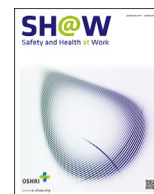




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Review Article

Men, Work, and Mental Health: A Systematic Review of Depression in Male-dominated Industries and Occupations



Ann M. Roche*, Ken Pidd, Jane A. Fischer, Nicole Lee, Anje Scarfe, Victoria Kostadinov

National Centre for Education and Training on Addiction, Flinders University, Adelaide, South Australia, Australia

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ABSTRACT

Among men, depression is often unrecognised and untreated. Men employed in male-dominated industries and occupations may be particularly vulnerable. However, efforts to develop tailored workplace interventions are hampered by lack of prevalence data. A systematic review of studies reporting prevalence rates for depression in male dominated workforce groups was undertaken. Studies were included if they were published between 1990 - June 2012 in English, examined adult workers in male-dominated industries or occupations (> 70% male workforce), and used clinically relevant indicators of depression. Twenty studies met these criteria. Prevalence of depression ranged from 0.0% to 28.0%. Five studies reported significantly lower prevalence rates for mental disorders among male-dominated workforce groups than comparison populations, while six reported significantly higher rates. Eight studies additionally found significantly higher levels of depression in male-dominated groups than comparable national data. Overall, the majority of studies found higher levels of depression among workers in male-dominated workforce groups. There is a need to address the mental health of workers in male-dominated groups. The workplace provides an important but often overlooked setting to develop tailored strategies for vulnerable groups.

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1. Introduction

Recent years have seen increasing interest in men's health, including mental health and wellbeing. There is growing recognition of the prevalence and implications of depression among men [1–3]. Although women have higher overall rates of depression [4], it is frequently unrecognized, undiagnosed, and untreated among men [5]. Given the significant costs associated with mental illness [6,7], poor mental health among men represents a large and preventable impost upon society.

Depression and bipolar disorders are among the main causes of disease and disability [8]. It is anticipated that by 2030 depressive disorders will become the number one cause of ill health and premature death world-wide, accounting for 6.2% of all disability-adjusted life years lost [7]. The prevalence of mental disorders comes at a substantial financial cost. It has been estimated that the annual economic cost of mental illness is at least £105 billion in

England [9], \$317 billion in the US [10], \$51 billion in Canada [11], and \$20 billion in Australia [12]. Depression and anxiety are also the most prevalent mental disorders in the working population [13] and a substantial proportion of costs associated with mental illness is due to lost workplace productivity. For example, annual lost productivity costs due to mental disorders are estimated at £30 billion in England [9], \$51 billion in the US [14], \$6.3 billion in Canada [15], and \$5.9 billion in Australia [6]. Much of these lost productivity costs are directly associated with workforce absenteeism and presenteeism [16–18].

Traditional masculine norms and the stigma associated with mental illness can promote a culture whereby men are reluctant to acknowledge or seek help for mental health problems [7,19–22]. Although there is a higher prevalence of depression amongst women in the general population, men have lower levels of mental health literacy than women [23] and are less likely to visit their doctor [21,22], use mental health services [24], and discuss mental

* Corresponding author. NCETA, Flinders University, Level 3B, Mark Oliphant Building, Laffer Drive, Bedford Park, South Australia 5042, Australia.
E-mail address: ann.roche@flinders.edu.au (A.M. Roche).

health issues [25]. Correspondingly, adverse consequences associated with poor mental health can be more severe among men, such as suicide [26].

Workplace factors can also contribute to poor mental health among men. Employment can promote wellbeing by providing regular activity, time structure, social contact, a sense of collective effort, and social identity [27]. However, the workplace can also be a source of psychological stress that can negatively affect employee mental health [28–33].

Male-dominated industries (i.e., those comprising >70% men) may be particularly problematic in this regard. Established risk factors for mental illness are commonly found in these industries, and include isolated/solitary work, excessive or irregular workloads, poor physical conditions, lack of control, and monotonous tasks [34]. Accordingly, workers in some Australian male-dominated industries have been found to have disproportionately high rates of depression and mood disorders [4]. However, it is uncertain whether the prevalence of depression among men in male-dominated industries is consistent across countries.

Given the potential impact of working conditions upon mental health, workplace health promotion programs and interventions are increasingly being implemented to prevent/minimize the emergence of problems and support workers with mental health issues. Such workplace programs are particularly relevant for mental health promotion targeting men.

The workplace provides ready access to large numbers of men and contains existing infrastructure and frameworks that can support mental health and wellbeing strategies. In addition, addressing mental health issues as part of wider occupational health, safety and wellbeing programs may create workplace norms that reduce stigma and facilitate help-seeking. Workplace programs can also target other barriers to mental health help-seeking behavior such as low levels of mental health literacy [35,36]. Moreover, the workplace offers an opportunity to develop tailored strategies that target specific high risk industries and occupations.

Such tailored strategies may be particularly beneficial for workers in male-dominated industries, due to the high prevalence of mental health problems in combination with low mental health literacy and a reluctance to seek help. While research is limited, there is some evidence that interventions in male-dominated industries can have a positive impact on the mental health of workers, particularly for high prevalence low severity disorders such as depression [37,38].

However, the development of tailored workplace strategies for men is hampered by a lack of prevalence data identifying high-risk workforce groups. While prevalence rates for depression are known to vary across different occupations and industries [39,40], it is not

clear whether rates of these disorders are consistently elevated in workforce groups where men predominate.

