

Psychosocial job stressors and suicidality: a meta-analysis and systematic review

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ABSTRACT

Objectives Job stressors are known determinants of common mental disorders. Over the past 10 years, there has been evidence that job stressors may also be risk factors for suicidality. The current paper sought to examine this topic through the first comprehensive systematic review and meta-analysis of the literature to date.

Methods We used a three-tier search strategy of seven electronic databases. Studies were included if they reported on a job stressor or job-related stress as an exposure and suicide ideation, self-harm, suicide attempt or suicide as an outcome. Two researchers independently screened articles. All extracted effect estimates were converted to log-transformed ORs.

Results There were 22 studies that were included in meta-analysis. Overall, exposure to job stressors was associated with elevated risk of suicide ideation and behaviours. The OR for suicide ideation (14 studies) ranged from 1.45 (95% CI 1.01 to 2.08) for poor supervisor and colleague support to 1.91 (95% CI 1.22 to 2.99) for job insecurity. For suicide (six studies), exposure to lower supervisor and collegial support produced an OR of 1.16 (95% CI 0.98 to 1.38), while low job control resulted in an OR of 1.23 (95% CI 1.00 to 1.50). There were only two studies that examined suicide attempt, both of which suggested an adverse effect of exposure to job stressors.

Conclusions This study provides some evidence that job stressors may be related to suicidal outcomes. However, as most studies in the area were cross-sectional and observational in design, there is a need for longitudinal research to assess the robustness of observed associations.

INTRODUCTION

The psychosocial conditions in which people are employed are recognised social determinants of health.¹ Common adverse psychosocial working conditions include low job control (characterised as a limited ability to learn new things or develop skills and lack of decision-making ability) and high job demands (characterised as excessive amount of work and work pressure).² Another prominent stressor is effort–reward imbalance, which arises from an imbalance between high extrinsic effort by workers (eg, pressure to work overtime, increasingly demanding work, constant time pressure and repeated interruptions) and the perception of low rewards financially (income), socially (respect and esteem) and organisationally (job security and promotion prospects).³ Job insecurity is a common job stressor and is defined as the perceived threat of job loss and the worries related to that threat.⁴

Exposure to poor working conditions, such as low job control, high demands and effort–reward imbalance, have been associated with poor mental health across a range of studies.^{5–10} There is also evidence from observational studies that improvement in psychosocial conditions are associated with better mental health.¹¹ Thus, there is some evidence that these are modifiable factors and that acting on these has the potential to lead to improvements in mental health. Close to 10 years ago, a number of researchers provided comment about the possibility that adverse working environments could also comprise risk factors for suicide.^{12–13} Since this time, there have been a number of papers on the topic, all of which have supported the idea that poor working conditions are related to risk of suicide ideation¹⁴ and suicide death.^{15–17} In addition to this, there is evidence to suggest that suicide rates are higher in occupations with poorer working conditions (eg, construction workers, labourers, forestry workers and agricultural workers and police) than occupations where the overall psychosocial environment is more positive (eg, professionals, managers and other highly skilled jobs).¹⁸ While there have been a number of studies on the relationship between psychosocial job stressors and suicide, these have tended to be based on limited sample sizes, which has limited statistical power to detect effects. Considering the substantial amount of policy and research on the relationship between psychosocial job stressors and suicidality in recent years, we sought to examine the full evidence base on this topic through systematic review and meta-analysis, thereby building on past narrative reviews.^{12–13} In this review, therefore, we sought to investigate whether exposure to job stressors was associated with a greater risk of suicidal ideation and/or behaviours.

METHODS

The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).¹⁹

Search strategy and keywords

We conducted a systematic search of seven electronic databases that index literature from a wide range of disciplines including medical science (Embase, PubMed and Web of Science), public health (Global Health), psychology (PsycINFO) and social science (ProQuest and Scopus). All databases were searched for eligible studies from their start date until 30 January 2017.

We used a three-tier search strategy to identify eligible studies. At the first stage, keywords

related to psychosocial job stressors and working contexts were combined (eg, 'job stress*' OR 'psychosocial job stress*' OR 'working condition'). We then searched for common terms for psychosocial job stressors (eg, 'job control' OR 'job demands' OR 'job secur*' OR 'job insecur*'). At the third stage, we searched for keywords inclusive of self-harm or suicide (eg, 'selfharm' OR 'suicid*' OR 'attempted suicid*' OR 'suicid* thought*'). We then conducted a search incorporating the search terms from tiers one, two and three using standard Boolean operators. A full list of the keywords can be seen in online supplementary file 1.

Keywords were adapted for the specific requirements of each electronic database. Truncation and wildcards were introduced where necessary to increase the sensitivity of the search. No restrictions were placed on publication status or language, but if we were unable to obtain adequate details for data extraction, these were later excluded from meta-analyses.

Reference lists of identified studies as well as prior relevant reviews in the field^{12 13 20} were additionally hand screened to identify further relevant studies. Experts in the field were also contacted to assist with the identification of ongoing evaluations.

INCLUSION AND EXCLUSION CRITERIA

Studies were included in the review provided they satisfied the following inclusion criteria¹: included a job stressor or job-related stress as exposures or risk factors and² included suicide ideation, self-harm, suicide attempt or suicide as an outcome (either as a primary or secondary outcome). Studies were also included that used the following designs: prospective cohort, case-control, retrospective mortality, cross-sectional or intervention trial (eg, either predesign or postdesign, or randomised controlled trial).

