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Gender differences in socioeconomic inequality of alcohol-attributable mortality: A systematic review and meta-analysis

CHARLOTTE PROBST[1], MICHAEL ROERECKE[2], SILKE BEHRENDT[1] & JÜRGEN REHM[1,2,3,4,5]

[1]*Institute of Clinical Psychology and Psychotherapy, Technische Universität Dresden, Dresden, Germany,* [2]*Social and Epidemiological Research Department, Centre for Addiction and Mental Health, Toronto, Canada,* [3]*Dalla Lana School of Public Health, University of Toronto, Toronto, Canada,* [4]*Institute of Medical Science, University of Toronto, Toronto, Canada, and* [5]*Department of Psychiatry, University of Toronto, Toronto, Canada*

Abstract

Introduction and Aims. *The present analysis contributes to understanding the societal distribution of alcohol-attributable harm by investigating socioeconomic inequality and related gender differences in alcohol-attributable mortality.* ***Design and Methods.*** *A systematic literature search was performed on Web of Science, MEDLINE, PsycINFO and ETOH from their inception until February 2013. Articles were included when they reported data on alcohol-attributable mortality by socioeconomic status (SES), operationalised as education, occupation, employment status or income. Gender-specific relative risks (RR) comparing low with high SES were pooled using random effects meta-analyses. Gender differences were additionally investigated in random effects meta-regressions.* ***Results.*** *Nineteen articles from 14 countries were included. For women, significant RRs across all measures of SES, except employment status, were found, ranging between 1.75 [95% confidence interval (CI) 1.21–2.54; occupation] and 4.78 (95% CI 2.57–8.87; income). For men, all measures of SES showed significant RRs ranging between 2.88 (95% CI 2.45–3.40; income) and 12.25 (95% CI 11.45–13.10; employment status). While RRs for men were in general slightly higher, only for occupation this gender difference was above chance (*$P = 0.01$*). Results refer to deaths 100% attributable to alcohol.* ***Discussion and Conclusions.*** *The results are predominantly based on data from high-income countries, limiting generalisability. Alcohol-attributable mortality is strongly distributed to the disadvantage of persons with a low SES. Marked gender differences in this inequality were found for occupation. Possibly male-dominated occupations of low SES were more strongly related to risky drinking cultures compared with female-dominated occupations of the same SES.* [Probst C, Roerecke M, Behrendt S, Rehm J. Gender differences in socioeconomic inequality of alcohol-attributable mortality: A systematic review and meta-analysis. *Drug Alcohol Rev* 2015;34:267–77]

Key words: socioeconomic status, gender, alcohol-related disorder, mortality, risk.

Introduction

Alcohol use has recently been shown to be the fifth largest risk factor for global burden of disease [1], associated with more than 200 ICD-10 (International Classification of Diseases, 10th revision) disease and injury categories [2]. Because alcohol-attributable burden is in principle avoidable, the high medical, social and economic burden [3] constitutes a large potential for prevention. Understanding the underlying societal structure could help in explicitly targeting those suffering the greatest harm.

As we have recently shown, socioeconomic inequality in alcohol-attributable mortality is higher than in all-cause mortality [4]. It remains unknown if such inequalities are greater in women or in men. Even though women are more vulnerable to the detrimental effects of alcohol given the same exposure level based

Charlotte Probst MS Psychology, PhD Candidate, Michael Roerecke PhD, Research Fellow, Silke Behrendt PhD, Research Fellow, Jürgen Rehm PhD, Professor, Director. Correspondence to Ms Charlotte Probst, Institute of Clinical Psychology and Psychotherapy, Technische Universität Dresden, Chemnitzer Str. 46, 01187 Dresden, Germany. Tel: ++49 351 463 38720; Fax: ++49 351 463 39830; E-mail: charlotte.probst@tu-dresden.de

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on biological reasons [5,6], due to higher levels of consumption, men are subject to more alcohol-attributable harm [7–9]. Even so, gender-specific consumption patterns per se cannot explain gender differences in the socioeconomic gradient of alcohol-attributable mortality. Only if gender-specific drinking patterns were differently distributed over socioeconomic groups, such gender differences could be explained. A systematic review on gender differences in the socioeconomic gradient of alcohol-attributable mortality is lacking: some surveys indicated steeper socioeconomic gradients of alcohol-attributable mortality in men than in women [10,11], others found the opposite effect [12,13], yet others did not find any statistically significant difference [14].

