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]

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

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

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,

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.

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
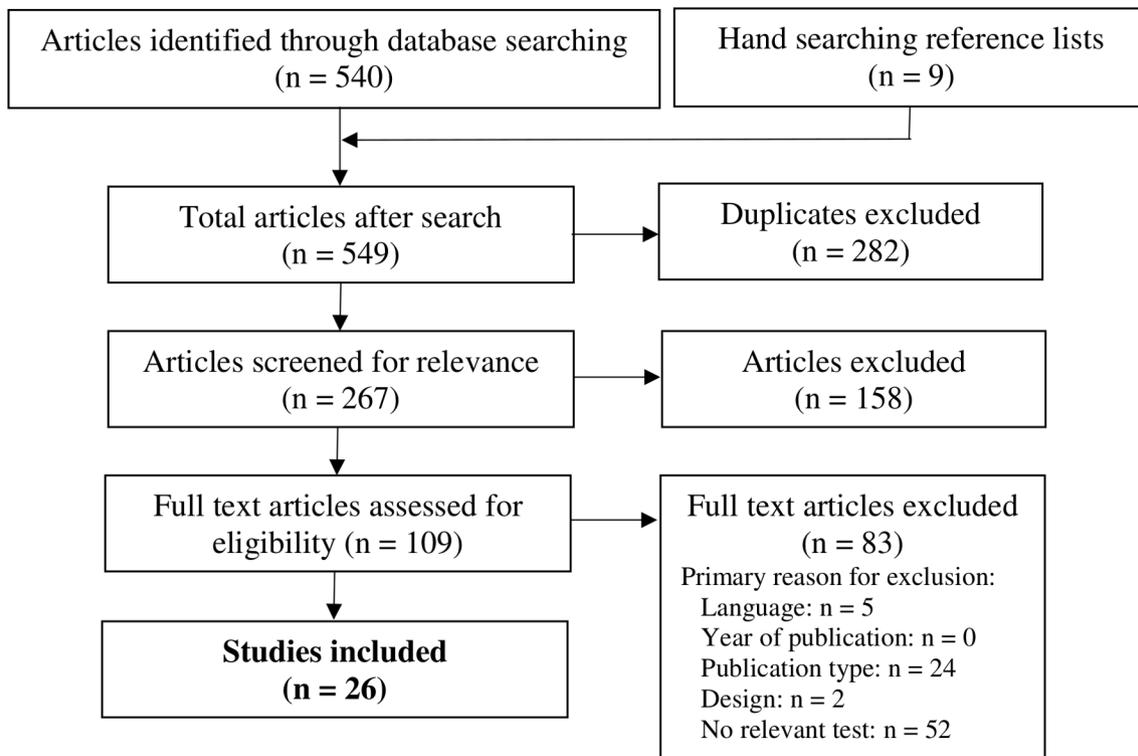

Figure 1 PRISMA flow chart of the study selection process. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

(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

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)).
Airila 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)).

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.

Table 2 Identified associations (n=132) according to direction/significance and assessed quality level

Quality level	Direction and significance of associations				
	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

Significance	Direction		Quality	Direction	
	Positive % (n)	Negative % (n)		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	

Quality	Publication year		Quality	Significance	
	≥Year 2000 % (n)	<Year 2000 % (n)		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.

Table 4 Identified associations (n=132) according to measurements of alcohol consumption and work performance

Alcohol measure	Work performance 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↓*], [12↑*], [14↑*], [15↓ns], [58↑*] and [59↑*]		[108↓ns], [109↑*], [124↑*] and **[126↑ns]**	[49↑*], [113↓*] and [114↓ns]	[13↑ns] and [16↑ns]	
Quantity	[10↑*], [28↑*], [29↑ns], [30↓ns], [31↓ns], [32↓ns], [33↓], [34↑*], [35↑ns], [39↑*], [50↑ns], **[85↓ns]**, [128↑ns], [129↑ns], [130↑ns], [131↑ns] and [132↑*]	[6↑ns], [7↑ns], [8↑ns], [9↑ns], **[86↓ns]**, **[87↑ns]**, **[88↓ns]** and **[89↓ns]**		[53↑*]	[24↓*], [25↑ns]	
Volume	[62↑*], [63↑ns], [68↓*], [69↑*], [73↑ns], [74↑ns], [75↑ns], [76↑ns], [77↑*], [78↑*], [79↑*], [80↑ns], [81↑*], [82↑*], [83↑*] and [84↑*]		[17↑*], [18↑ns], [19↑*], [20↑ns], [21↑ns], [22↓ns], [23↑*] and [111↓ns]	[116↓*]		
Heavy episodic/binge drinking	[5↑*]	[1↑*], [2↑*], [3↑*] and [4↑*]	[112↓*], [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↑ns], [65↑ns], [92↓ns], [93↓ns], [94↓*], [122↑ns] and [123↑ns]		[70↑ns], **[72↑*]**, [95↑*], [96↑*], [97↑*], [98↑*], [99↓ns], [100↑ns], [101↑*], [102↑ns], [103↑ns], [104↑ns], [105↑*], [106↑*] and [107↑ns]			**[71↑ns]**
Diagnosis	[51↑*], [52↑*], [56↑*], [57↑ns], [60↑*] and [61↑*]		[26↑*], [27↑*], [90↓ns] and [91↑ns]			

Number in brackets=associationID; 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.

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

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

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

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.

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.