey as part of the Norwegian national WIRUS-project (Workplace Interventions preventing Risky Use of alcohol and Sick leave). Other results from the WIRUS-project are published elsewhere [24, 29, 42]. The study was conducted in 2018 among 357 health care professionals in 69 OHS units in Norway. OHS in Norway is regulated by the Working Environment Act [56] and OHS' are accredited by the Norwegian Labour Inspection Authority, based on having at least three OHS professionals with expertise in the field of systematic health, safety and environmental (HSE) work (systematic activities undertaken in order to secure and improve the work environment), such as occupational hygiene and medicine, ergonomics and psychosocial work environment [3]. Systematic HSE work constitutes an interdisciplinary field, and the most frequent educational backgrounds among OHS professionals in Norway are nursing, medicine and physical therapy [57]. The proportion of employees in the Norwegian workforce who has access to OHS coverage is approximately 60%, which is somewhat higher than in the USA, but quite comparable to other European countries [2]. In Norway, Akan represents an organisation that plays a key role in handling issues related to alcohol, drugs, gaming and gambling among employees [58]. Exploration of the role of Akan is beyond the scope of this study.

Data collection and sample

Contact information for accredited OHS' was obtained from the Norwegian Labour Inspection Authority, and all 206 accredited OHS' were invited to participate in the study. Ninety-three (45.2%) OHS' responded to the invitation. Twenty-four of the 93 responding units declined to participate, and 12 of these units provided the following reasons for declining the invitation: Nine units did not have capacity to participate in research due to high workload, two units declined due to being involved in reorganisation processes, and one unit perceived the study as irrelevant to them. Sixty-nine units (74.2% of the responding OHS') agreed to participate and sent lists of contact information for all health care professionals in their OHS. OHS' from all geographical counties in Norway were represented in the study. Moreover, OHS' providing services for companies in all work divisions (based on Eurostat's classification of economic activities [59]) were represented. Electronic questionnaires were distributed to 601 OHS professionals. A total of 357 (59.4%) responded, while 295 (49.1%) responded on all relevant items (20.0% males; 80.0% females), and thus constituted the study sample. Respondents' mean age was 49.1 years (*SD* = 9.9 years) and, on average, they had 12.3 years of experience as OHS professionals (*SD* = 9.1 years). A wide range of professions participated. Nurses (38.6%), physical therapists (17.3%), and physicians (13.9%) were the most frequent professions. Study sample characteristics are presented in Table 1.

Measures

Alcohol prevention activity

Respondents were asked to rate, on a five-point Likert scale (1 = not at all; 2 = to a small extent; 3 = to some extent; 4 = to a large extent; 5 = to a very large extent), to what extent their OHS unit engages in alcohol

Table 1 Characteristics of the study sample ($N = 295$)

Variable	*M*	*SD*	Median	Range Min	Range Max
Age (years)	49.1	9.9	49.0	25.0	75.0
OHS experience (years)	12.3	9.1	10.0	< 1.0	39.0
Variable	*n*		%		
Gender					
Male	59		20.0		
Female	236		80.0		
Professional background					
Occupational therapist	8		2.7		
Nutritionist	1		0.3		
Physical therapist	51		17.3		
Physician	41		13.9		
Psychologist	6		2.0		
Nurse	114		38.6		
Occupational hygienist	23		7.8		
Other[a]	51		17.3		

M mean, *SD* standard deviation; [a] e.g., medical secretaries, engineers, educationalists/teachers, economists and social scientists

prevention targeting employees, separately for three prevention levels (primary prevention, targeting low-risk drinkers; secondary prevention, targeting moderate to high-risk drinkers; tertiary prevention, targeting high to dependence likely-drinkers). A sum score for overall alcohol prevention activity was computed by combining the scores for activities on all three prevention levels (potential range = 1–15). Categorisations of risk levels were based on WHO guidelines [31] (see Fig. 1).

Perceived barriers to implementation of alcohol prevention programmes

On a visual analogue scale ranging from 1 (to a very small extent) to 11 (to a very large extent), respondents were asked to rate the extent to which they perceived the following seven factors as barriers to implementation of alcohol prevention programmes in the OHS: (i) "alcohol is a personal/private matter"; (ii) "companies are not interested in employees' alcohol consumption"; (iii) "companies counteract programmes targeting their employees' alcohol consumption"; (iv) "lack of knowledge on the importance of alcohol prevention among OHS professionals"; (v) "lack of knowledge on how to conduct alcohol prevention programmes among OHS professionals"; (vi) "lack of time and/or resources"; and (vii) "others than the OHS are responsible for treating/intervening against employees' alcohol consumption".

The implementation barrier items were developed as part of the WIRUS-project, based on findings from previous research studying implementation of alcohol-preventive efforts in primary care settings [48, 50–52], and on three qualitative interview panels where nine OHS professionals were openly asked about barriers and facilitators for working with alcohol prevention in occupational health settings. Qualitative interview data was thematically analysed, resulting in categories corresponding to the seven implementation barrier items.

The implementation barrier items were subjected to an exploratory factor analysis (maximum likelihood approach with oblique rotation), resulting in a simple two-factor solution. The first factor (*OHS competence/time/resources*) contained barriers concerning OHS' competence and resources (items iv; v; vi). The second factor (*employer/employee barriers)* consisted of barriers concerning employers and employees (items i; ii; iii; vii). Factor structure and internal consistency for the implementation barrier items are presented in Additional file 1.

Covariates

Respondents' perceptions of whether employees' alcohol consumption may be characterised as a public health challenge (*challenge perception*) were measured with a five-point Likert scale ranging from 1 (no, not at all) to 5 (yes, to a very large extent). Respondents' personal attitudes toward alcohol and work-related drinking (*drinking social norms*) were measured with the Drinking Norms Scale [60] (mean score of seven items; low score = restrictive attitudes, high score = liberal attitudes) . *Frequency of alcohol cases* (how often the OHS professional typically works with alcohol-related cases) was measured on a seven-point Likert scale (1 = never; 2 = less than yearly; 3 = yearly; 4 = less than monthly; 5 = monthly; 6 = weekly; 7 = daily). To what extent respondents believed OHS' should focus on alcohol prevention targeting employees (*attitudes towards increasing alcohol prevention activity*) was measured on a Likert scale (1 = considerably less than today; 2 = less than today; 3 = same as today; 4 = more than today; 5 = considerably more than today), with the addition of a neutral category of "unsure". Respondents also reported their *age* (years), *gender* (male; female), *OHS experience* (years) and *professional background* (occupational therapist; nutritionist; physical therapist; physician; psychologist; nurse; occupational hygienist; other).