One factor potentially influencing gender differences in the socioeconomic gradient is the measure of socioeconomic status (SES) applied [15,16]. In mortality research, SES is traditionally operationalised through education, occupation or income [17]. These operationalisations have different properties [15]: education is considered to be a stable measure of SES that hardly changes after the age of 25 [18]. Income and occupation are more strongly influenced by the course of life. Thus, cause and consequence are less separable, that is, socioeconomic differences in mortality could be explained by both, social drift (i.e. SES as consequence) or social causation (i.e. SES as cause; Hudson [19]). For occupation, specific work-related drinking cultures might influence the socioeconomic gradient in alcohol-attributable mortality as well as respective gender differences. Furthermore, occupation entails a special bias with respect to gender: traditionally, married women have been classified according to their husband's occupation [20], and the classification of housewives still constitutes a problem. In some cases, women are excluded from the analysis when no occupation can be assigned [21]. These different properties (susceptibility to life events and challenges in measurement) might influence each measure's probability to detect gender differences in socioeconomic inequality. However, reviews investigating gender differences in health inequality found no systematic effects for the measure of SES [15,22]. The objective of this paper was to provide a systematic analysis of gender differences in the socioeconomic gradient of alcohol-attributable mortality. Taking into account the different properties of each measure of SES, all analyses were carried out separately for each measure of SES.

Methods

The study protocol followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA Statement [23]; the study protocol has been published as supporting information elsewhere [4], see Table S1 for PRISMA checklist). The meta-analysis was carried out in Germany at the Technische Universität Dresden where no ethics approval is required for meta-analyses of published data.

Search strategy

A systematic literature search of the electronic databases Web of Science, MEDLINE, PsycINFO and ETOH was performed using the following search string as a basis: (alcohol related mortality OR alcohol attributable death OR alcohol attributable mortality) AND (ratio* OR risk*) AND (ses OR social class OR socioeconomic variable* OR socioeconomic status OR socioeconomic factor*). The search included the time from the inception of the respective database to the second week of February 2013, with the exception of the ETOH database that has not been actively updated since December 2003. The search string was adapted to meet specific requirements of the databases searched. Additionally, reference lists of the retrieved articles were searched.

Article inclusion

All articles that reported alcohol-attributable mortality in adolescents and adults (at least 15 years old) by SES were included. The articles were required to: (i) report a measure of risk or enough data to calculate relative risks (RR) and corresponding 95% confidence intervals (CI); (ii) operationalise SES by education, occupation, employment status or income; and (iii) report results by gender. To ensure representativeness for the general population, intervention studies and studies based on clinical samples were excluded. Languages were restricted to English and German. For further details, see study protocol (published as supporting information elsewhere [4]).

Silke Behrendt (S. B.), Jürgen Rehm (J. R.) and Charlotte Probst (C. P.) performed a rating of accordance by independently applying the inclusion criteria to a sample of 10 exemplary titles and abstracts from the initial search of online databases. Because mean accordance between all three was 73%, we decided to retrieve all potentially relevant articles in full text. Michael Roerecke (M. R.), J. R. and C. P. discussed all final decisions on inclusion based on full texts. When multiple articles reported results based on the same or overlapping data, articles were selected using the quality criteria stated below.

Dataset construction

For each article chosen for final inclusion, information about study population, design, assessment of SES,

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mortality assessment, results and adjustment for confounding were abstracted. SES (highest vs. lowest SES group) was categorised into education (e.g. upper tertiary vs. basic), occupation (e.g. white collar worker vs. blue collar worker), employment status (e.g. employed vs. unemployed) and income (e.g. highest quintile vs. lowest). ICD-10 codes for alcohol-attributable diagnoses included in each article were documented. Rate ratios, hazard ratios, RRs and odds ratios were treated as equivalent measures of RR and in the following referred to as RRs. To avoid over-adjustment (e.g. for other measures of SES), risk estimates that were only age-adjusted were preferred over SES-adjusted estimates. Missing value imputation was applied as described elsewhere in the study protocol [4]. In two cases with missing data on key variables, it was possible to obtain original data directly from the authors [13,24]. All issues concerning abstraction were discussed and consensually decided between J. R., M. R. and C. P.

Study quality

As most common quality scales are tailored for randomised clinical trials, a custom-made quality checklist was generated, taking major quality features for observational studies into account [25]. Quality criteria were representativeness of the sample, loss of data due to problems in measurement of SES, operationalisation of alcohol-attributable mortality concerning alcohol-attributable fractions (AAF), linkage of survey data and age-adjustment. All quality features were documented in the checklist (see Table S2). To account for diverging importance of the quality features, no aggregate score was applied. We tested the quality characteristics in random effects meta-regressions [26]. A significant result led to the exclusion of the respective lower quality studies.

Statistical analysis

The analysed RRs were based on the mortality rate of the lowest SES category divided by the mortality rate of the highest SES category. This procedure was applied to include as many articles as possible. Separately for each indicator of SES and gender, RRs were pooled using inverse-variance weighted DerSimonian–Laird random effects models to allow for between-study heterogeneity [27]. The resulting RR describes the factor by which subjects with lower SES have a higher risk of dying from an alcohol-attributable cause of death compared with subjects with higher SES. Between-study heterogeneity was quantified using Cochran's Q [28] and the I^2 statistic [29]. I^2 represents the proportion of the total variance in point estimates (i.e. RRs) from heterogeneity between studies. Egger's regression-based test was used to detect potential publication bias [30]. Leave one out analyses were performed to control for disproportionate influence of any single article. Gender differences and the influence of quality criteria were analysed using random effects meta-regressions [26]. All calculations were conducted on the natural log-scale using Stata software [31].