Studies investigating associations with physical, ergonomic and/or chemical exposures were excluded. Case reports, qualitative papers, study protocols and/or descriptions were also excluded as these did not report quantifiable data on suicide-related outcomes that could be used in meta-analysis. We also excluded studies that reported on suicide rates within specific occupational groups if these did not also provide a measure of psychosocial job stressors. Finally, we also excluded studies that specifically examined bullying and harassment as predictors of suicide, given that there has been a recent review on this topic.²⁰

Titles and abstracts of retrieved records were evaluated using a two-stage screening process. At the first stage, studies with relevant titles were selected for second screening by two of the authors working independently of one another (AM and KW). At the second stage, only those studies satisfying inclusion criteria following a review of the full text were retained. Disagreements were resolved by consensus between two of the review authors (AM and KW).

Data extraction

Methodological information extracted from each study included the location of the study, time period the study was conducted, author names, description of studied sample, study design, exposure definition and outcome definition. For each exposure, effect sizes were recoded so that higher values represent greater exposure to poorer psychosocial job stressors. Data extraction was checked for accuracy between three authors working independently (KW, AM and IN).

All effect size estimates were considered, including odds ratios (ORs), rate ratios, relative risks and correlation coefficients. However, raw data were extracted as a preference over aggregated effect measures to enable estimation of unadjusted

associations between each psychosocial job stressor and suicidality. Estimates needed to present either an SE or 95% CIs to be included in meta-analyses. Alternatively, studies needed to provide raw data so that the SE and CIs could be calculated.

Statistical analysis

Data were pooled between studies using the OR and its 95% CI. This necessitated conversion between the different effect size statistics reported in the original studies. Specifically, for continuous outcomes, we converted data presented as Pearson's correlation to a standardised mean difference using guidance from Borenstein,²¹ which then allowed us to convert the standardised mean difference to an OR. All ORs were coded so that higher scores represented greater exposure to poorer psychosocial job stressors.

All ORs and their 95% CIs were log-transformed to allow for meta-analysis. The pooled OR represents the risk of suicide associated with the exposure of interest (eg, each job stressor) compared with those who were not exposed to this stressor. Where possible, we conducted separate analyses for males and females.

Heterogeneity between studies was assessed through the I^2 statistic that indicates the percentage of variability in effect sizes due to methodological or statistical differences between the studies included in a meta-analysis.²² We also used meta-regression to assess the extent to which statistical heterogeneity between results of studies were related to study characteristics. Funnel plots were also used to assess small study effects.²³ All analyses were conducted using Stata for Windows, V.14.1, using the 'metan' suite of commands (implementing the DerSimonian-Laird random-effects model²⁴) and 'metareg'.²⁵

RESULTS

A total of 4644 records were identified following the systematic search strategy outlined above. A further three were obtained following correspondence with researchers working in the area. Following deduplication, this was reduced to 4334. Of these, 4247 were excluded at the first screening stage, and a further 59 were excluded following application of the inclusion and exclusion criteria at the second screening stage. A total of 25 records were therefore included in the present review comprising 22 independent, non-overlapping studies (figure 1). Of these, we were able to extract data from 22 studies for quantitative meta-analysis.

Study characteristics

These 22 studies have been conducted in a variety of locations, including Germany,^{16 26} Norway,²⁷ South Korea,^{28 29} the USA,³⁰⁻³² France,³³ China (Hong Kong Special Administrative Region),³⁴ Australia,^{15 35 36} Canada³⁷ and Sweden.³⁸ There were two studies that reported data from more than one sample, one study reported data from Italy and Sweden³⁹ and the second included data from Australia, China, Germany and South Korea.¹⁴

A number of studies covered a range of specific groups, most notably medical doctors^{14 31 38 39} followed by sawmill workers,³⁷ police,²⁷ firefighters,³⁰ medical students,^{17 40} nurses,¹⁴ textile workers,¹⁴ industrial workers,¹⁴ retail sales workers²⁹ and subway drivers.²⁸ The remaining studies covered the general working population. The earliest study was published in 1999,³¹ and the latest was published in 2017.^{32 35} The majority of the 22 studies investigated associations with suicide ideation

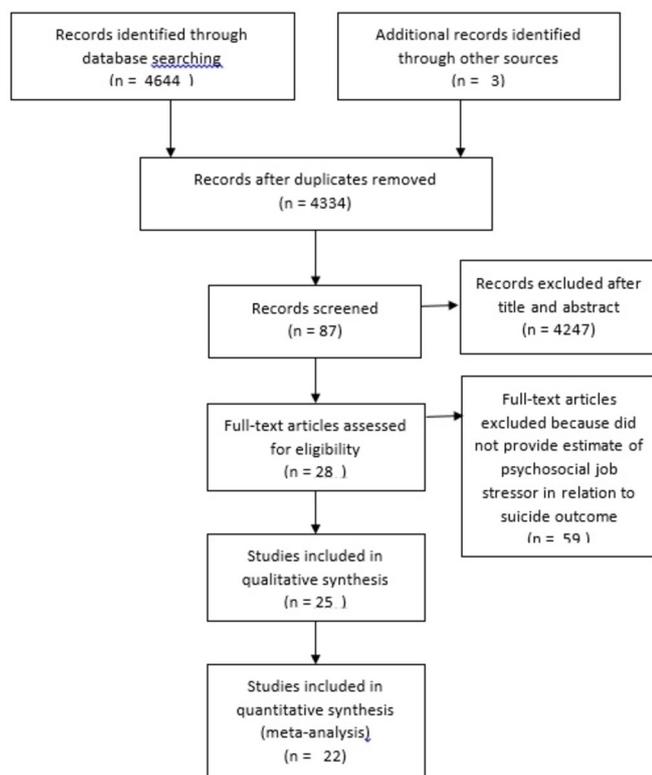


Figure 1 PRISMA flow chart. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

only,^{14 15 27–30 32 33 38–44} while smaller numbers assessed suicide death^{15–17 26 34 37} and attempted suicide.^{31 37}

These studies investigated a wide range of psychosocial job stressors, including poor colleague or supervisor support,^{16 27 30 32 36–39} low job control,^{14–17 29 35–37 39 42} high psychological job demands,^{14–17 27–29 31 35–37 42} job strain,^{14 26 33} effort–reward imbalance,^{14 28 35} job insecurity,^{15 28 33–35 44} role conflict,^{38 39} long working hours and shift work.^{32 38 40 44} There were a number of studies that did not report specific psychosocial job stressors, but rather reported associations with a measure of ‘general’ self-reported job stress, which is more proximal to suicidality than job stressor exposures, as job-related stress or distress is a response to job stressors^{16 26–28 30 31 40 43} (please see table 1).