A better understanding of the prevalence of depression in industries and occupations with a high proportion of men could inform the development of appropriate policies and tailored workplace mental health interventions. However, to date, no research has systematically examined the prevalence rates of common mental disorders, such as depression, amongst male workers employed in male-dominated workforce groups.

In order to address this issue, a systematic review of literature was undertaken to determine the prevalence of depression amongst men employed in male-dominated industries and occupations. The review forms part of a larger program of work exploring risk factors for mental illness in male-dominated industries and effective intervention approaches [28,37]. Specifically, the following research questions were investigated:

Q1. Is depression among male workers in male-dominated industries and occupations greater than in comparable populations? Comparable populations are defined as general population/total workforce/all male workers.

Q2. Is depression more prevalent in particular male-dominated industry/occupational groups?

2. Materials and methods

A systematic literature search was undertaken to identify and assess the findings and methodological rigor of relevant studies.

2.1. Inclusion and exclusion criteria

Studies were included in the review if they examined paid workers employed in “male-dominated” industries or occupations (agriculture, construction, manufacturing, mining, transport, or utilities); administered validated indicators of depression, or related disorders; and were published in English between January 1990 and June 2012. Studies were excluded if they examined volunteers or migrant workers who were not citizens, or were government or industry reports [41] (Table 1).

Male-dominated industries and occupations were defined as those where at least 70% of the civilian workforce were men. In Australia, male-dominated industries include: agriculture (forestry, fishing, and farming), construction, manufacturing, mining, transport, and utilities (electricity, gas, water supply, and waste management) [42]. Male-dominated occupations include: farming and forestry workers, laborers, production workers, tradespersons, and transport workers [43]. Similar industries and occupations are also classified as male-

Table 1
Study inclusion and exclusion criteria

Criteria	Included	Excluded
Male-dominated industries and/or occupations	Agriculture; construction; manufacturing; mining; transport; utilities	Other industries Migrant workers who are not citizens
Language	English	Non-English
Sex	Any sex	NA
Mental Health	Depression; psychological distress symptoms, and conditions	Not depression
Type of work	Paid work in developed countries including full-time, part-time, casual, temporary/contract/transient; formal work	Volunteer work
Types of research	Primary research studies published in the English language	Nonprimary research (e.g., literature reviews; government reports; industry reports), and studies not published in the English language

Table 2
Percentage of employed men working in male-dominated industries (MDI) of all male workers and total workers by country*

Country	Persons in the working population	Men in the working population	Men employed in MDI	% men employed in MDI, of all male workers	% men employed in MDI, of all workers
Australia [47]	10,058,325	5,366,669	2,163,766	40.32	21.51
Canada [48]	17,802,200	9,328,000	8,392,600	89.97	47.14
Denmark [49]	2,456,962	1,248,228	422,670	33.86	17.20
Finland [50]	2,457,000	1,261,000	720,000	57.10	29.30
Netherlands [51]	17,398,000	9,174,000	1,275,000	13.90	7.33
Norway [52]	2,505,500	1,314,500	467,100	35.53	18.64
United Kingdom [53]	30,966,000	16,464,000	7,042,000	42.77	22.74
United States of America [54]	146,305,000	77,687,955	35,819,000	46.16	24.48

* Data not available in English for Japan and France.

dominated in the USA [44,45] and most European countries [46]. Defense and emergency services (police, ambulance, fire) were excluded from the study due to the potential for confounding. The manifestation and presentation of depression is likely to be much more complex in these industries/occupations, given the nature of the work and exposure to trauma, and they warrant separate consideration.

Data on the number and proportion of men employed in male-dominated industries and occupations for countries where studies were located are provided in Table 2.

The focus of the review was symptoms of depression that may require intervention. Symptoms of depression were indicated by positive screens on validated self-report instruments (e.g., Center for Epidemiologic Studies Depression Scale, Depression, Anxiety, and Stress Scale, and Kessler 6/10), or clinician or trained researcher administration of validated clinical instruments (e.g., Clinical Interview Schedule, Mini International Neuropsychiatric Interview, University of Michigan Composite International Diagnostic Interview). The former are designed to detect the likelihood of depression in a person, whilst the latter gather more detailed information from individuals on the potential presence and seriousness of depression. As these instruments are highly correlated with a diagnosis, we have used the general term “depression” [28]. Prevalence data for depression were subsequently extracted/calculated from the results section of each included study. Further details of the measures used are shown in Table 3.

To further assess and compare the prevalence of depression, additional national data for the countries in which studies were located were sourced to identify the prevalence among the wider working/general population. These additional data were sourced from high quality representative surveys, and are presented in Table 3. Where possible, z scores were calculated for both within study prevalence comparisons and general population prevalence levels in order to identify statistically significant differences.

2.2. Search strategy

Searches were conducted using the electronic databases: Cumulative Index of Nursing and Allied Health Literature, Cochrane Library, Informit, PsycINFO, PubMed, and Scopus. Searches combined relevant MeSH and other database thesaurus headings, Boolean terms, and keywords. Hand searches of study reference lists and searches of the grey literature were also conducted using conventional electronic search engines, such as Google. The main search terms used were:

- prevalence
- “mental health” OR “mental illness” OR “mental disorder” OR “depression”

- “male-dominated” OR “work” OR “worker” OR “labor” OR “labour” OR “industry” OR “industrial” OR “blue collar” OR “white collar” OR “agriculture” OR “construction” OR “mining” OR “building” OR “manufacture” OR “transport”

2.3. Study selection

Studies identified in the initial search underwent a two-stage screening process. Firstly, two reviewers screened each article title and abstract to remove duplicate and irrelevant studies. Secondly, the title and abstract were perused to assess whether the study was likely to meet the inclusion criteria. For those studies meeting the inclusion criteria the full text was reviewed and assessed. A senior researcher checked all excluded studies. Fig. 1 displays the studies remaining at each step.