Analysis

Descriptive statistics were utilised to analyse OHS professionals' perceptions of employee alcohol consumption as a public health challenge, how often they typically work with alcohol-related cases, perceived implementation barriers, and the OHS' alcohol prevention activity. One-way analysis of variance (ANOVA) was applied to explore whether frequency of working with alcohol-related issues differed according to professional background. Differences between alcohol prevention activity

on different prevention levels were tested by means of paired samples t-tests. Multivariate linear regression analyses were used to investigate whether and how OHS' alcohol prevention activity was associated with perceived implementation barriers. In order to allow meaningful comparisons between independent (predictor) variables, results from regression analyses were expressed in terms of standardised coefficients (β). Statistical procedures were utilised based on sample size and exploration of whether specific tests' assumptions were appropriately met (e.g., the normality of data were tested by inspection of histograms, standardised residual plots, normal and detrended normal q-q plots). All statistical analyses were performed with IBM SPSS version 24. Significant results were defined as $p < .05$.

Ethics

OHS' and respondents were informed about the study's aim, assured confidentiality and that participation was voluntary. Written informed consent was obtained from all respondents. The study was approved by the Norwegian Centre for Research Data (NSD; reference no. 58038). The study was carried out in accordance with relevant guidelines and regulations.

Results

Current practices of alcohol prevention

Eight out of ten (80.4%) OHS professionals agreed that employees' alcohol consumption constitute a public health challenge (17.3% disagreed; 2.4% were unsure). However, seven out of ten (69.5%) reported that they typically worked with alcohol-related cases less than monthly (21.7% on a monthly basis; 8.8% on a weekly basis). Those who, to some extent, did work with alcohol cases did not differ from those who never worked with alcohol cases with regard to perception of OHS alcohol prevention activity and perception of implementation barriers (see Additional file 2: Table S2, 1). The reported frequency of working with alcohol-related cases differed significantly according to professional background (F [2, 287] = 12.4, $p = <.001$, $\eta^2 = 0.2$). Alcohol-related issues were primarily handled by physicians ($M = 4.4$; $SD = 1.1$), psychologists ($M = 4.3$; $SD = 1.4$) and nurses ($M = 4.0$; $SD = 1.4$), with a mean case frequency corresponding to between "less than monthly" and "monthly". Occupational therapists ($M = 2.9$; $SD = 1.7$), physical therapists ($M = 2.7$; $SD = 1.5$), and occupational hygienists ($M = 1.9$; $SD = 1.1$) were to a smaller extent involved in alcohol prevention, with a mean case frequency corresponding to between "less than yearly" and "yearly".

Overall, alcohol prevention activity were quite limited within the OHS' (only one out of ten OHS professionals worked with alcohol-related cases on a weekly basis). In their prevention activities, OHS' were most focused on tertiary prevention ($M = 3.3$; $SD = 0.8$), followed by secondary prevention ($M = 2.9$; $SD = 0.7$) and primary prevention ($M = 2.8$; $SD = 0.8$). The difference between tertiary and primary activities was statistically significant, t (294) = 8.9, $p = <.001$. Similarly, the difference between tertiary and secondary activities was significant, t (294) = 10.0, $p = <.001$. The difference between primary and secondary activities was not significant, t (294) = – 1.4, $p = .17$. OHS' alcohol prevention activity, according to prevention level and differences between levels, are presented in Table 2.

Almost seven out of ten (67.1%) OHS professionals agreed that OHS' should focus more on alcohol prevention targeting employees (12.3% disagreed; 20.3% were unsure).

Implementation barriers and associations with prevention activity

When asked which barriers to alcohol prevention in the workplace were perceived as most salient, OHS professionals focused on alcohol being a personal/private matter ($M = 6.9$; $SD = 2.9$), and lack of employer interest in targeting their employees' alcohol consumption ($M = 6.1$; $SD = 2.7$). An implementation barrier importance ranking is presented in Fig. 2.

Results from analyses of associations between perceived implementation barriers and alcohol prevention activity are presented in Table 3.

Barriers concerning OHS competence, time and resources demonstrated statistical significant associations with alcohol prevention activity, both overall (β = – 0.22; $p = .001$) and across all prevention levels. All associations were negative, implying that higher levels of perceived barriers were associated with lower reported prevention activity. With regard to specific prevention levels, OHS competence and resources were most strongly associated with primary prevention activities (β = – 0.20; $p = .002$), followed by tertiary (β = – 0.17; $p = .008$) and secondary prevention activities (β = – 0.14; $p = .034$). Reported

Table 2 Alcohol prevention activity according to prevention level, and matrix of differences between prevention levels ($N = 295$)

	Primary activities ($M = 2.8$; $SD = 0.8$)	Secondary activities ($M = 2.9$; $SD = 0.7$)
Primary activities ($M = 2.8$; $SD = 0.8$)	–	$M_{diff} = 0.1^{ns}$ $p = .173$ t (294) = – 1.4
Secondary activities ($M = 2.9$; $SD = 0.7$)	$M_{diff} = 0.1^{ns}$ $p = .173$ t (294) = – 1.4	–
Tertiary activities ($M = 3.3$; $SD = 0.8$)	$M_{diff} = 0.5$* $p = <.001$ t (294) = 8.9	$M_{diff} = 0.5$* $p = <.001$ t (294) = 10.0

Results from paired samples t-tests; M mean, SD standard deviation, M_{diff} mean difference; * Statistically significant difference ($p < .05$); ^{ns} Statistically non-significant difference ($p > .05$)