Suicide ideation

Figure 2 shows the results for different exposures and suicide ideation. Across all psychosocial exposures, there was an elevated odds of suicide ideation. The OR ranged from 1.45 (95% CI 1.01 to 2.08) for poor supervisor and colleague support to 1.91 (95% CI 1.22 to 2.99) for job insecurity. However, the I^2 was high across all studies. We also assessed pooled results for general self-reported job-related stress for five studies,^{27 28 30 40 43} producing an OR of 1.53 (95% CI 0.99 to 2.38, I^2 88.8%). Exposure to any job stressor was associated with an OR of 1.16 (95% CI 1.13 to 1.19). However, the validity of conducting a pooled analysis of all stressors is somewhat questionable given the large number of different exposures included in the estimate.

Suicide attempt

We identified only single studies of specific jobs stressors in relation to suicide attempts, precluding meta-analyses for this outcome. In one study, exposure to poor colleague and

supervisor support (OR 1.19, 95% CI 1.18 to 1.21) and low job control (1.04, 95% CI 1.04 to 1.04)³⁷ were associated with an increased odds of suicide attempt. One other study found that general self-reported job-related stress was associated with higher risk of suicide attempt (2.62, 95% CI 2.19 to 3.13).³¹ Exposure to any job stressor was associated with an OR of 1.17 (95% CI 1.11 to 1.24).

Suicide death

Figure 3 shows the results for suicide death for males, females and all persons. There was a higher risk of suicide associated with lower supervisor and collegial support (OR 1.16, 95% CI 0.98 to 1.38) and low job control (OR 1.23, 95% CI 1.00 to 1.50). There were no significant associations between job demands or job strain and suicide death. Although not included in figure 3, we also calculated a pooled effect for general self-reported job-related stress from two studies^{16 26} (OR 1.48, 95% CI 0.94 to 2.32, I^2 29.0%). Exposure to any job stressor was associated with an OR of 1.17 (95% CI 1.03 to 1.34). As we note above, it is necessary to acknowledge the large number of different exposures that was included in this analysis.

As a sensitivity analysis, we removed females from this analysis, given that the epidemiology of suicide is vastly different for males and females. This may have affected the result for job demands, which was non-significantly associated with death for males (OR 1.16, 95% CI 0.57 to 2.36, I^2 88.5%). The OR for colleague and supervisor support decreased to 1.09 (95% CI 0.89 to 1.33, I^2 98.6%), while the OR for job control increased to 1.29 (95% CI 1.19 to 1.40, I^2 100%) for males only. Meta-regression indicated that a large part of the between study variance is driven by the difference in study populations (eg, occupational vs general cohort) (36.95%), country (23.11%) and study design (21.62%). In particular, results regarding study design found that cross-sectional studies were much more likely to identify a significant and positive association between job stressors and suicidality than other designs. A much smaller proportion of the between study variance was driven by gender (3.25%) or year (1.85%). Funnel plots for suicide ideation and deaths can be found in online supplementary file 2. These suggest that analysis was potentially affected by an absence of studies finding non-significant associations between exposure to adverse psychosocial working conditions and suicidal ideation and/or behaviour. As a final sensitivity analysis, we removed Wall *et al*³⁸ from the analysis of working hours as this represented work–family conflict. Pooled results were largely unchanged (OR 1.69, 95% CI 0.85 to 3.34).

DISCUSSION

Our review included 22 independent studies, which examined suicide ideation, suicide attempt and death by suicide. The studies included a wide range of sample types (eg, occupation specific vs working population based) and were set in a diverse range of countries. Across this broad range of studies, results of this review suggest that exposure to various psychosocial job stressors was associated with elevated risk of suicide ideation, attempts and death. Job insecurity was associated with higher odds of suicide ideation, while job control appeared to be more of a risk for suicide attempt and death.

There were a number of limitations that must be taken into consideration when interpreting these results. While we assessed a wide range of job stressors in this review, it was not feasible to include all possible adverse experiences at work. The studies identified by our search strategy mainly focused on modifiable