2.4. Data extraction

There is no standard tool for data extraction or for assessing study quality [78]. Guidelines such as the Meta-analysis of Observational Studies in Epidemiology [79] are designed for meta-analytic reviews. Examination of papers in this review indicated that a meta-analysis would not be appropriate. Strengthening The Reporting of Observational Studies in Epidemiology statement was therefore used as a guideline for data extraction from observational research, i.e., cohort, case-control, and cross-sectional study designs [80].

To ensure consistency in data extraction [81], a data extraction template and codebook were developed based on the Strengthening The Reporting of Observational Studies in Epidemiology [80] and covered: citation details, source of citation (e.g., Cumulative Index of Nursing and Allied Health Literature), study objectives, methods (selection of participants, assessment, confounders, and statistical analyses), results, conflicts of interest, and bias [78]. The template also allowed reviewers to make preliminary assessments of the information quality provided in the study (well covered, poor, adequate, not addressed, not reported, or not applicable). Data extraction results were reviewed by all authors.

2.5. Quality assessment

The methodological rigor of the studies was evaluated against a modified version of a qualitative assessment tool for quantitative studies [82]. This tool was developed to assess the methodological quality of primary studies in public health [83], and is based on guidelines by Mulrow and colleagues [84] and Jadad and colleagues [85]. Guidelines provided in the tool dictionary assess the methodological adequacy of research against eight criteria. Studies were

Table 3 (continued)

Author	Study details	Mental disorder	Male prevalence %	Comparison population prevalence %	Significance testing
			Machine operators/assemblers/inspectors (n = 66): 4% Metal and plastic machine operators (n = 89): 4% Operators (machine not specified) (n = 118): 4% Machine operators (assorted materials) (n = 177): 2% Precision workers (assorted materials) (n = 154): 2% Printing machine operators (n = 55): 2% Precision textile workers (n = 53): 0% Manufacturing average: 3.4% Truck drivers (n = 138): 4% Transport workers (n = 237): 4% Vehicle repairers (n = 67): 3% Movers (n = 58): 2% Clerks/traffic shipping receiving (n = 66): 2% Auto mechanics (n = 68): 0% Transport average: 2.5% Mail distributors (n = 110): 2% Misc. mechanics & repairers (n = 57): 0% Electrical equipment repairers (n = 69): 0% Utilities average: 0.7% Laborers (n = 102): 6% Handlers/equipment cleaners/laborers (n = 144): 3% Manual workers average: 4.5% Machinery operators, drivers, & laborers (n = 153): 9.2%		(z = 4.1, p < 0.01), precision workers (assorted materials) (z = 6.9, p < 0.01), repairers (industrial machinery) (z = 4.1, p < 0.01), other repairers (z = 4.2, p < 0.01), mail distributors (z = 5.9, p < 0.01), printing machine operators (z = 4.3, p < 0.01), movers (z = 4.4, p < 0.01), other construction workers (z = 8.4, p < 0.01), engineers/architects/surveyors (z = 6.2, p < 0.01), clerks/traffic shipping receiving (z = 4.7, p < 0.01), engineering & related technologists (z = 8.1, p < 0.01), auto mechanics (z = 26.0, p < 0.01), electrical equipment repairers (z = 26.0, p < 0.01), misc. mechanics & repairers (z = 26.0, p < 0.01), and precision textile workers (z = 26.0, p < 0.01) sig. lower than national prevalence.
Fragar et al 2010 [60]	Study population: Respondents to the Australian Rural Mental Health Study (ARMHS) Total sample size: 2,639 (response rate not reported) Participant characteristics: mean age: 55.1 Y; 41% men Study design: Cross sectional stratified random Measure: K10 Prevalence time period: Past 4 wks Study strength: Weak	Psychological distress		Not reported	Unable to be conducted
Gann et al 1990 [61]	Study population: Employees of Scottish offshore oil mining company Total sample size: 796 (response rate 98%) Participant characteristics: mean age: 40.6 Y; 96% male Study design: Cross-sectional convenience Measure: GADS Prevalence time period: "Recent" symptoms Study strength: Weak	Depression	Total sample: 28%	National prevalence (1994, past y) [62]: 5%	Study sample sig. higher than national prevalence (z = 14.2, p < 0.01).
Hilton et al 2008 [17]	Study population: Employees of 58 large (> 1,000 employees) Australian government & private organizations Total sample size: 60,556 (response rate 24.7%) Participant characteristics: age: 18+ y; 42.4% male Study design: Cross-sectional purposive Measure: K6 Prevalence time period: Past 4 wks Study strength: Moderate	Psychological distress	Agriculture: 3.4% Manufacturing: 3.4% Utilities: 4.2%	Total sample: 4.5% All males (n = 25,697): 4.3%	Unable to be conducted