Results

Literature search results

Of the 851 articles identified in the literature search, 19 articles fulfilled our eligibility criteria and were kept for statistical analyses. The PRISMA flow chart of our search strategy is displayed in Figure 1. The 19 included articles comprised about 179 million persons (90 million women and 89 million men) and 189 000 alcohol-attributable deaths (35 000 women and 154 000 men) from 14 different countries. More specifically, articles reported data from Finland ($n = 6$), Sweden ($n = 3$), the UK ($n = 3$), Russia ($n = 2$), the United States, Canada, Spain, Italy, Switzerland, Belgium, Denmark, Norway, Estonia and Poland (one article each). One article reported data from eight different cohorts of six countries [24], and two reported multiple cohorts from one country [32,33]. Table 1 summarises information on all 19 articles included in the statistical analyses.

Quality assessment

Each article was evaluated in the custom-made checklist (Table S2): six articles did include diagnoses that are not wholly attributable to alcohol; six articles did not individually link SES data to mortality data; three articles did not report age-adjusted data; three articles excluded considerable shares of the sample due to problems in SES assignment; in two articles the representativeness of the sample was limited.

Random effects meta-regressions were calculated for all quality criteria for each measure of SES (results not presented). In some cases, all articles reporting on one measure of SES fulfilled a certain criterion, and therefore meta-regression was not feasible (see Table S2). Only the operationalisation of alcohol-attributable mortality showed significant effects: differences in the RRs were found for education (men and women), occupation and employment status (men only). The result indicates significantly higher RRs when only diagnoses 100% attributable to alcohol are considered. We thus removed the six articles reporting on less than 100% alcohol-attributable diagnoses from our main analysis and calculated pooled estimates, including less than 100% as a sensitivity analysis. All other

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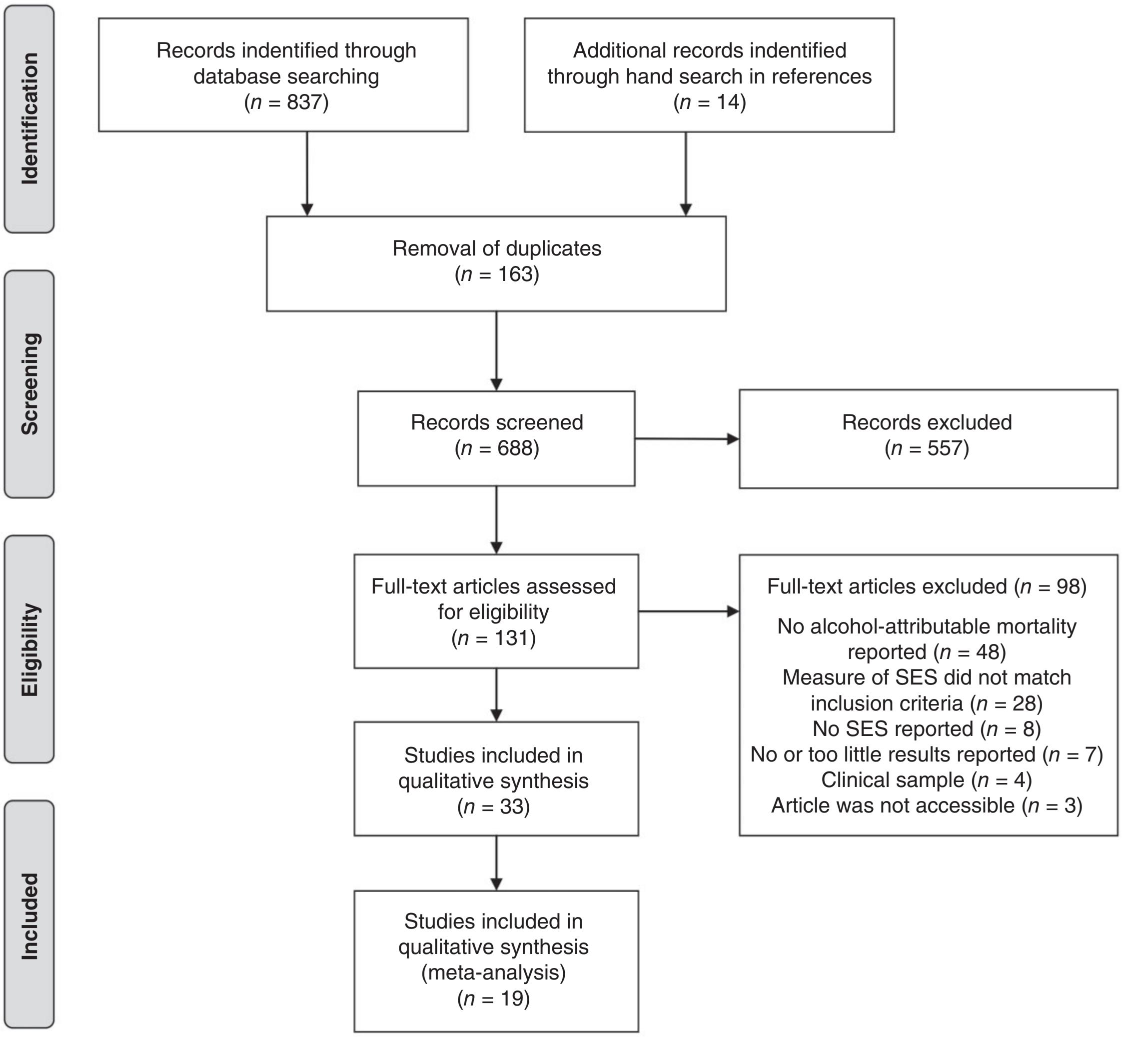