Table 1 Descriptive characteristics of studies included in the study

Author, year, country	Sample under study	Total sample size	Design	Exposure	Outcome	Results
Baumert <i>et al.</i> ²⁶ 2014, Germany	General population	6817	Cohort	Poor psychosocial working conditions ▶ adverse chronobiological/physical working conditions ▶ psychosocial working conditions Job strain	Suicide death	Sig+suicide in relation to poor psychosocial working conditions Sig – in relation to job strain
Berg <i>et al.</i> ²⁷ 2006, Norway	Police	3272	Cross-sectional survey	Poor psychosocial working conditions ▶ serious operational tasks Social support Job demands ▶ job pressure	Suicide ideation	Sig – job demand NS Sig+social support and psychosocial working conditions
Byun <i>et al.</i> ²⁸ 2016, Korea	Subway drivers	980	Cross-sectional survey	Job demands Effort reward imbalance ▶ lack of reward General job stress ▶ occupational climate Job insecurity	Suicide ideation	NS+job demands Sig+effort reward NS change general job stress NS+job insecurity
Carpenter <i>et al.</i> ³⁰ 2015, USA	Professional firefighters	315	Cross-sectional survey	Colleague/supervisor support General job stress ▶ occupational stress	Suicide ideation	Sig+poor social support Sig+general job stress
Daglish <i>et al.</i> ³³ 2015	General population	1128	Cross-sectional survey	Job insecurity Job strain	Suicide ideation	Sig+job insecurity NS – job strain
Frank <i>et al.</i> ³¹ 1999, USA	Female doctors	4287	Cross-sectional survey	Job control Job demands ▶ work amount General job stress ▶ work stress	Suicide attempt	Sig+high job demands Sig+general job stress
Fridner <i>et al.</i> ³⁹ 2011, Italy/Sweden	Male doctors	241 Italy, 456 Sweden	Cross-sectional survey	Colleague/supervisor support ▶ discussion about experiences at work ▶ support at work Job control ▶ control over work hours ▶ influence at work Role stressors ▶ role conflict Working hours/shift work Total work hours/week Night call	Suicide ideation	Sig+poor social support Sig+low job control Sig+general job stress
Law <i>et al.</i> ³⁴ 2014, Hong Kong	General population	175	Case-control	Job insecurity ▶ in danger of losing job/demotion ▶ changes in workplaces Pay changes ▶ pay cut ▶ pay freeze	Suicide death	NS – job insecurity NS – pay changes
Loerbroks <i>et al.</i> ¹⁴ 2016, Multicountry	Australian general working population, Chinese nurses, Chinese textile workers, German industrial workers, German physicians, Korean metro workers	3923, 498, 824, 721, 405, 6051	Cross-sectional survey	Job control Job demands Effort-reward imbalance Job strain	Suicide ideation	Difference across countries (Sig and NS+) low job control Difference across countries (Sig and NS+) high job demands Difference across countries (Sig and NS+) effort reward imbalance Difference across countries (Sig and NS+) job strain
McLean <i>et al.</i> ³² 2017, USA	Military personnel with post-traumatic stress disorder	366	Cross-sectional survey	Colleague/supervisor support	Suicide ideation	Sig+low social support
Milner <i>et al.</i> ³⁵ 2017, Australia	General male population	11 862	Cross-sectional survey	Job demands Job control Effort reward imbalance Job insecurity	Suicide ideation	Sig+low job control Sig – high job demands Sig+effort reward imbalance Sig+job insecurity
Milner <i>et al.</i> ³⁶ 2016a, Australia	General population	817	Cross-sectional survey	Job demands Job control Colleague/supervisor support Job insecurity	Suicide ideation	NS+job demands Sig+low job control Sig+low social support Sig+job insecurity

continued

Table 1 continued

Author, year, country	Sample under study	Total sample size	Design	Exposure	Outcome	Results
Milner <i>et al.</i> ¹⁵ , 2016b, Australia	General population	23 017	Case-control study	Job control Job demands	Suicide death	Sig+low job control (males) NS – low job control (females) NS – high job demands (females) Sig+job demands (males)
Ostry <i>et al.</i> ³⁷ 2007, Canada	Male sawmill workers	28 794	Cohort study	Job control Job demands Colleague/supervisor support	Suicide attempt Suicide death	NS+low social support (death) NS+low social support (attempt) Sig+low job control (attempt) NS+low job control (death) Sig+high job demands (attempt) Sig+high job demands (death)
Schneider <i>et al.</i> ¹⁶ 2011, Germany	General population	285	Case-control study	Colleague/supervisor support ▶ satisfaction with colleagues ▶ satisfaction with superiors Job control ▶ variety at work (monotonous work) ▶ interestingness of work Job demands ▶ time pressure ▶ responsibility General job stress ▶ psychic strain through contact with clients	Suicide death	Sig+low job control Sig+low social support NS+high job demands NS+general job stress
Sugawara <i>et al.</i> ⁴² 2012, Japan	General population (40–60 years)	5878	Cross-sectional survey	Job control Job demands	Suicide ideation	Sig+low job control Sig+high job demands
Takada <i>et al.</i> ⁴³ 2009, Japan	General population	2834	Cross-sectional survey	General job stress Working hours/shift work Working time Overtime work	Suicide ideation	Sig+general job stress
Takusari <i>et al.</i> ⁴⁴ 2011, Japan	General population	3213	Cross-sectional survey	Working hours/shift work ▶ working hour distribution ▶ overtime work ▶ working schedule irregularity ▶ shift work	Suicide ideation	Sig+job insecurity (males and females) Sig and NS+working hours/shift work (male and female)
Tsutsumi <i>et al.</i> ¹⁷ 2007, Japan	Medical school cohort	3125	Cohort	Job control Job demands	Suicide death	Sig+low job control NS – high job demands
Tyssen <i>et al.</i> ⁴⁰ 2001, Norway	Medical students	371	Cohort	General job stress Working hours/shift work ▶ working hours per week	Suicide ideation	Sig+general job stress NS+working hours/shift work
Wall <i>et al.</i> ³⁸ 2014, Sweden	Doctors	272	Cross-sectional survey	Colleague/supervisor support ▶ regular meetings to discuss situations at work ▶ taken care of in the organisation ▶ empowering leadership Role stressors ▶ role conflict Working hours/shift work ▶ hours on night call ▶ work demands interfere with family life	Suicide ideation	Sig+low supervisor support Sig+general job stress Sig+working hours/shift work
Yoon <i>et al.</i> ²⁹ 2016, Korea	Service and sales workers	1995	Cross-sectional survey	Job demands Job control	Suicide ideation	Sig+low control Sig+high demands