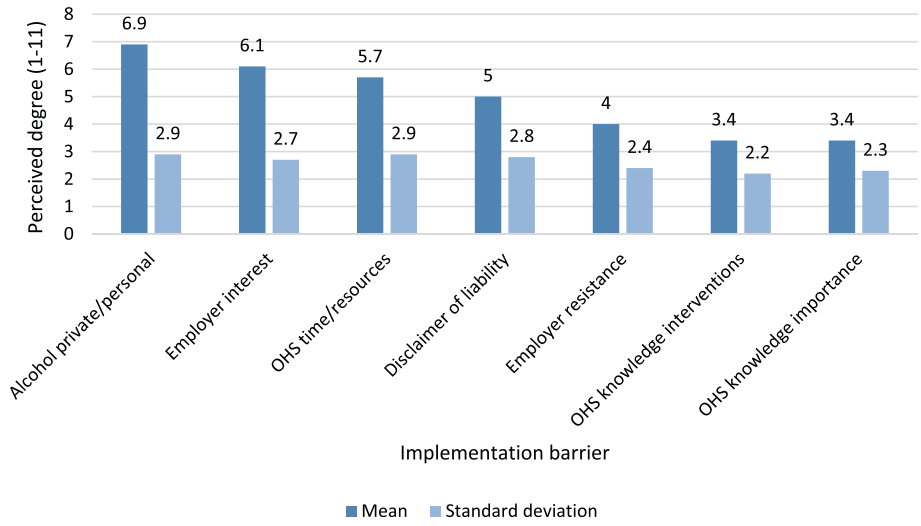


Fig. 2 Perceived barriers to implementing alcohol-preventive efforts in occupational health services ($N = 295$). Means and standard deviations. Visual analogue scales ranging from 1 (barrier to a very small extent) to 11 (barrier to a very large extent)

employer/employee barriers were not significantly associated with alcohol prevention activity.

Discussion

The primary aims of this study were to explore current practices of alcohol prevention targeting employees in occupational health settings, and examine whether and which perceived implementation barriers were associated with alcohol prevention activity. The majority of OHS professionals agreed that employees' alcohol consumption constitute a public health challenge (eight out of ten), and that OHS' should increase its prevention activity (seven out of ten). However, alcohol prevention activity was quite limited (seven out of ten worked with alcohol-related cases less than monthly, while only one out of ten did so on a weekly basis), and current activity was significantly more focused on tertiary prevention than on primary and secondary prevention. These findings are consistent with previous research that has emphasised that the OHS should be more actively involved in alcohol prevention [1, 5, 6, 22].

Table 3 Associations between perceived implementation barriers and alcohol prevention activity, overall and differentiated according to prevention level ($N = 295$)

Alcohol prevention activity				
Implementation barriers	All groups β (*p* value)	Primary β (*p* value)	Secondary β (*p* value)	Tertiary β (*p* value)
OHS competence, time, resources[a]	−0.22** (.001)	−0.20** (.002)	− 0.14* (.034)	−0.17** (.008)
Employer, employee[b]	−0.03[ns] (.624)	−0.04[ns] (.527)	− 0.03[ns] (.651)	−0.01[ns] (.945)

Results from multivariate hierarchical linear regression analyses; All models are adjusted for gender, age, professional background, OHS experience and drinking social norms; β = standardised coefficient; [a]Barriers internal to the OHS' organisation (items: "lack of knowledge on interventions", "lack of knowledge on importance", "lack of time/resources"); [b]Barriers external to the OHS' organisation (items: "lack of employer interest", "employer resistance", "alcohol is a private/personal matter", "disclaimer of liability"); *$p < .05$; **$p < .01$; [ns]Non-significant ($p \geq .05$)

Detrimental health and work performance outcomes related to alcohol consumption are well documented [10–13, 36–42], and reducing harmful use of alcohol has been defined as a keystone in sustainable development [12]. Promotion of employees' safety and health are emphasised in the aims of the OHS [1–3]. Hence, positive attitudes toward increased alcohol prevention in the OHS are not so surprising. Overall low prevention activity and favouring tertiary over primary and secondary prevention activities, may both be understood in terms of how the larger health care system is designed. The OHS do not operate in isolation from the health care system. Despite an increased awareness of benefits associated with preventive medicine and public health interventions, the health care system still tends to favour treatment (tertiary activities) over prevention (primary and secondary activities) [61]. According to Marvasti and Stafford [62], the health care system, designed in an era where handling infectious diseases was the major priority, is still today largerly characterised by an acute or reactive approach to health care. A system resting upon such a pathogenic paradigm [63] has been described as inexpedient in the current era where chronic and noncommunicable diseases (largely affected by lifestyle factors such as alcohol consumption) constitute the greatest threat to public health [62]. That OHS' in the present study were most focused on employees already experiencing adverse health consequences

(tertiary prevention) was also reflected in the finding that alcohol-related cases were primary handled by physicians, psychologists and nurses.

Descriptively, OHS professionals reported alcohol being a private/personal matter for employees as the most salient barrier against alcohol prevention activity, followed by lack of employer interest in targeting their employees' alcohol consumption. Hence, when asked to identify and rank implementation barriers on a purely descriptive basis, our sample emphasised barriers related to employees and employers. However, analyses of associations between implementation barriers and alcohol prevention activity did display a quite different picture. Barriers concerning employers and employees (e.g., alcohol as a private/personal matter for employees, and lack of employer interest) were not significantly associated with alcohol prevention activity. In contrast, barriers internal to the OHS' organisation (competence, time and resources) demonstrated significant associations with activity on all prevention levels, implying that lack of knowledge on the importance of working with alcohol and training in administering alcohol prevention programmes, as well as lack of time and resources, were associated with low alcohol prevention activity. This finding is in line with research studying barriers against implementation of alcohol prevention programmes in primary care settings [48–52], and implies that successful implementation strategies should involve not only an emphasis on individual OHS professionals, units, employees and employers. Facilitation of successful implementation of alcohol prevention programmes in the OHS may hinge on emphasising both inner (organisational level) and outer (system level) contextual factors [64, 65] in order to ensure adequate training, time and resources.