Figure 1. *PRISMA flow diagram for article selection and exclusion. SES, socioeconomic status.*

meta-regressions for quality criteria did not reveal statistically significant differences.

Meta-analyses: socioeconomic inequality

Results of meta-analyses (AAF = 100%) separated by gender and measure of SES are shown in Figures 2 and 3. For occupation as measure of SES, six cohorts remained for statistical analyses. Statistically significant RRs of 1.75 (95% CI 1.21–2.54) and 4.03 (95% CI 3.52–4.62) were found for women and men, respectively. The analyses of education included 16 cohorts for women and 17 cohorts for men. The meta-analysis led to significant RRs of 2.66 (95% CI 2.19–3.23) for women and 2.88 (95% CI 2.45–3.40) for men. Two eligible cohorts were found for each income and employment status as measure of SES. For income, significant RRs were found for women RR = 4.78 (95% CI 2.57–8.87) and men RR = 4.87 (95% CI 3.00–7.93). Regarding employment status, a significant RR of 12.25 (95% CI 11.45–13.10) was found for men. No statistically significant association was found for women with RR = 6.08 (95% CI 0.82–44.99). Overall, the results indicated a substantial and statistically significantly elevated risk of dying from an alcohol-attributable cause of death for both men and women of low SES for all measures of SES investigated with only one exception (employment status, women, which did not reach statistical significance).

Meta-regressions: gender differences in socioeconomic inequality

Random effects meta-regressions comparing genders were calculated for each measure of SES separately. For occupation (12 RRs included), meta-regression

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Table 1. *Characteristics of all articles (n = 19) included in meta-analyses (AAF ≤ 100%; published between 1992 and 2012)*

Article	Country	Sex (age)	SES assessment[a]	SES indicator (number of levels)	Mortality assessment[b]	N all-cause mortality	N alcohol-attributable deaths	Quality[c]
Agren and Romelsjö [34]	Sweden	W, M (25–46)	1970	Occupation (3), employment status (2)	1971–1975	4 052 000*	2642	(+)
Valkonen [35]	Finland	W, M (35–64)	1970, 1975, 1980	Occupation (4)	1971–1975, 1976–1980, 1981–1985	1 567 000*	11 000*	(+)
Koskinen and Martelin [10]	Finland	W, M (35–64)	1980	Education (3)	1981–1985	1 622 000*	993	(+)
Shkolnikov *et al.* [13]	Russia	W, M (20–69)	1989	Education (2)	1989	89 436 000*	9200*	(–)
Harrison and Gardiner [36]	England, Wales, Scotland	W, M (16+)	1991	Occupation (5)	1988–1994	18 346 000*	12591	(–)
Mäkelä [11]	Finland	W, M (30–69)	1985, 1990	Education (3), occupation (4), income (5)	1987–1990, 1991–1995	1 960 000*	21 922	(+)
Hemström [37]	Sweden	W, M (20–64)	1980, 1990	Occupation (3)	1990–1995	1 480 000*	9547	(+)
Braver [38]	USA	W, M (25–64)	1995	Education (3)	1995	39 426	3692	(–)
Leinsalu *et al.* [32]	Estonia	W, M (20–70)	1989, 2000	Education (3)	1987–1990; 1999–2000	2 097 607	3500*	(–)
Kivimäki *et al.* [39]	Finland	W, M (19–64)	Occupation: 1994–2000, education: 1995	Education (2), occupation (3)	1994–2000	65 405	179	(–)
Herttua *et al.* [40]	Finland	W, M (15+)	2000, 2003	Education (4), income (5), employment status (3), occupation (4),	2001–2003	3 909 000*	9914	(+)
Mackenbach *et al.* [24]	Norway	W, M (30–74)	1990	Education (3)	1990–2000	1 995 500*	10 800*	(+)
—	Belgium	W, M (30–74)	1991	Education (3)	1991–1995	5 524 500*	13 500*	(+)
—	Italy (Turin)	W, M (30–74)	1991	Education (3)	1991–2001	487 000*	2600*	(+)
—	Sweden	W, M (30–74)	1991	Education (3)	1991–2000	4 583 000*	23 700*	(+)
—	Spain (Barcelona)	W, M (30–74)	1992	Education (3)	1992–2001	858 000*	4400*	(+)
—	Denmark	W, M (30–74)	1996	Education (3)	1996–2000	3 094 500*	7600*	(+)
—	Spain (Basque country)	W, M (30–74)	1996	Education (3)	1996–1997	3 663 300*	2000*	(+)
—	Spain (Madrid)	W, M (30–74)	1996	Education (3)	1996–2001	1 108 800*	3300*	(+)
Mäki and Martikainen [41]	Finland	M (25–64)	1990	Education (4), income (4), occupation (5), employment status (2)	1991–2001	1 051 000*	2703	(–)
Zagozdzon *et al.* [14]	Poland (Gdansk)	W, M (20–64)	1999	Employment status (2)	1999–2004	367 848	1500*	(–)
Connolly *et al.* [42]	Ireland	W, M (25–74)	2001	Education (5), occupation (5), employment status (2)	2001–2006	720 627	578	(–)
Faeh *et al.* [43]	Switzerland	W, M (30–69)	1992/1993	Education (3)	1990–2000	3 450 120	16 156	(–)
Pridemore *et al.* [44]	Russia (Izhevsk)	M (25–54)	2002	Education (6)	2003–2005	3 149	100*	(–)
Siegler *et al.* [12]	England and Wales	W, M (25–59)	2001	Occupation (7)	2001–2003	25 768 100*	10 880	(–)
Tjepkema *et al.* [45]	Canada	W, M (25–80)	1991	Education (4)	1991–2006	2 734 800	4117	(+)