NS, non-significant; sig +, significant and positive relationship (eg, job stressor associated with increase in suicidality); sig –, significant and negative relationship (eg, job stressor associated with decrease in suicidality).

task-based stressors, most of which are likely to represent chronic rather than episodic conditions occurring in workplaces. Other stressors that occur in workplace settings that we did not include in this review include bullying and harassment, which have been shown to be related to suicidality in a recent systematic review.²⁰ There may be other, more acute stressors that increase the risk of suicide not considered in this review, such as workplace restructuring or exposure to traumatic incidents at

work (such as those experienced by police, firefighters and other emergency responders). Considering this, our review undoubtedly underestimates the complexity of the workplace and the influence it may have on a person who thinks about, attempts and/or dies by suicide.

It is also notable that the majority of our studies came from high-income countries. There is a need for more research on the relationship between work and suicide (and mental health

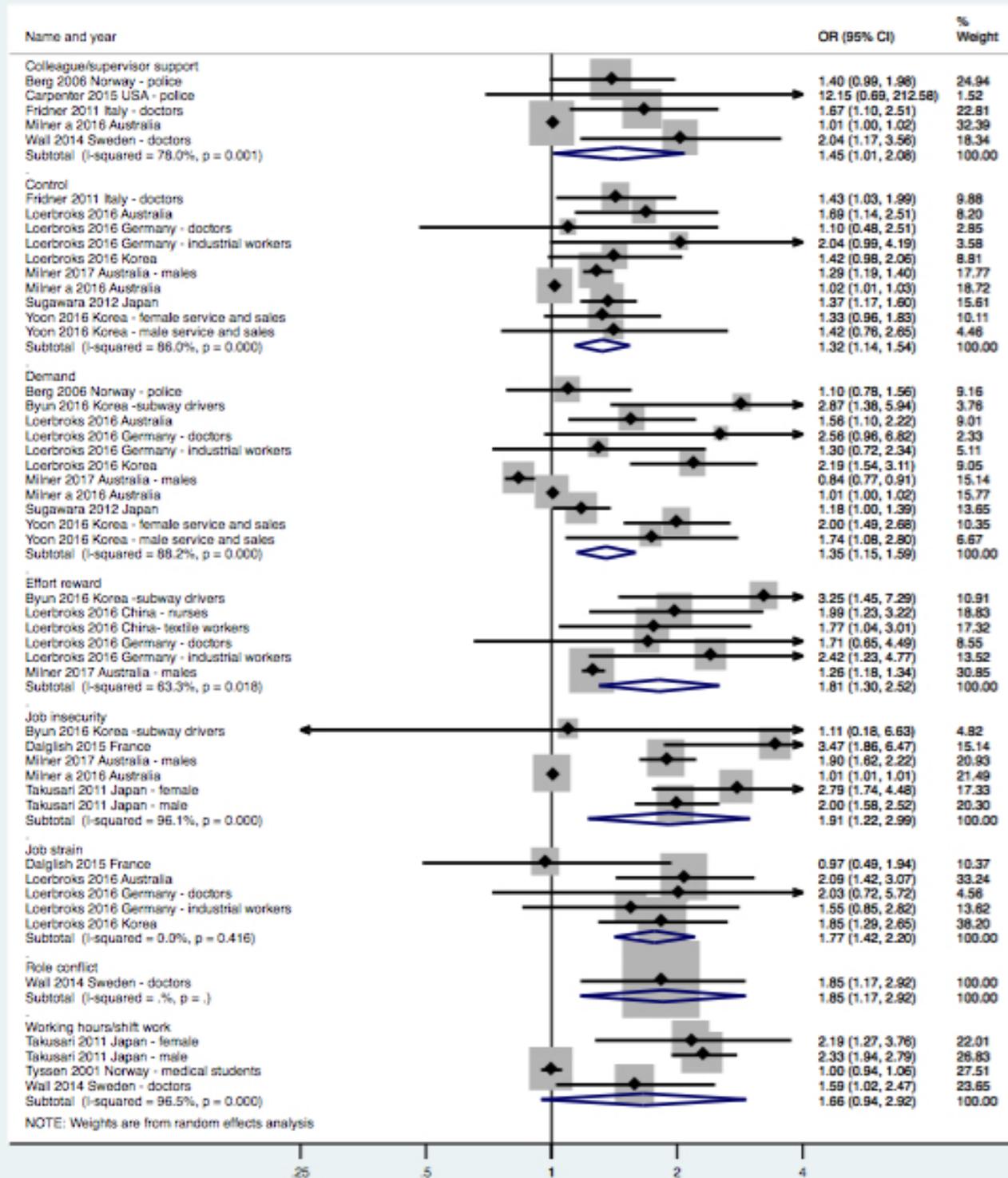


Figure 2 Psychosocial job stressors and suicide ideation, males, female and all persons.

more generally) in low-income and middle-income countries, especially given the changing nature of work in these areas in the face of globalisation.⁴⁵

Though our primary interest was in job stressor exposures as suicide risk factors, some studies only included measures of job-related stress or distress. These were included for completeness, though should be distinguished from job stressors as

generally more proximal to mental health and suicidality outcomes,¹² as reflected in results by the relatively high summary ORs compared with specific job stressors. The other limitations of our review were connected to its methodology and the methodology of the studies we included. As the majority of the studies in this review were cross-sectional, self-reported exposures and outcomes (eg, suicide ideation and attempts) dominated. We