The present study does not contain data that can enlighten the observed discrepancy between the descriptive and analytical findings regarding implementation barrier perception. Overall, OHS professionals were in agreement on the importance on working with alcohol prevention. At the same time, they did express quite limited prevention activity. It is possible to conceive that an organisational-level self-serving bias may have played a role in explaining why the main barriers were attributed externally (to employees and employers) rather than to the OHS' themselves. Self-protective attributional strategies is considered normal cross-cultural social-psychological phenomena [66, 67], and have also been identified within organisations [68]. The identified discrepancy does underscore the importance of studying implementation barriers beyond merely asking respondents to rate which barriers they perceive to be most salient.

The secondary aim of this study was to examine whether implementation barriers were differentially associated with primary, secondary and tertiary prevention activities. Results showed that implementation barriers were similarly associated with alcohol prevention activity on all three levels (i.e., that internal OHS barriers were related to prevention activity while external barriers were not). Hence, we found no fundamental reason to assume that different barriers apply when working on different prevention levels. Adequate training, resources and time stand out as important priorities in order to increase the implementation of alcohol prevention programmes in the OHS, regardless of whether they target individuals within the frames of primary, secondary or tertiary prevention.

Methodological considerations

The present study has some limitations. Conducted within a cross-sectional design, exploration of causal relationships was not possible in this study. The aims were, however, related to investigating current practices and associations between variables. Thus, a cross-sectional design was deemed appropriate.

Results are based on data from 295 OHS professionals in 67 different OHS'. Of the 206 OHS' contacted, 113 did not respond to the invitation and 24 declined to participate. In order to explore possible selection bias more thoroughly we have, on an organisational level, compared data from the included OHS' with a representative sample of OHS' included in a Norwegian official evaluation from 2016 [57] (see Additional file 3: Table S3, 1). With the exception of an overrepresentation of physical therapists in our sample (17.3 versus 9.4%, $p < .05$), distributions of professional background were not significantly different. OHS' size (number of employees) and number of employers served by the OHS' were not significantly different, with the exception of a few more OHS' in our sample serving between 2 and 49 companies (28.8 versus 13.0%, $p < .05$). OHS' from all geographical counties in Norway, providing services for companies across work divisions, were represented in this study. On an individual level, 59.4% ($n = 357$) responded to the questionnaire, while 49.1% ($n = 295$) were included in the study as a result of responding on all relevant items. Of those 62 not responding on all relevant items, 57 did respond to the sociodemographic items. With the exception of these 57 non-responders having somewhat shorter OHS experience than the study sample (median 7.0 versus 10.0 years, $p < .05$), the non-responders did not differ significantly with regard to age, gender or professional background (see Additional file 3: Table S3, 2). The gender distribution was quite skewed in this study (males: 20.0%; females 80:0%) but does correspond with the actual gender distribution among employees in health and social services in Norway (males: 19.0%; females: 81%) [69]. Moreover,

male and female OHS professionals in our sample did not differ with regard to perception of OHS alcohol prevention activity and implementation barriers (see Additional file 2: Table S2, 2). Although we do not have reasons to believe that our sample was substantially non-representative, selection bias may constitute a possible limitation for this study. Hence, generalisations should be made with some caution.

The sample size was deemed satisfactory for analysing associations between variables as a result of well exceeding a recommended ratio of 15 participants per predictor variable [70], as well as exceeding the required size according to the formula $N > 50 + (8 \times number\ of\ predictors)$ [71].

In order to avoid losing statistical power, some OHS professionals who reported not to work with alcohol-related cases ($n = 42$) were included in the analyses, which may be perceived as a potential limitation. However, a series of additional tests did reveal that those professionals who did work with alcohol cases did not differ significantly from those who never worked with alcohol cases with regard to perception of OHS alcohol-preventive efforts and perception of implementation barriers (see Additional file 2: Table S2, 1).

Alcohol prevention activity and implementation barriers were measured by means of items developed particularly for the present study, which may be a limitation insofar that the instruments have yet to be validated. However, responses on all items were provided in the format of well-established response scales (Likert scales and Visual Analogue Scales). Moreover, the implementation barrier items were based on previous research as well as results from three qualitative focus group interviews with OHS professionals.

Implications

The present study implies that current practices of primary and secondary alcohol prevention activities in the OHS are quite limited. This seems particularly true for primary prevention activities. Our identification of significant associations between implementation barriers and alcohol prevention activity across all prevention levels, and the fact that barriers were most strongly associated with primary prevention activities, imply that (i) an increase in overall alcohol prevention activity, and (ii) a shift from mainly focusing on tertiary activities to an increased emphasis on general health promotion and early intervention (primary and secondary activities), may both be dependent on adequate training of OHS professionals as well as allocation of time and resources. Our findings suggest that strategies aimed at enabling implementation of alcohol prevention programmes in the OHS should place an emphasis on targeting barriers relating to the OHS organisation itself, and should take both organisational-level and system-level factors into consideration.

Conclusions

Alcohol consumption is associated with detrimental health and work performance outcomes, and occupational health settings may be particularly serviceable for alcohol prevention programmes targeting employees. However, this study found that the OHS infrequently engage in primary and secondary alcohol prevention activities. Factors internal to the OHS emerged as barriers against primary, secondary and tertiarty prevention activity . By ensuring adequate training, time and resources in the OHS, one may release an abeyant asset for preventing alcohol problems among employees, and thus contribute to remedy a major public health issue.

The relationship between implementation barriers and alcohol prevention activity in the OHS should be studied more thoroughly, preferably by means of longitudinal designs that enable exploration of causal mechanisms, and with studies investigating implementation processes in OHS related to specific alcohol prevention programmes (such as face-to-face interventions versus digital/web-based interventions). Moreover, future research would also benefit from exploring facilitating factors as well as implementation barriers.