*Estimated value as described in study protocol, see Probst *et al.* [4]. [a]All data are based on census or register data except of Pridemore *et al.* who performed proxy interviews and Kivimäki *et al.* who also included survey data. [b]All data are based on some sort of death register except of Pridemore *et al.* who performed proxy interviews. [c]Quality: (+) = all quality criteria are met; (–) = at least one quality criterion is not met. AAF, alcohol-attributable fraction; M, men; SES, socioeconomic status; W, women.

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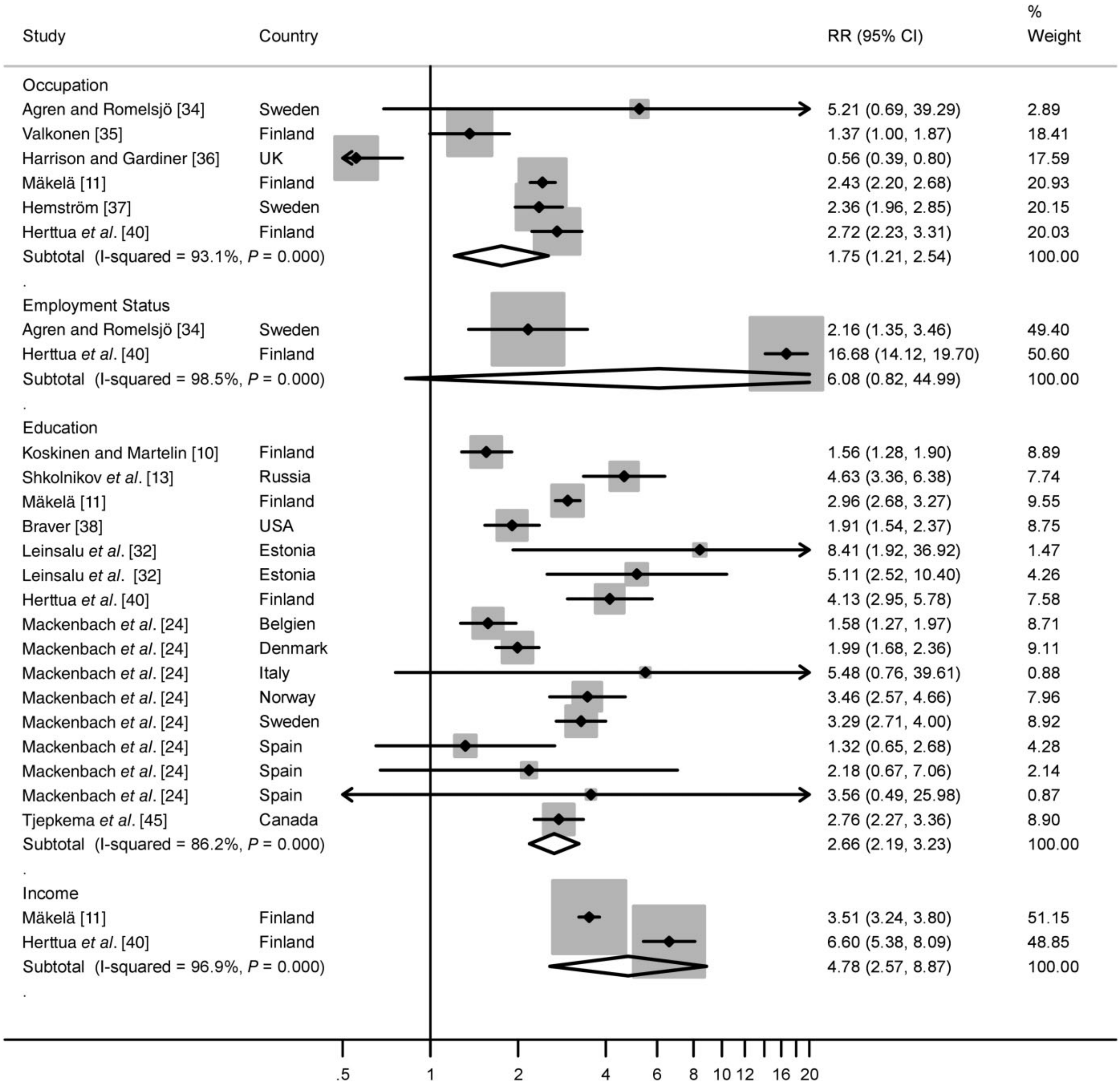