Hilton et al 2009 [63]	Study population: Employed Australian heavy truck drivers Total sample size: 1,292 (response rate 8% (phase 1); 35.9% (phase 2)) Participant characteristics: age: 18+ y; 98.3% male Study design: Cross-sectional convenience Measure: DASS-21 Prevalence time period: Past wk Study strength: Weak	Depression	Total sample: 13.3%	DASS-21 Norms (n = 1,771): 18.3% National prevalence (2007, past y) [4]: 4.1%	Sample sig. lower than normative data (z = 3.8, p < 0.01). Study sample sig. higher than national prevalence (z = 9.5, p < 0.01).
Hounsome et al 2012 [64]	Study population: Attendees of Welsh Agricultural Show 2002–2004 Total sample size: 784 (response rate not reported) Participant characteristics: age: 16+ y; 64.4% male Study design: Cross-sectional convenience Measure: GHQ-12 Prevalence time period: Past few wks Study strength: Weak	Psychological distress	Farmers and their spouses (both men and women)* (n = 287): 35%	Nonfarmers (n = 497): 27%	Farmers sig. higher than nonfarmers (z = 2.3, p < 0.05).
Inoue & Kawakami 2010 [65]	Study population: Employees of nine Japanese manufacturing companies Total sample size: 20,313 (response rate 85%) Participant characteristics: mean age: 37 y; 85.6% men Study design: Cross-sectional purposive Measure: CES-D Prevalence time period: Past fortnight Study strength: Moderate	Depression	High SES (n = 6,045): 20% Moderate SES (n = 3,882): 22.1% Low SES (n = 7,463): 26.8% All: 23.38%	Total sample: 24% National prevalence (2002–2003, past y) [66]: 2.9%	High (z = 6.7, p < 0.01) and moderate SES (z = 2.6, p < 0.01) sig lower than total sample. Low SES sig. higher than total sample (z = 4.7, p < 0.01). High (z = 27.7, p < 0.01), moderate (z = 25.7, p < 0.01), and low (z = 38.8, p < 0.01) SES sig. higher than national prevalence.
Kawakami et al 1995 [67]	Study population: Employees of a Japanese electrical manufacturing company Total sample size: 468 (response rate 91%) Participant characteristics: mean age: 37.8 y; 100% men Study design: Prospective cohort Measure: SDS Prevalence time period: Past several days Study strength: Weak	Depression	Total sample: 13%	National prevalence (2002–2003, past y) [66]: 2.9%	Study sample sig. higher than national prevalence (z = 6.3, p < 0.01).
Niedhammer et al 1998 [68]	Study population: Employees of national French utility company who participated in 1995–1996 Gazel Cohort longitudinal study Total sample size: 11,552 (response rate 64.1%) Participant characteristics: age range: 41–56 y; 73% men Study design: Prospective cohort Measure: CES-D Prevalence time period: Past fortnight Study strength: Moderate	Depression	All men (n = 8,422): 24.9%	Total sample: 25.7% National prevalence (1999–2003, past fortnight) [56]: Men: 8.9%	Unable to be conducted Study sample sig. higher than national prevalence (z = 32.4, p < 0.01).
Sanne et al 2004 [69]	Study population: Employed respondents to 1997–1999 Norwegian Hordaland Health Study survey Total sample size: 17,295 (response rate 65%) Participant characteristics: age range: 40–49 y; 46% men Study design: Cross-sectional random Measure: HADS Prevalence time period: Past wk Study strength: Moderate	Depression	Farmers (n = 917): 17.3%	Male nonfarmers (n = 16,378): 9.3%	Farmers sig. higher than nonfarmers (z = 6.3, p < 0.01).
Scarth et al 2000 [70]	Study population: Farmers residing in Iowa and Colorado Total sample size: 855 (Iowa = 385, Colorado = 470); (response rate 32.8%)	Depression	Farmers in Iowa (n = 385): 12.2% Farmers in Colorado (n = 470): 7.4% Total sample: 9.8%	National prevalence (2001–2003, past y) [71]: 6.7%	Total study sample sig. higher than national prevalence (z = 3.0, p < 0.01)

(continued on next page)

Table 3 (continued)