Additional files

Additional file 1: Factor structure and internal consistency for the implementation barrier items. (XML 7 kb) (PDF 287 kb)

Additional file 2: Mann-Whitney U tests for possible differences between professionals who worked with alcohol cases and those who did not, and between male and female OHS professionals. (PDF 22 kb)

Additional file 3: Study selection analyses. (PDF 304 kb)

Abbreviations

ANOVA: Analysis of variance; b: unstandardised regression coefficient; HSE: systematic health, safety and environmental work; *M*: mean; *N*: sample size; NSD: Norwegian centre for research data; OHS: Occupational health services; *p*: probability value; *SD*: Standard deviation; WHO: World Health Organization; WIRUS: Workplace Interventions preventing Risky Use of alcohol and Sick leave; β: standardised regression coefficient

Acknowledgements

Not applicable.

Authors' contributions

RWA is the principal investigator and project manager of the WIRUS project. The WIRUS OHS study was designed by MMT and RWA, including questionnaire development. MMT recruited OHS', analysed the data, and drafted the manuscript. JCS, IK, IJ and RWA provided scientific input to the different drafts and provided data interpretation. All authors made critical revisions and provided intellectual content to the manuscript, approved the final version to be published, and agreed to be accountable for all aspects of this work.

Funding
This study is funded by the Norwegian Directorate of Health and the Research Council of Norway. The funding bodies had no role in the design of the study, nor in data collection, analysis or data interpretation.

Availability of data and materials
Data from the WIRUS OHS study are available from the project owner (University of Stavanger, Faculty of Health Sciences, Department of Public Health, Research group Societal Participation in School and Work) by principal investigator and project manager Randi Wågø Aas on reasonable request.

Ethics approval and consent to participate
The study was approved by the Norwegian centre for research data (NSD; reference no. 58038). Written informed consent was obtained from all participants.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Author details
[1]Department of Occupational Therapy, Prosthetics and Orthotics, Faculty of Health Sciences, OsloMet – Oslo Metropolitan University, PO box 4 St. Olavs plass, NO-0130 Oslo, Norway. [2]Presenter – Making Sense of Science, PO box 8118, NO-4068 Stavanger, Norway. [3]Department of Health Promotion, Norwegian Institute of Public Health, PO box 973, NO-5808 Bergen, Norway. [4]Center for Alcohol & Drug Research, Stavanger University Hospital, PO box 8100, NO-4068 Stavanger, Norway. [5]Department of Public Health, Faculty of Health Sciences, University of Stavanger, PO box 8600, Forus, NO-4036 Stavanger, Norway. [6]National Advisory Unit on Rehabilitation in Rheumatology, Diakonhjemmet Hospital, PO box 23, Vindern, NO-0319 Oslo, Norway. [7]Institute of Environmental Medicine, Division of Intervention and Implementation Research for Worker Health, Karolinska Institutet, SE-171 77 Stockholm, Sweden.

Received: 22 February 2019 Accepted: 18 June 2019
Published online: 26 June 2019

References

1. Holmqvist M, Hermansson U, Nilsen P. Towards increased alcohol intervention activity in Swedish occupational health services. Int J Occup Med Env. 2008;21:179–87.
2. Rantanen J, Lehtinen S, Valenti A, Iavicoli S. A global survey on occupational health services in selected international commission on occupational health (ICOH) member countries. BMC Public Health. 2017. https://doi.org/10.1186/s12889-017-4800-z.
3. Lie A, Bjørnstad O. Accreditation of occupational health services in Norway. Occup Med-C. 2015;65:722–4.
4. Ames GM, Grube JW, Moore RS. Social control and workplace drinking norms: a comparison of two organizational cultures. J Stud Alcohol. 2000;61:203–19.
5. Kuokkanen M, Heljälä L. Early identification and brief intervention for risky drinkers in Finnish occupational health services. Scand J Work Env Hea. 2005;1:35–7.
6. Richmond R, Wodak A, Bourne S, Heather N. Screening for unhealthy lifestyle factors in the workplace. Aust Nz J Publ Heal. 1998;22:324–31.
7. Hermansson U, Helander A, Huss A. Brandt L, Rönnberg S. The alcohol use disorders identification test (AUDIT) and carbohydrate-deficient transferrin (CDT) in a routine workplace health examination. Alcohol Clin Exp Res 2000; 24:180–187.
8. Hermansson U, Knutsson A, Rönnberg S, Brandt L. Feasibility of brief intervention in the workplace for the detection and treatment of excessive alcohol consumption. Int J Occup Env Heal. 1998;4:71–8.
9. Kääriäinen J, Sillanaukee P, Poutanen P, Seppä K. Opinions on alcohol-related issues among professionals in primary, occupational, and specialized health care. Alcohol Alcoholism. 2001;36:141–6.
10. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the global burden of disease study 2010. Lancet. 2012;380:2224–60.
11. Wood AM, Kaptoge S, Butterworth AS, et al. Risk thresholds for alcohol consumption: combined analysis of individual-participant data for 599 912 current drinkers in 83 prospective studies. Lancet. 2018;391:1513–23.
12. World Health Organization. Global status report on alcohol and health, 2018. Geneva: World Health Organization; 2018.
13. Griswold MG, Fullman N, Hawley C, et al. Alcohol use and burden for 195 countries and territories, 1990-2016: a systematic analysis for the global burden of disease study 2016. Lancet. 2018;392:1015–35.
14. Roerecke M, Rehm J. Alcohol consumption, drinking patterns, and ischemic heart disease: a narrative review of meta-analyses and a systematic review and meta-analysis of the impact of heavy drinking occasions on risk for moderate drinkers. BMC Med. 2014. https://doi.org/10.1186/s12916-014-0182-6.
15. Knott C, Bell S, Britton A. Alcohol consumption and the risk of type 2 diabetes: a systematic review and dose-response meta-analysis of more than 1.9 million individuals from 38 observational studies. Diabetes Care. 2015;38:1804–12.
16. Bellos S, Skapinakis P, Rai D, et al. Cross-cultural patterns of the association between varying levels of alcohol consumption and the common mental disorders of depression and anxiety: secondary analysis of the WHO collaborative study of psychological problems in general health care. Drug Alcohol Depen. 2013;133:825–31.
17. Milic J, Glisic M, Voortman T, et al. Menopause, ageing, and alcohol use disorders in women. Maturitas. 2018;111:100–9.
18. Grønbæk M. The positive and negative health effects of alcohol- and the public health implications. J Intern Med. 2009;265:407–20.
19. Skog OJ. Public health consequences of the J-curve hypothesis of alcohol problems. Addiction. 1996;91:325–37.
20. Rehm J, Gmel GE, Gmel G, et al. The relationship between different dimensions of alcohol use and the burden of disease - an update. Addiction. 2017;112:968–1001.
21. Frone MR. Alcohol and illicit drug use in the workforce and workplace. Washington, DC: American Psychological Association; 2013.
22. Ames GM, Grube JW, Moore RS. The relationship of drinking and hangovers to workplace problems: an empirical study. J Stud Alcohol. 1997;58:37–47.
23. Mangione TW, Howland J, Amick B, et al. Employee drinking practices and work performance. J Stud Alcohol. 1999;60:261–70.
24. Nordaune K, Skarpaas LS, Sagvaag H, et al. Who initiates and organises situations for work-related alcohol use? The WIRUS culture study. Scand J Public Healt. 2017;45:749–56.
25. Nesvåg S, Lie T. Rusmiddelbruk blant ansatte i norsk privat arbeidsliv [Drug use among employees in Norwegian private sector]. Nordisk Alkohol- og Narkotikatidsskrift. 2004;21:91–109.
26. Howland J, Mangione T, Kuhlthau K, et al. Work-site variation in managerial drinking. Addiction. 1996;91:1007–17.
27. Kawakami N, Harantani T, Hemmi T, Araki S. Prevalence and demographic correlates of alcohol-related problems in Japanese employees. Soc Psych Psych Epid. 1992;27:198–202.
28. Marchand A, Parent-Lamarche A, Blanc ME. Work and high-risk alcohol consumption in the Canadian workforce. Int J Env Res Pub He. 2011;8: 2696–705.
29. Thørrisen MM, Skogen JC, Aas RW. The associations between employees' risky drinking and sociodemographics, and implications for intervention needs. BMC Public Health. 2018. https://doi.org/10.1186/s12889-018-5660-x.
30. Webb GR, Redman S, Hennrikus D, Rostas JAP, Sanson-Fisher RW. The prevalence and sociodemographic correlates of high-risk and problem drinking at an industrial worksite. Brit J Addict. 1990;85:495–507.
31. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. AUDIT: the alcohol use disorders identification test. Guidelines for use in primary health care. Geneva: World Health Organization; 2001.
32. Coohey C, Marsh JC. Promotion, prevention, and treatment: what are the differences? Res Social Work Prac. 1995;5:524–38.
33. Babor TF, Higgins-Biddle JC. Brief intervention for hazardous and harmful drinking: a manual for use in primary care. Geneva: World Health Organization; 2001.
34. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. Addiction. 1993;88:791–804.