Figure 2. *Random effects meta-analyses for women, including 100% alcohol-attributable causes of death only. Forest plot of pooled RR for women, by measure of SES. Size of squares corresponds to the weight of each article in the meta-analysis. Leinsalu* et al. [32] *and Mackenbach* et al. [24] *are represented multiple times because they reported on different cohorts. CI, confidence interval; RR, relative risk; SES, socioeconomic status.*

revealed a significant gender difference in RRs ($P = 0.01$), with gender explaining over 50% of the variance (adjusted $R^2 = 52.18\%$). No significant gender differences were found in the RRs for education (33 RRs included, $P = 0.55$), income (4 RRs included, $P = 0.96$) and employment status (4 RRs included, $P = 0.55$) as underlying measure of SES.

Heterogeneity, bias and sensitivity analysis

Substantial heterogeneity was detected in all meta-analyses, with one exception (employment status, men; see Table 2). Where applicable, we did not find evidence for publication bias (Egger's regression-based test), and omitting single articles case by case did not lead to a

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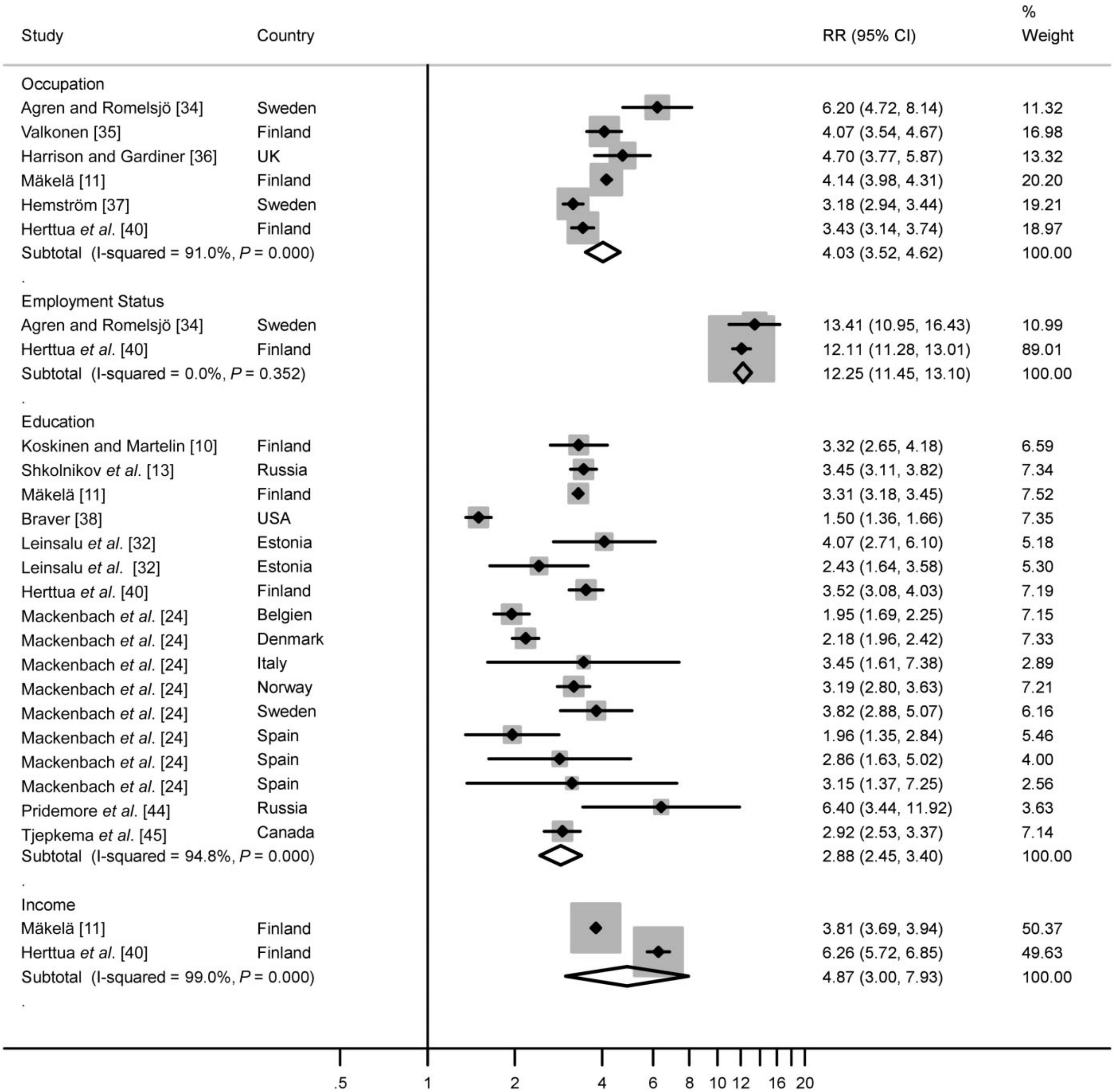