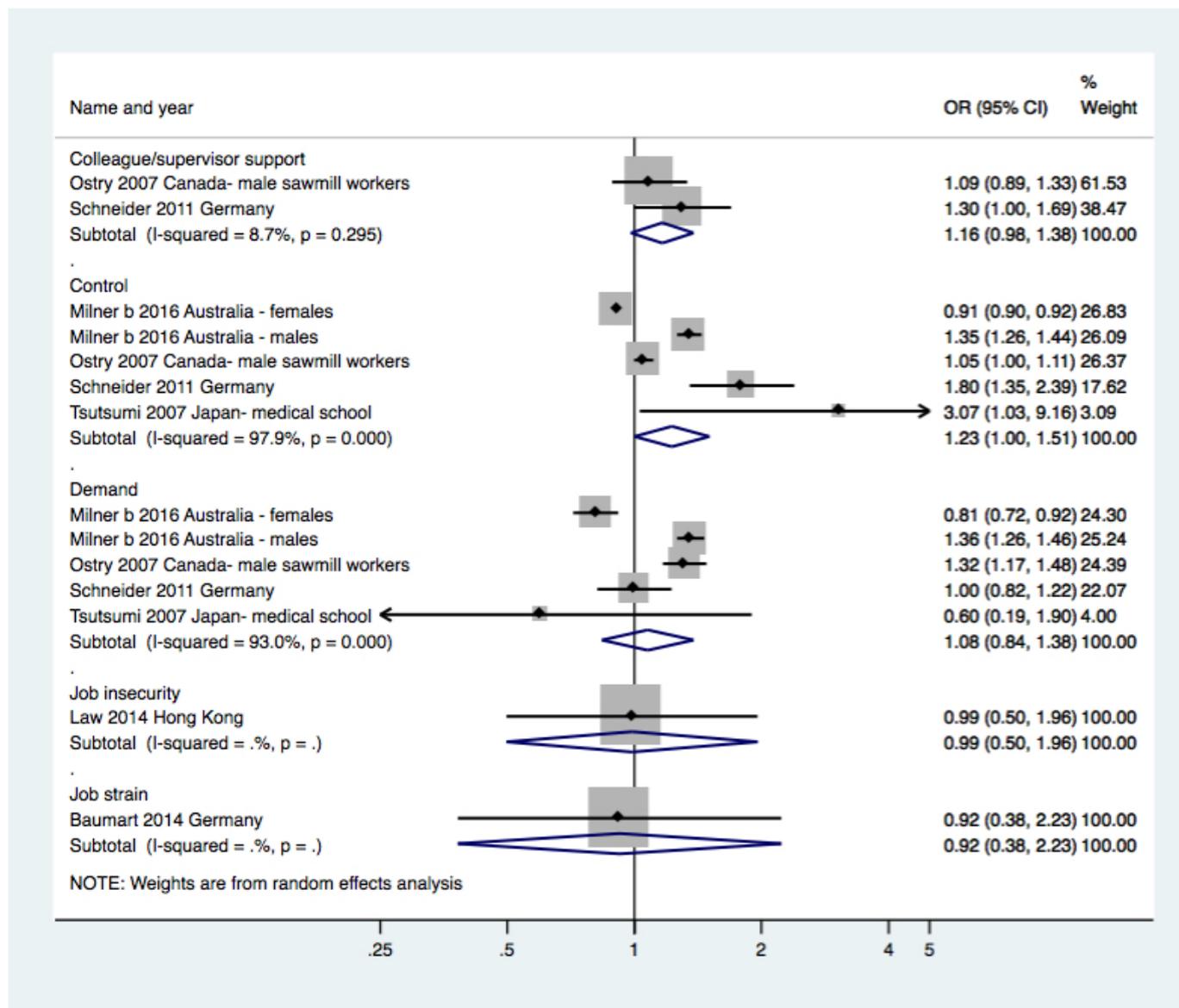


Figure 3 Psychosocial job stressors and suicide death, males, female and all persons.

found that cross-sectional studies were more likely to identify an association between job stressors and suicidality outcomes than prospective studies. There is therefore the potential for common method variance and inflated associations and for reverse causality (as it is impossible to identify whether the exposure to job stressors occurred before suicidality). There is also the possibility of health selection in those studies that reported suicide mortality, whereby those people who were more vulnerable to suicide were also more likely to be employed in, or to report, poor psychosocial working conditions.

A number of analyses resulted in quite a high I^2 , which suggests there was substantial heterogeneity between studies. This may be driven by the diversity of sample types, countries, exposure measures (and how these exposures were measured) and outcome measures we included. It is also important to highlight the potential for publication bias, as most studies suggested that there was an adverse effect of psychosocial job stressors on suicide outcomes. We would acknowledge that we did not control for socioeconomic factors in the meta-analysis. It is possible that socioeconomic status to some extent confounds relationships between some stressors and suicidality (eg, low job

control patterns by occupational skill level and socioeconomic status). Notwithstanding these considerations, our review has a number of strengths, including the large number of studies we were able to include, large sample size and the thorough methodology we used.

We noted some evidence of gender differences in the relationships between job stressors and suicide. For suicide, the available data suggest that males exposed to job stressors are at much greater risk than females.^{15-17 37} This would align with research evidence on suicide among males more generally, which has consistently shown that males are particularly vulnerable to external social and economic stressors.⁴⁶ Although, we would note that these are not the same as job stressors. Associations might also differ across occupational groups and country.^{28 33 44} For example, females in Japan exposed to job stressors were at elevated risk of suicide ideation.⁴⁴ There was also some evidence of an elevated risk of suicide ideation among medical doctors,³⁹ nurses¹⁴ and people employed in male-dominated manual labour occupations.¹⁴ However, the possibility that the relationship between jobs stressors and suicide is modified by occupation, country context and gender must be considered as

hypothetical at this stage, given that not all studies produced stratified results.