Author	Study details	Mental disorder	Male prevalence %	Comparison population prevalence %	Significance testing
	Participant characteristics: mean age: 50.12 y; 100% men Study design: Cross-sectional random Measure: CES-D Prevalence time period: Past fortnight Study strength: Moderate				
Stansfeld et al 2011 [39]	Study population: Employed UK residents Total sample size: 5,497 (response rate 65.9%) Participant characteristics: age range: 16–64 y; sex not reported Study design: Cross-sectional random Measure: CIS-R Prevalence time period: Past wk Study strength: Moderate	Common mental disorders	Skilled construction trades: 13% Drivers/mobile machine operators: 7% Industrial plant and machine operators/assemblers: 9% Science/engineering associate professionals: 6% Other elementary occupations: 8%	Total sample: 13%	Unable to be conducted
Velander et al 2010 [72]	Study population: Employees of WA gold mining company Total sample size: 591 (response rate 61%) Participant characteristics: mean age: 35.8 y; 90% men Study design: Cross-sectional convenience Measure: DASS-21 Prevalence time period: Past wk Study strength: Weak	Depression	All men (n = 530): 19.3%	Total sample: 16% National rural and remote population: 5.4% National prevalence (2007, past y) [4]: 4.1%	Unable to be conducted Study sample sig. higher than national prevalence (z = 8.8, p < 0.01).
Studies using long-term measures					
Cohidon et al 2009 [56] [†]	Study population: Respondents to 1999–2003 International Survey on Mental Health in the General Population (SMPG) Total sample size: 36,000 (response rate not reported) Participant characteristics: age: 18+ y; 46% men Study design: Cross-sectional stratified quota Measure: MINI Prevalence time period: Lifetime Study strength: Weak	Depression	Farmers (n = 307): 1.4% Manual workers (n = 3,773): 4.4%	All employed men (n = 10,968): 3.9%	Farmers sig. lower than all employed males (z = 3.6, p < 0.01).
Joensuu et al 2010 [73]	Study population: Participants in Still Working Study of Forestry workers who had not been admitted to hospital for a mental disorder in past 15 y Total sample size: 13,868 (response rate 76%) Participant characteristics: age range: 16–65 y; 75% men Study design: Prospective cohort Measure: ICD-9 Prevalence time period: Past 15 y Study strength: Strong	Depression	All men (n = 10,620): 1.3%	Total sample: 1.3% National prevalence (2000–2001, past y) [74]: 4.9%	Unable to be conducted Study sample sig. lower than national prevalence (z = 13.2, p < 0.01)
Petersen & Zwerling 1998 [75]	Study population: Males born between 1931–1941 who responded to Wave 1 (1992) of US Health and Retirement Study Total sample size: 4,092 (response rate not reported) Participant characteristics: age range: 51–61 y; 100% men Study design: Cross-sectional random	Emotional/psychiatric problems	Construction workers (n = 312): 11.3%	White collar workers in other industries (n = 2,064): 5.3% Blue collar workers in other industries (n = 1,716): 6.4%	Construction workers sig. higher than white collar workers in other industries (z = 3.2, p < 0.01) & blue (z = 2.6, p < 0.05)

<p>Measure: Single item: "Has a doctor ever told you that you had emotional, nervous, or psychiatric problems?" Prevalence time period: Lifetime Study strength: Weak</p>	<p>Study population: Alberta residents who had been employed in the last 12 months (2009) Total sample size: 2,817 (response rate 42.3%) Participant characteristics: age: 18+ y; 39.8% male Study design: Cross-sectional random Measure: MINI</p>	<p>Depression</p>	<p>Agriculture/mining (n = 324): 10.3% Construction (n = 183): 11.0% Manufacturing (n = 132): 2.6% Transport (n = 121): 8.5%</p>	<p>Total sample: 13.1% National prevalence (2012, past y) [77]: 4.7%</p>	<p>Manufacturing sig. lower than total sample (z = 6.9, p < 0.01). Agriculture/mining (z = 3.3, p < 0.01) and construction (z = 2.7, p < 0.01) sig higher than national prevalence.</p>
<p>Thompson et al 2011 [76]</p>	<p>Prevalence time period: Lifetime Study strength: Moderate</p>	<p>Affective disorders</p>	<p>Skilled agriculture & fishery workers (n = 760): 16.18% Extraction & building workers (n = 1,264): 13.69% Metal/machinery workers (n = 1,528): 12.57% Precision, handcraft, printing (n = 159): 12.59% Other craft workers (n = 225): 17.78% Stationary plant operators (n = 125): 14.40% Machine operators/assemblers (n = 759): 15.81% Drivers/mobile plant operators (n = 781): 13.70% Agriculture/fishery laborers (n = 60): 8.33% Other laborers (n = 664): 13.25%</p>	<p>Not reported</p>	<p>Unable to be conducted</p>
<p>Wieclaw et al 2005 [40]</p>	<p>Study population: Danish residents with an affective disorder or stress-related diagnosis 1995-1998 Total sample size: 28,971 cases & 144,855 referents Participant characteristics: age range: 18-65 y; 36.1% men Study design: Population level nested case control Measure: ICD-10 Prevalence time period: Lifetime Study strength: Strong</p>	<p>Affective disorders</p>			

CES-D, Center for Epidemiologic Studies Depressive Symptoms Scale; CIS-R, Clinical Interview Schedule; DIS, National Institute of Mental Health Diagnostic Interview Schedule; G-ADS, Goldberg Anxiety and Depression Scale; GHQ-12, General Health Questionnaire; HADS, Hospital Anxiety and Depression Scale; ICD, International Classification of Disease codes; K6, Kessler 6; K10, Kessler 10; MINI, Mini International Neuropsychiatric Interview; SDS, Zung Self-rating Depression Scale; SES, socioeconomic status.

* Data unable to be disaggregated by gender.
† This study used both short- and long-term measures. Results have been separated accordingly and are reported in two places in the table.