Figure 3. *Random effects meta-analyses for men, including 100% alcohol-attributable causes of death only. Forest plot of pooled RR for men, by measure of SES. Size of squares corresponds to the weight of each article in the meta-analysis. Leinsalu* et al. [32] *and Mackenbach* et al. [24] *are represented multiple times because they reported on different cohorts. CI, confidence interval; RR, relative risk; SES, socioeconomic status.*

significantly different result. As a sensitivity analysis, meta-analyses and meta-regressions for gender differences were repeated, including articles that investigated diagnoses with AAFs less than 100% [12,14,39,41,42]. The resulting RRs were smaller, but not substantially different with respect to the pattern of significances (results not presented). The gender difference found for occupation did not remain statistically significant (18 RRs included, $P = 0.11$), and the adjusted R^2 went down to 12.65%.

Discussion

Significant gender differences in RRs of 100% alcohol-attributable mortality were found for occupation as measure of SES, with men having a significantly higher

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Table 2. *Heterogeneity (Cochran's Q and I^2) and publication bias (Egger's regression regression-based test and leave one out analysis) for the main analysis (AAF = 100%)*

	Number of estimates	Q (*P* value)	I^2, %	Egger (*P* value)	Leave one out
Occupation					
Women	6	72.5 (0.00)	93	0.34	No influence
Men	6	55.9 (0.00)	91	0.91	No influence
Employment status					
Women	2	64.8 (0.00)	99	NA	NA
Men	2	0.9 (0.35)	0	NA	NA
Education					
Women	16	108.6 (0.00)	86	0.73	No influence
Men	17	307.7 (0.00)	95	0.62	No influence
Income					
Women	2	31.9 (0.00)	97	NA	NA
Men	2	104.6 (0.00)	99	NA	NA

AAF, alcohol-attributable fraction; NA, not applicable.

RR, but not for education, income and employment status. Nevertheless, for all four measures of SES included in this meta-analysis, and for both genders, substantial and statistically significant RRs of dying from alcohol-attributable causes of death were found, comparing groups of highest to groups of lowest SES. The only exception was employment status in women, possibly due to the small number of articles available for this indicator of SES. These results indicate, depending on the measure of SES, a three- to 10-fold elevated risk of dying from an alcohol-attributable cause of death in men with a lower SES. For women, the RRs were roughly between 1.5 and 6.

Methodological limitations

The vast majority of articles included in the present meta-analysis report on western high-income countries. Thus, results of these meta-analyses can only be generalised to high-income countries with a comparable structure of socioeconomic indicators. Finnish cohorts were clearly overrepresented, with about 22% and 25% of all cohorts included in the main analysis, and the sensitivity analysis (AAF ≤ 100%) being from Finland, respectively.

The present meta-analysis did not control for the number of groupings applied in each article to categorise SES. This needs to be kept in mind when interpreting differences between measures of SES.

The Cochrane Handbook recommends to conduct meta-regressions only when at least 10-point estimates are available [46]. As this was not always the case, the meta-regressions for gender differences based on employment status and income, as well as the meta-regressions for study quality based on employment status, income and occupation, should be interpreted with caution.

In all meta-analyses except for one (employment status, men; see Table 2), substantial between-study heterogeneity was found. This could be partly due to small errors of the mean arising from large sample sizes. We allowed for between-study heterogeneity using inverse-variance weighted DerSimonian–Laird random effects models [27].

Study quality documented in the checklist was overall satisfactory (see Table S2). Due to the results of the meta-regressions for quality criteria, the main analysis included only 100% alcohol-attributable causes of death. Sensitivity analyses showed that the inclusion of lower-quality studies (i.e. less than 100% alcohol-attributable) did not change the results and respective conclusions substantially. The attenuation of the gender difference in occupation under inclusion of diagnoses not 100% attributable to alcohol (i.e. diagnoses that might not or only partially have been caused by alcohol consumption) indicates that alcohol might in fact be the relevant risk factor for gender differences in socioeconomic inequality when occupation is used as measure of SES. This underlines the importance of cause of death-specific investigations of gender differences in socioeconomic inequality.