The pathways through which job stressors result in higher suicidality is likely to be related to increased psychological distress and worsening mental health. There is a known association between mental health problems and suicide.⁴⁷ There is also research showing that job stressor exposure and other adverse experiences at work are independent risk factors for mental ill health.^{5–8} Hence, it is possible that psychosocial job stressors are causes of mental health problems, which are in turn a cause of suicide and related outcomes. It is also possible that changes in psychosocial job stressors are related to adverse changes in other areas of life, such as financial or relationship change, both of which have been associated with an increased risk of suicide.^{48–49} Problems at work are likely to interact with these factors, heightening the risk of suicide. Beyond this, there are plausible biological pathways linking job stress to health through allostatic load and the hippocampus (memory), amygdala (fear and anxiety) and prefrontal cortex (decision making, impulse and mood control) in the brain.⁵⁰

Regardless of the pathways through which it occurs, it is clear that job stressors are associated with increased risk of suicide. Thus, job stress prevention and control should be a key component of workplace as well as some other suicide prevention strategies.^{41–51} Furthermore, as poor psychosocial working conditions are highly prevalent, addressing these could have large population impacts in terms of reductions in suicidality. Indeed, a past study demonstrates the high population-attributable risk associated with socioeconomic factors for suicide comparative to mental illness.⁵² At the same time, it is clear that much more research is needed to unpack the complexity of the relationships between psychosocial job stressors and suicidality, particularly in regards to differences by country context, gender and occupation.

Correction notice This article has been corrected since it published Online First. The conclusions paragraph in the abstract, figures 2 and 3, and OR and CI results have all been corrected.

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Contributors AM conceived the study. AM and KW developed the methodology, conducted the searches, screened the articles and conducted data extraction. IN checked the data extracted. ADL commented on the draft of the paper, along with other coauthors. All authors contributed to the final manuscript.

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REFERENCES

- WHO. What are social determinants of health? 2012 http://www.who.int/social_determinants/sdh_definition/en/ (accessed 3 Mar 2017).
- Karasek RA. Job demands, job decision latitude, and mental strain: implications for job redesign. *Administrative Science Quarterly* 1979;24:285–308.
- Siegrist J. Effort-reward imbalance at work and health. In: Perrewe P L, Ganster D C, eds. *Historical and current perspectives on stress and health*, 2002:261–91.
- De Witte H. *Job insecurity: review of the international literature on definitions, prevalence, antecedents and consequences*, 2005.
- Bonde JP. Psychosocial factors at work and risk of depression: a systematic review of the epidemiological evidence. *Occup Environ Med* 2008;65:438–45.
- Netterström B, Conrad N, Bech P, et al. The relation between work-related psychosocial factors and the development of depression. *Epidemiol Rev* 2008;30:118–32.
- Siegrist J. Chronic psychosocial stress at work and risk of depression: evidence from prospective studies. *Eur Arch Psychiatry Clin Neurosci* 2008;258 Suppl 5:115–9.
- Stansfeld S, Candy B. Psychosocial work environment and mental health—a meta-analytic review. *Scand J Work Environ Health* 2006;32:443–62.
- Madsen IEH, Nyberg ST, Magnusson Hanson LL, et al. Job strain as a risk factor for clinical depression: systematic review and meta-analysis with additional individual participant data. *Psychol Med* 2017;47:1342–56.
- Theorell T, Hammarström A, Aronsson G, et al. A systematic review including meta-analysis of work environment and depressive symptoms. *BMC Public Health* 2015;15:738.
- Milner A, Krnjack L, LaMontagne AD. Psychosocial job quality and mental health among young workers: a fixed-effects regression analysis using 13 waves of annual data. *Scand J Work Environ Health* 2017;43:50–8.
- LaMontagne AD, Keegel T, Louie AM, et al. Job stress as a preventable upstream determinant of common mental disorders: A review for practitioners and policy-makers. *Advances in Mental Health* 2010;9:17–35.
- Woo JM, Postolache TT. The impact of work environment on mood disorders and suicide: Evidence and implications. *Int J Disabil Hum Dev* 2008;7:185–200.
- Loerbroks A, Cho SI, Dollard MF, et al. Associations between work stress and suicidal ideation: Individual-participant data from six cross-sectional studies. *J Psychosom Res* 2016;90:62–9.
- Milner A, Spittal MJ, Pirkis J, et al. Low control and high demands at work as risk factors for suicide: an Australian national population-level case-control study. *Psychosom Med* 2017;79:358–64.
- Schneider B, Grebner K, Schnabel A, et al. Impact of employment status and work-related factors on risk of completed suicide. A case-control psychological autopsy study. *Psychiatry Res* 2011;190:265–70.
- Tsutsumi A, Kayaba K, Ojima T, et al. Low control at work and the risk of suicide in Japanese men: a prospective cohort study. *Psychother Psychosom* 2007;76:177–85.
- Milner A, Spittal MJ, Pirkis J, et al. Suicide by occupation: systematic review and meta-analysis. *Br J Psychiatry* 2013;203:409–16.
- Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ* 2009;339:b2700.
- Leach LS, Poyser C, Butterworth P. Workplace bullying and the association with suicidal ideation/thoughts and behaviour: a systematic review. *Occup Environ Med* 2017;74.
- Borenstein M. Chapter 7. converting among effect sizes. *Introduction to meta-analysis: Chichester, West Sussex, U.K.* 2009. Hoboken: John Wiley & Sons, 2009.
- Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ* 2003;327:557–60.
- Sterne JCA, Harbord RM. Funnel plots in meta-analysis. *The Stata Journal* 2004;4:127–41.
- Harris R, Bradburn M, Deeks J, et al. *METAN: Stata module for fixed and random effects meta-analysis*. Boston: Statistical Software Components; Boston College Department of Economics, 2006.
- Harbord RM, Higgins JP. Meta-regression in Stata. *The Stata Journal* 2008;8:493–519.
- Baumert J, Schneider B, Lukaschek K, et al. Adverse conditions at the workplace are associated with increased suicide risk. *J Psychiatr Res* 2014;57:90–5.
- Berg A, Hem E, Lau B, et al. An exploration of job stress and health in the Norwegian police service: a cross sectional study. *J Occup Med Toxicol* 2006;1:26.
- Byun J, Kim H-R, Lee H-E, et al. Factors associated with suicide ideation among subway drivers in Korea. *Ann Occup Environ Med* 2016;28:31.
- Yoon J-H, Jeung D, Chang S-J. Does high emotional demand with low job control relate to suicidal ideation among service and sales workers in Korea? *J Korean Med Sci* 2016;31:1042–8.
- Carpenter GSJ, Carpenter TP, Kimbrel NA, et al. Social support, stress, and suicidal ideation in professional firefighters. *Am J Health Behav* 2015;39:191–6.
- Frank E, Dingle AD. Self-reported depression and suicide attempts among U.S. women physicians. *Am J Psychiatry* 1999;156:1887–94.
- McLean CP, Zang Y, Zandberg L, et al. Predictors of suicidal ideation among active duty military personnel with posttraumatic stress disorder. *J Affect Disord* 2017;208:392–8.
- Dalglish SL, Melchior M, Younes N, et al. Work characteristics and suicidal ideation in young adults in France. *Soc Psychiatry Psychiatr Epidemiol* 2015;50:613–20.
- Law YW, Yip PSF, Zhang Y, et al. The chronic impact of work on suicides and under-utilization of psychiatric and psychosocial services. *J Affect Disord* 2014;168:254–61.
- Milner A, Currier D, LaMontagne AD, et al. Psychosocial job stressors and thoughts about suicide among males: a cross-sectional study from the first wave of the Ten to Men cohort. *Public Health*. In Press. 2017;147:72–6.
- Milner A, Page K, Witt K, et al. Psychosocial working conditions and suicide ideation: evidence from a cross-sectional survey of working Australians. *J Occup Environ Med* 2016;58:584–7.
- Ostry A, Maggi S, Tansey J, et al. The impact of psychosocial work conditions on attempted and completed suicide among western Canadian sawmill workers. *Scand J Soc Med* 2007;35:265–71.
- Wall M, Schenck-Gustafsson K, Minucci D, et al. Suicidal ideation among surgeons in Italy and Sweden – a cross-sectional study. *BMC Psychol* 2014;2:53.