35. de Meneses-Gaya C, Zuardi AW, Loureiro SR, Crippa JAS. Alcohol use disorders identification test (AUDIT): an updated systematic review of psychometric properties. Psychol Neurosci. 2009;2:83–97.
36. Schou L, Moan IS. Alcohol use-sickness absence association and the moderating role of gender and socioeconomic status: a literature review. Drug Alcohol Rev. 2016;35:158–69.
37. Lidwall U, Marklund S. Trends in long-term sickness absence in Sweden 1992-2008: the role of economic conditions, legislation, demography, work environment and alcohol consumption. Int J Soc Welf. 2011;20:167–79.
38. Andreasson S, Holder HD, Norström T, Österberg E, Rossow I. Estimates of harm associated with changes in Swedish alcohol policy: results from past and present estimates. Addiction. 2006;101:1096–105.
39. Kirkham HS, Clark BL, Bolas CA, et al. Which modifiable health risks are associated with changes in productivity costs? Popul Health Manag. 2015; 18:30–8.
40. Pensola T, Haukka E, Kaila-Kangas L, Neupane S, Leino-Arjas P. Good work ability despite multisite musculoskeletal pain? A study among occupationally active Finns. Scand J Public Health. 2016;44:300–10.
41. Tsuchiya M, Kawakami N, Ono Y. Impact of mental disorders on work performance in a community sample of workers in Japan: the world mental health Japan survey 2002-2005. Psychiatry Res. 2012;198:140–5.
42. Aas RW, Haveraaen L, Sagvaag H, Thørrisen MM. The influence of alcohol consumption on sickness presenteeism and impaired daily activities. The WIRUS screening study. PLoS ONE. 2017. https://doi.org/10.1371/journal.pone.0186503.
43. Buvik K, Moan IS, Halkjelsvik T. Alcohol-related absence and presenteeism: beyond productivity loss. Int J Drug Policy. 2018;58:71–7.
44. Kaner EF, Beyer FR, Muirhead C, et al. Effectiveness of brief alcohol interventions in primary care populations. Cochrane Database Syst Rev. 2018. https://doi.org/10.1002/14651858.CD004148.pub4.
45. O'Donnell P, Anderson P, Newbury-Birch D, et al. The impact of brief alcohol interventions in primary healthcare: a systematic review of reviews. Alcohol Alcoholism. 2014;49:66–78.
46. Riper H, van Straten A, Keuken M, Smit F, Schippers G, Cuijpers P. Curbing problem drinking with personalized-feedback interventions. Am J Prev Med. 2009;36:247–55.
47. Schulte B, O'Donnell AJ, Kastner S, Schmidt CS, Schäfer I, Reimer J. Alcohol screening and brief intervention in workplace settings and social services: a comparison of literature. Frontiers in Psychiatry. 2014. https://doi.org/10.3389/fpsyt.2014.00131.
48. Barry KL, Blow FC, Willenbring M, McCormick R, Brockmann LM, Visnic S. Use of alcohol screening and brief interventions in primary care settings: implementation and barriers. Subst Abus. 2004;25:27–36.
49. Kaner EF, Lock CA, McAvoy BR, Heather N, Gilvarry E. A RCT of three training and support strategies to encourage implementation of screening and brief alcohol intervention by general practitioners. Brit J Gen Pract. 1999;49:699–703.
50. Johnson M, Jackson R, Guillaume L, Meier P, Goyder E. Barriers and facilitators to implementing screening and brief intervention for alcohol misuse: a systematic review of qualitative evidence. J Public Health. 2011;33:412–21.
51. Broyles LM, Rodriguez KL, Sevick MA, Price PA, Gordon AJ. A qualitative study of anticipated barriers and facilitators to the implementation of nurse-delivered alcohol screening, brief intervention, and referral to treatment for hospitalized patients in a veterans affairs medical center. Addict Sci Clin Pract. 2012. https://doi.org/10.1186/1940-0640-7-7.
52. Babor TF, Higgins-Biddle J, Dauser D, Higgins P, Burleson JA. Alcohol screening and brief intervention in primary care settings: implementation models and predictors. J Stud Alcohol. 2005;66:361–8.
53. Hulshof CT, Verbeek JH, van Dijk FJ, van der Weide WE, Braam IT. Evaluation research in occupational health services: general principles and a systematic review of empirical studies. Occup Environ Med. 1999;56:361–77.
54. Nilsson PM, Klasson EB, Nyberg P. Life-style intervention at worksite – reduction of cardiovascular risk factors in a randomized study. Scand J Work Env Hea. 2001;27:57–62.
55. Verbeek J, Husman K, van Dijk F, Jauhiainen M, Pasternack I, Vainio H. Building an evidence base for occupational health interventions. Scand J Work Env Hea. 2004;30:164–8.
56. Working environment act. Act relating to working environment, working hours and employment protection, etc. Oslo: Norwegian ministry of labour and social affairs; 2005.
57. Mandal R, Dyrstad K, Melby L, Midtgård T. Evaluering av bedriftshelsetjenesten i Norge [Evaluation of the occupational health services in Norway]. Oslo: Sintef; 2016.
58. Akan kompetansesenter. English information about Akan [cited 2019 May 28]. Available from: https://akan.no/english-information-about-akan/.
59. Eurostat. NACE rev. 2. Statistical classification of economic activities in the European community. Luxembourg: Eurostat; 2008.
60. Barrientos-Gutierrez T, Gimeno D, Mangione TW, Harrist RB, Amick BC. Drinking social norms and drinking behaviours: a multilevel analysis of 137 workgroups in 16 worksites. Occup Environ Med. 2007;64:602–8.
61. Rheinberger CM, Herrera-Araujo D, Hammitt JK. The value of disease prevention vs treatment. J Health Econ. 2016;50:247–55.
62. Marvasti FF, Stafford RS. From sick care to health care - reengineering prevention into the U.S. system. New Engl J Med. 2012;367:889–91.
63. Fries CJ. Healing health care: from sick care towards salutogenic healing systems. Soc Theor Health. 2019. https://doi.org/10.1057/s41285-019-00103-2.
64. Harvey G, Kitson A. PARIHS revisited: from heuristic to integrated framework for the successful implementation of knowledge into practice. Implement Sci. 2016. https://doi.org/10.1186/s13012-016-0398-2.
65. Harvey G, Kitson A. PARIHS re-visited: introducing i-PARIHS. In: Harvey G, Kitson A, editors. Implementing evidence-based practice in health care: a facilitation guide. Oxon: Routledge; 2015. p. 25–46.
66. Fletcher GJO, Ward C. Attribution theory and processes: a cross-cultural perspective. In: Bond MH, editor. The cross-cultural challenge to social psychology. Newbury Park: Sage; 1988. p. 230–44.
67. Hogg MA, Vaughan GM. Social psychology. 6 ed. Harlow: Pearson Education Limited; 2011.
68. Gioia DA, Sims HP. Self-serving bias and actor-observer differences in organizations: an empirical analysis. J Appl Soc Pscyhol. 1985;15:547–63.
69. Statistics Norway. Sysselsatte per 4. kvartal, etter region, næring, kjønn, alder og år [Employees per 4th quarter, by region, industry, gender, age and year]. Oslo, Norway: Statistics Norway; [cited 2019 Feb 15]. Available from: https://www.ssb.no/statbank/table/07984/
70. Stevens J. Applied multivariate statistics for the social sciences. 3rd ed ed. Mahwah: Lawrence Erlbaum; 1996.
71. Tabachnick BG, Fidell LS. Using multivariate statistics. 6th ed. ed. Pearson Education: Boston; 2013.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