Gender differences in socioeconomic inequality

Three factors seem to play a role when it comes to gender-specific differences in the socioeconomic gradient of alcohol-attributable mortality: the operationalisation of alcohol-attributable mortality (as mentioned above), the measure of SES and the specific country. The latter two will be discussed in detail below.

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Influence of the measure of SES

The finding that gender differences were found only for occupation as measure of SES may point to: (i) potential confounding with occupation-specific drinking cultures that are unevenly distributed across genders; or (ii) a biased assessment of women's SES when using occupation as measure of SES.

Occupations included in the same SES category may differ considerably with respect to their drinking culture and norms, as well as their gender distribution. Low SES in terms of occupation was summarised in categories as 'manual worker', 'routine worker' or 'blue collar worker', comprising occupations in construction, transportation or production, as well as service sector occupations in cleaning, catering and personal care industry (as e.g. hairdressers). Clear gender differences are observable across different work areas: e.g. in Europe, occupations related to operating systems and machines, as well as craft occupations, are clearly male dominated, while service providers and vendors in shops and markets are more often female [47].

Looking at the drinking culture of the respective SES-specific occupations, a study by Parker and Harford found that 'white collar workers' showed proportionally higher rates of regular alcohol use, but the group of 'blue collar workers' clearly drank higher quantities [48]. In this as well as in other studies, especially male-dominated sectors, such as construction work, manufacturing, carpenter trade and occupations related to operating machines were associated with elevated rates of risky alcohol use and alcohol use disorders [49,50]. These findings support the hypothesis that certain male-dominated occupations of low SES are related to an unfavourable drinking culture and elevated levels of alcohol consumption, which in turn might influence the socioeconomic gap in alcohol-attributable mortality as well as respective gender differences.

There are, however, counter-examples of female-dominated occupations related to unfavourable drinking cultures, for example, the sex industry or gastronomy. The latter has repeatedly been shown to be related to elevated levels of alcohol consumption and associated harm [50,51].

Another explanation for the observed gender differences in SES inequality could be the systematic bias when classifying women based on occupation. In the present meta-analysis, three articles reported problems with classifying women [12,36,40], which might have impacted the accuracy in the determination of women's SES and thereby might have led to lower RRs in women. Future research should classify women according to their own occupation and consider using a combined measure of SES to compensate for respective problems.

For all other measures of SES, no gender differences above chance were found, indicating that socioeconomic inequalities in alcohol-attributable mortality may not be different by gender for these measures. However, only two articles were available for an examination of employment status and income, limiting the possibility to derive a trend for gender differences regarding this measure of SES.

Influence of country-specific drinking cultures

The specific country we look at might also influence gender differences in the socioeconomic gradient of alcohol-attributable mortality. Kuntsche *et al.* [52] found in eight European countries that heavy drinking was decreasing with increasing education (see also Bloomfield *et al.* [53]). This was only the case for men. For women, the picture was much more complex: the described association was only present in women from Finland, Sweden and Czech Republic, with women from Switzerland, Germany and France showing the opposite picture. The data available in the present study did not allow for a detailed and systematic investigation of such country differences. But given the differences between countries with respect to gender roles and respective drinking norms, further research is recommended. Between-country heterogeneity in gender differences of socioeconomic inequality should be looked at, taking indicators as the gender inequality index into account.

Implications for policy and practice

Overall, the results indicate an urgent need for alcohol preventive measures for people with low SES, who are at greatest risk for alcohol-attributable mortality. The gender differences in occupation suggest a potential moderating effect of work-related drinking cultures. Perceived permissive drinking norms in the occupational setting have been shown to be a strong predictor for employee's alcohol use at work as well as problem drinking [54–56]. These occupation-specific drinking cultures could be a starting point for effective measures to reduce socioeconomic inequalities in alcohol-attributable mortality and respective gender differences. There already is a large body of effective work-related interventions (see Roman and Blum [57] for an overview) that can be adapted to each workplace's needs to prevent alcohol-attributable harm, especially in occupations of low SES that are known to have unfavourable drinking cultures [58–60].

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Conflict of interest

The authors declare no conflict of interest. Unrelated to this work, with respect to connections to the pharmaceutical industry, J. R. received unrestricted grants and honoraria from Lundbeck, and is an advisory board member for Lundbeck.

Details of Contributors: C. P. is named as the Guarantor and has overall responsibility of all steps. J. R. and S. P. supervised the whole working process. C. P., J. R. and S. B. conceived and designed the meta-analysis. C. P., J. R. and M. R. performed the literature research and article selection. C. P., S. B. and J. R. performed rating of inclusion/exclusion. M. R., J. R. and C. P. decided on statistical procedures and analysed the data. They had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. C. P. wrote the first draft of the manuscript. All authors contributed to the writing and revision of the manuscript, and approved the final version to be published.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. PRISMA research checklist.
Table S2. Quality checklist. Ratings on population representativeness of the sample, measurement of SES, operationalisation of alcohol-attributable mortality, data linkage and age-adjustment for each article included in meta-analysis.

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