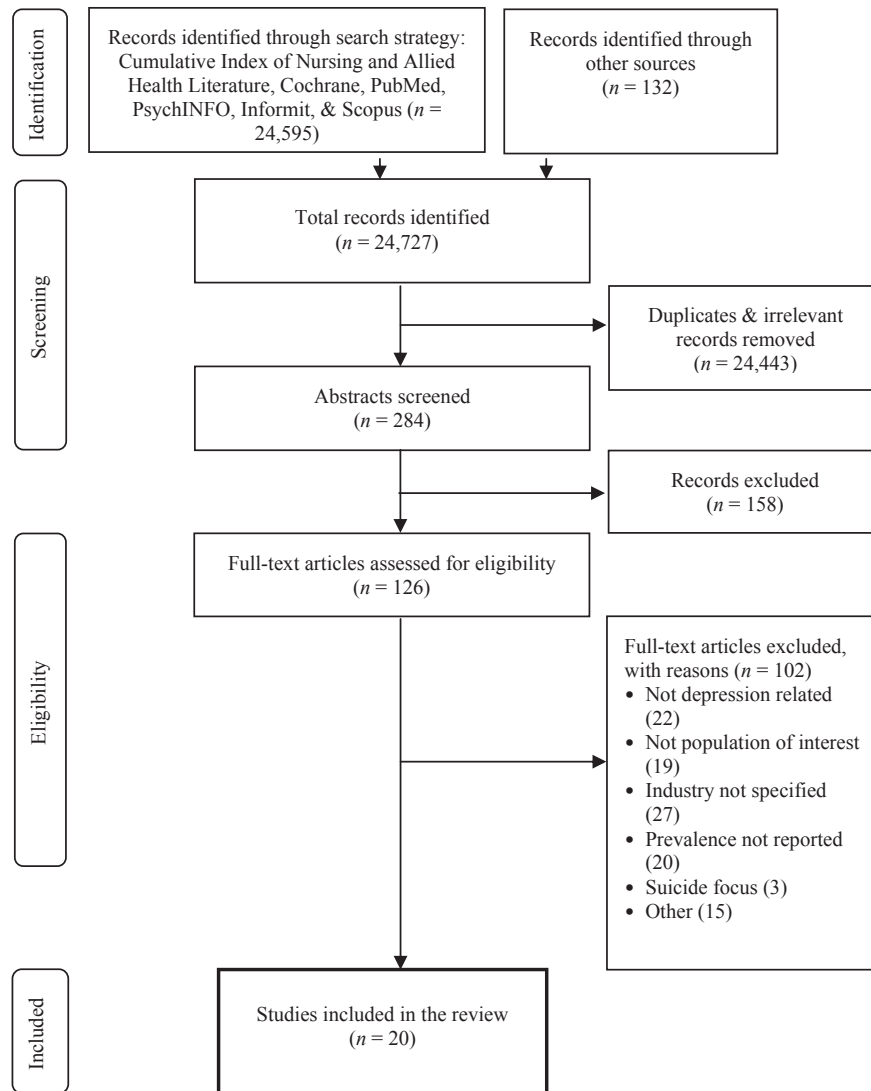


Fig. 1. Flow diagram of study selection for systematic review of published research on the prevalence of depression in male-dominated industries and occupations.

assessed in terms of the quality of prevalence data provided. As the current review focused on identifying prevalence rates, the criterion “selection bias” was replaced with the criterion “representativeness” and two criteria (blinding and intervention integrity) were not relevant and deleted. This resulted in six criteria (representativeness, study design, confounders, data collection, response rate, and analysis) that were each assessed as being strong, moderate, or weak. Studies that obtained at least four ratings of strong, with no ratings of weak for any of the assessment criteria, were assessed as methodologically strong. Studies that obtained less than four strong ratings but no more than one weak rating for any of the assessment criteria were assessed as methodologically moderate. Studies that obtained two or more weak ratings for any of the assessment criteria were assessed as methodologically weak.

3. Results

A total of 20 studies met the inclusion criteria. A description of each study, together with the main findings concerning the prevalence (short term and long term) of depression is presented in Table 3.

The studies were undertaken in 10 countries: (1) four in Australia [6,17,60,72]; (2) three in the UK [39,61,64]; (3) three in the USA [58,70,75]; (4) three in France [56,57,68]; (5) two in Japan [65,67]; (6) one in Canada [76]; (7) one in the Netherlands [55]; (8) one in Denmark [40]; (9) one in Finland [73]; and one in Norway [69]. The majority of studies ($n = 12$) were undertaken within the past 10 years, suggesting increasing interest in workers’ mental health.

Labor force data on the total number of male workers and male workers employed in male-dominated industries and occupations were available for eight countries (see Table 2). In these countries, the proportion of men employed in male-dominated industries and occupations as a percentage of the total workforce ranged from 7.3% to 29.3%, with Canada as an outlier (47.1%). The proportion of men employed in male-dominated industries and occupations as a percentage of all male workers ranged from 13.9% and 57.1%, with Canada again an outlier (90.0%). In all eight countries, male-dominated industries and occupations (i.e., where men comprised > 70% of the workforce) were consistently identified as agriculture, construction, manufacturing, mining, transportation, and utilities.

Three studies were assessed as methodologically strong [40,58,73] and nine as having moderate methodological rigor [17,39,55,57,65,68–70,76]. The remaining studies were assessed as methodologically weak (Table 3).

3.1. Male-dominated occupations and industries

The prevalence of depression among male-dominated industries and occupations varied widely across studies, ranging from 0.0% to 28.0%.

3.1.1. Within-study comparisons

Tests for differences in levels of depression between workers in male-dominated industries and within-study comparator groups were able to be conducted for 10 studies (for the remaining 10 studies, within study comparisons could not be calculated).

Six male-dominated industries were found to have significantly higher levels of depression than within-study comparison populations. These male-dominated industries included: machinists in the Netherlands [55], manual workers in France [57], low socio-economic status (SES) manufacturing workers in Japan [65], and farmers in the UK [64] and Norway [69]. Construction workers in the USA [75] were also found to have significantly higher lifetime reports of emotional/psychiatric problems (assessed with a single item) than white or blue collar workers in other industries.