Additional file 1: Factor structure and internal consistency for the implementation barrier items

Table A1

Factor structure and internal consistency for the implementation barrier items

	Pattern matrix		Structure matrix		
Item	F_1	F_2	F_1	F_2	Communality
(v) knowledge interventions	**1.03**	-0.08	**0.99**	0.38	0.99
(iv) knowledge importance	**0.90**	-0.04	**0.89**	0.37	0.79
(vi) time/resources	**0.48**	0.07	**0.51**	0.28	0.27
(ii) employer interest	-0.11	**0.98**	0.33	**0.93**	0.88
(iii) employer resistance	0.16	**0.54**	0.40	**0.61**	0.39
(i) alcohol private/personal	-0.04	**0.51**	0.19	**0.50**	0.25
(vii) disclaimer of liability	0.22	**0.25**	0.33	**0.35**	0.16
		F_1	F_2		Both
Eigenvalue λ (% explained variance)		3.05 (43.50)	1.31 (18.71)		(62.22)
Cronbach's α		0.80	0.68		0.77
Mean inter-item correlation		0.60	0.35		0.33

Factor structure generated with exploratory maximum likelihood extraction with oblique rotation; Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) = 0.69; Bartlett's test of sphericity p <.001

Additional file 2: Mann-Whitney U tests for possible differences between professionals who worked with alcohol cases and those who did not, and between male and female OHS professionals

Table A2,1

Mann-Whitney U tests for possible differences between professionals who worked with alcohol cases and those who did not