- 39 Fridner A, Belkić K, Minucci D, *et al.* Work environment and recent suicidal thoughts among male university hospital physicians in Sweden and Italy: the health and organization among university hospital Physicians in Europe (HOUPE) study. *Gen Med* 2011;8:269–79.
- 40 Tysen R, Vaglum P, Grønvold NT, *et al.* Suicidal ideation among medical students and young physicians: a nationwide and prospective study of prevalence and predictors. *J Affect Disord* 2001;64:69–79.
- 41 Witt K, Milner A, Allisey A, *et al.* Effectiveness of suicide prevention programs for emergency and protective services employees: a systematic review and meta-analysis. *Am J Ind Med* 2017;60:394–407.
- 42 Sugawara N, Yasui-Furukori N, Sasaki G, *et al.* Gender differences in factors associated with suicidal ideation and depressive symptoms among middle-aged workers in Japan. *Ind Health* 2013;51:202–13.
- 43 Takada M, Suzuki A, Shima S, *et al.* Associations between lifestyle factors, working environment, Depressive symptoms and suicidal ideation: a large-scale study in Japan. *Ind Health* 2009;47:649–55.
- 44 Takusari E, Suzuki M, Nakamura H, *et al.* Mental health, suicidal ideation, and related factors among workers from medium-sized business establishments in northern Japan: comparative study of sex differences. *Ind Health* 2011;49:452–63.
- 45 Nuwayhid IA. Occupational health research in developing countries: a partner for social justice. *Am J Public Health* 2004;94:1916–21.
- 46 Möller-Leimkühler AM. The gender gap in suicide and premature death or: why are men so vulnerable? *Eur Arch Psychiatry Clin Neurosci* 2003;253:1–8.
- 47 Arsenault-Lapierre G, Kim C, Turecki G. Psychiatric diagnoses in 3275 suicides: a meta-analysis. *BMC Psychiatry* 2004;4:37.
- 48 Evans R, Scourfield J, Gender MG. relationship breakdown, and suicide risk: A review of research in Western countries. *Journal of Family Issues* 2016;37:2239–64.
- 49 Meltzer H, Bebbington P, Brugha T, *et al.* Personal debt and suicidal ideation. *Psychol Med* 2011;41:771–8.
- 50 McEwen BS, Tucker P. Critical biological pathways for chronic psychosocial stress and research opportunities to advance the consideration of stress in chemical risk assessment. *Am J Public Health* 2011;101(Suppl 1):S131–S9.
- 51 Milner A, Butterworth P, Bentley R, *et al.* Sickness absence and psychosocial job quality: an analysis From a longitudinal survey of working Australians, 2005–2012. *Am J Epidemiol* 2015;181:781–8.
- 52 Li Z, Page A, Martin G, *et al.* Attributable risk of psychiatric and socio-economic factors for suicide from individual-level, population-based studies: a systematic review. *Soc Sci Med* 2011;72:608–16.