A number of other male-dominated industries were found to have significantly lower levels of depression or psychological distress than within study comparison populations. These male-dominated industries included: delivery/truck drivers, plumbers/gas fitters, and foremen in the Netherlands [55], foremen and manufacturing workers in Canada [76], high/moderate SES manufacturing workers in Japan [65], and farmers in France [56]. One study also found lower levels of depression among Australian truck drivers [63]. However, UK normative data was used as the comparator, which may not be analogous to the Australian study population. One study found no differences in depression between workers in male-dominated industries and the total male population [57].

3.1.2. Comparisons with national prevalence data

The findings of 10 studies were able to be compared to national prevalence data for depression, obtained for approximately the same time period as when the study was undertaken. Levels of depression which were significantly higher than the national average were found among truck drivers and mining company

workers in Australia [63,72], offshore mining company workers in Scotland [61], manufacturing workers in Japan [65,67], utility workers in France [68], farmers in the US [70], and agriculture, mining, and construction workers in Canada [76]. Only two studies reported levels of depression among workers in male dominated industries which were significantly lower than national prevalence data [58,73].

Overall, the majority of studies found higher levels of depression among workers in male-dominated industries when compared with either within study comparators or general population data.

3.2. Prevalence of depression by industry

To examine prevalence patterns more closely, the available data were also grouped by the six identified male-dominated industries.

3.2.1. Agriculture

Ten studies reported the prevalence of depression among agricultural workers (Fig. 2). With one exception [56], the methodological rigor of these studies was strong or moderate. Prevalence of depression in agriculture ranged from 1.3% to 17.3%. Agriculture workers were found to have higher rates of depression than comparison populations in three studies; however, the difference was significant only in the Sanne and colleagues study [69]. Lower or equal rates of depression were found in three studies [56,73,76]. One study did not report comparisons [70].

3.2.2. Construction

Depression among construction workers was examined in two studies; one methodologically strong [58] and the other moderate [76]. Prevalence of depression among construction workers ranged from 2.4% to 11.0%. Both studies reported (insignificant) lower rates of depression in construction than in the comparison population (Fig. 3).

3.2.3. Manufacturing

Four studies examined depression among manufacturing workers; one was methodologically strong [58], two moderate [65,76], and one weak [67] (Fig. 4). Prevalence of depression among manufacturing workers ranged from 2.6% to 23.4%. One study reported significantly lower levels of depression among manufacturing workers than workers in the comparison population [76]; one found no significant difference between the groups [65], and two were unable to be tested.

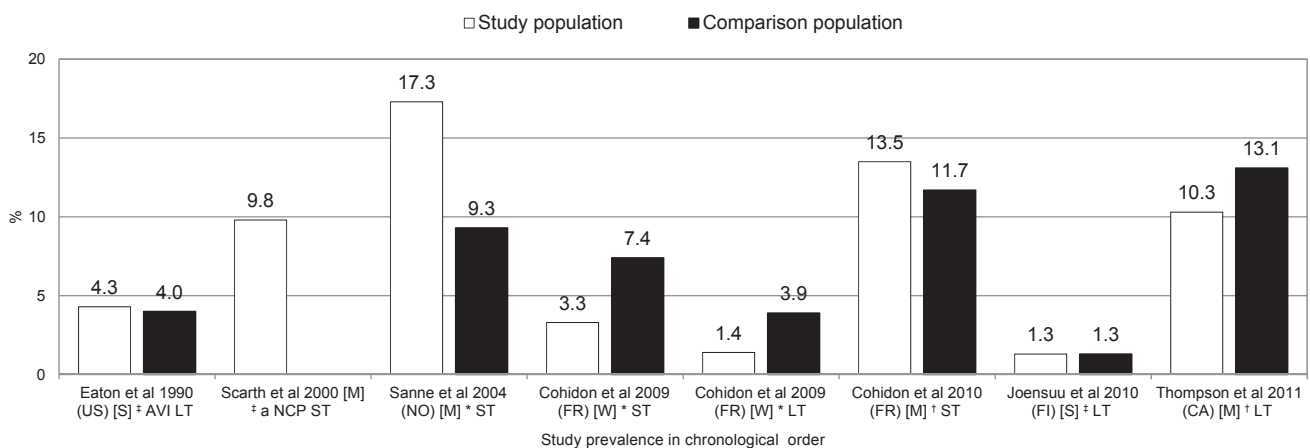


Fig. 2. Prevalence of depression in agriculture. AVI, Mean of three occupations; CA, Canada; FI, Finland; FR, France; JA, Japan; LT, long term; M, moderate strength; NCP, no comparison population; NO, Norway; S, strong strength; ST, short term; US, United States; W, weak strength. * Significant at 0.05. † Not significant. ‡ Not able to be tested.