Variable	Group*	Mean rank	U (z)	*p*
Alcohol-preventive efforts (all groups)	Alcohol cases	150.55	4668.50	.20^{ns}
	No alcohol cases	132.65	(-1.29)	
Alcohol-preventive efforts (low-risk drinkers)	Alcohol cases	151.43	4444.50	.07^{ns}
	No alcohol cases	127.43	(-1.84)	
Alcohol-preventive efforts (at-risk drinkers)	Alcohol cases	149.38	4963.50	.43^{ns}
	No alcohol cases	139.68	(-0.80)	
Alcohol-preventive efforts (probl./heavy drinkers)	Alcohol cases	148.64	5151.50	.73^{ns}
	No alcohol cases	144.15	(-0.35)	
Impl. barriers (OHS competence/resources)	Alcohol cases	149.83	4849.00	.36^{ns}
	No alcohol cases	136.95	(-0.91)	
Impl. barriers (employer/employees)	Alcohol cases	149.38	4964.00	.50^{ns}
	No alcohol cases	139.69	(-0.68)	

* Alcohol cases: n = 253, No alcohol cases: n = 42; ns = non-significant

Table A2,2

Mann-Whitney U tests for possible differences between male and female OHS professionals

Variable	Group*	Mean rank	U (z)	*p*
Prevention activity (all groups)	Males	147.38	6925.500	.95^{ns}
	Females	148.15	(-0.06)	
Prevention activity (low-risk drinkers)	Males	135.84	6244.50	.18^{ns}
	Females	151.04	(-1.33)	
Prevention activity (at-risk drinkers)	Males	149.84	6853.50	.83^{ns}
	Females	147.54	(-0.22)	
Prevention activity (probl./heavy drinkers)	Males	153.13	6659.50	.57^{ns}
	Females	146.72	(-0.57)	
Impl. barriers (OHS competence/resources)	Males	136.30	6271.50	.24^{ns}
	Females	150.93	(-1.18)	
Impl. barriers (employer/employees)	Males	135.76	6240.00	.22^{ns}
	Females	151.06	(-1.23)	

* Males: n = 59; Females: n = 236; ns = non-significant

Additional file 3: Study selection analyses

Table A3,1

Characteristics of sample and occupational health services included in the study, compared with distributions reported in an official evualtion in Norway (Mandal et al., 2016[a])

OHS professionals' background	Study sample (N=295), % (n)	Mandal et al. (2016) (N=766), % (n)	Difference (*p* value)
Nurse	38.6 (114)	42.0 (322)	.314 ns[b]
Physical therapist	17.3 (51)	9.4 (72)	<.001*[b]
Physician	13.9 (41)	11.1 (85)	.206 ns[b]
Occupational hygienist	7.8 (23)	7.7 (59)	.959 ns[b]
Occupational therapist	2.7 (8)	3.8 (29)	.393 ns[b]
Psychologist	2.0 (6)	2.1 (16)	.955 ns[b]
Nutritionist	0.3 (1)	1.0 (8)	.458 ns[c]
Number of employees in OHS	Study sample OHS (N=56), % (n)	Mandal et al. (2016) OHS (N=163), % (n)	Difference (*p* value)
0-4	12.5 (7)	12.9 (21)	.941 ns[b]
5-9	50.0 (28)	46.0 (75)	.606 ns[b]
10-19	23.2 (13)	31.3 (51)	.252 ns[b]
20-49	12.5 (7)	6.1 (10)	.148 ns[c]
50-99	1.8 (1)	2.5 (4)	1.000 ns[c]
Number of employers served by OHS	Study sample OHS (N=59), % (n)	Mandal et al. (2016) OHS (N=169), % (n)	Difference (*p* value)
1	25.4 (15)	23.1 (39)	.715 ns[b]
2-49	28.8 (17)	13.0 (22)	.006*[b]
50-99	11.9 (7)	8.3 (14)	.413 ns[b]
100-199	10.2 (6)	20.7 (35)	.070 ns[b]
200-299	8.5 (5)	13.0 (22)	.352 ns[b]
300-399	3.4 (2)	8.9 (15)	.250 ns[c]
400-499	5.1 (3)	5.3 (9)	1.000 ns[c]
≥500	6.8 (4)	7.7 (13)	1.000 ns[c]

ns=non-significant; *significant (*p* <.05); [a]Mandal R, Dyrstad K, Melby L, Midtgård T. Evaluering av bedriftshelsetjenesten i Norge [Evaluation of the occupational health services in Norway]. Oslo, Norway: Sintef; 2016; [b]Difference tested with chi square test of independence; [c]Difference tested with Fisher's exact test

Table A3,2

Characteristics of study sample (N=295), compared to non-responders (N=57) in the survey

	Study sample	Non-responders[a]	Difference (*p* value)
Age (years)			.079 ns[b]
Median	49.0	47.0	
Range	25.0-75-0	28.0-65.0	
OHS experience (years)			.018*[b]
Median	10.0	7.0	
Range	0.0-39.0	0.0-30.0	
Gender			.856 ns[c]
Male, % (n)	20.0 (59)	21.1 (12)	
Female, % (n)	80.0 (236)	78.9 (45)	
Professional background			.074 ns[c]
Occupational therapist, % (n)	2.7 (8)	5.4 (3)	
Nutritionist, % (n)	0.3 (1)	0.0 (0)	
Physical therapist, % (n)	17.3 (51)	16.1 (9)	
Physician, % (n)	13.9 (41)	7.1 (4)	
Psychologist, % (n)	2.0 (6)	3.6 (2)	
Social worker, % (n)	0.0 (0)	3.6 (2)	
Nurse, % (n)	38.6 (114)	35.7 (20)	
Occupational hygienist, % (n)	7.8 (23)	8.9 (5)	
Other[d], % (n)	17.3 (51)	19.6 (11)	

ns=non-significant; *significant (p <.05); [a]OHS professionals who only responded to the sociodemographic items in the survey; [b]Difference tested with Mann-Whitney U test; [c]Difference tested with chi square test of independence; [d]E.g., medical secretaries, engineers, educationalists/teachers, economists and social scientists