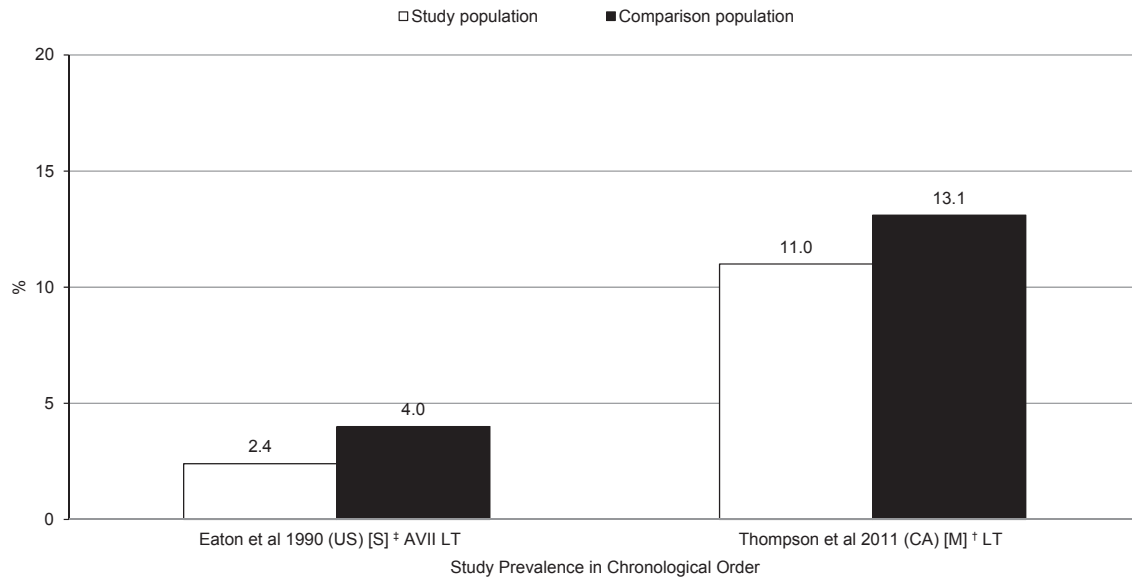


Fig. 3. Prevalence of depression in construction. AVII, Mean of nine occupations; CA, Canada; LT, long term; M, moderate strength; S, strong strength; ST, short term; US, United States. * Significant at 0.05. † Not significant. ‡ Not able to be tested.

3.2.4. Mining

Depression in the mining industry was examined by two studies [61,72], both of which were methodologically weak. Gann et al [61] reported that 28% of the mining sample experienced short-term depression, which was higher than the national rate of 5%. Similarly, Velander et al [72] reported that 19.3% of gold company employees experienced depression, much higher than the within study comparison population (5.4%) and the national rate (4.1%) (data not shown).

3.2.5. Transportation

Four studies reported the prevalence of depression among transportation workers (Fig. 5). The methodological rigor of each study varied, with one strong [58], one moderate [76], and one

weak [63]. Prevalence of depression among transportation workers ranged from 2.5% to 13.3%. In each study the prevalence of depression among transportation workers was lower than the comparison population, but only significantly so for Hilton et al [63].

3.2.6. Utilities

Depression among utility workers was examined in two studies. Methodological rigor was strong in one study [58] and moderate in the other [68]. In the Eaton et al [58] study, the average prevalence of depression over three utility occupations was 0.7%, lower than the 4% reported in the comparison population. In the Niedhammer et al [68] study, the prevalence of depression among utility workers was 24.9%, which was

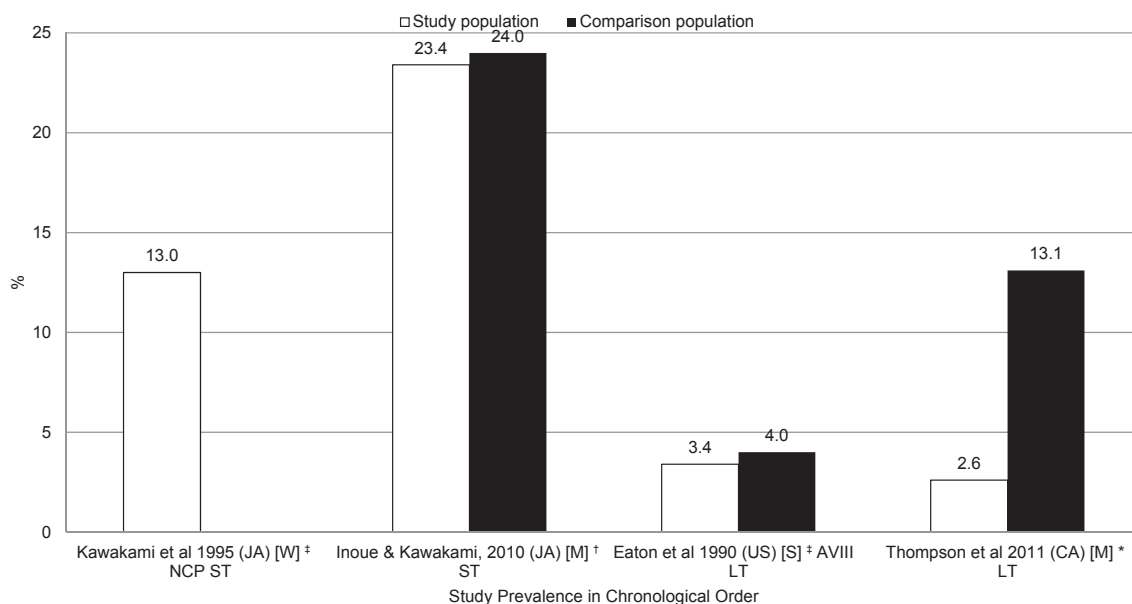


Fig. 4. Prevalence of depression in manufacturing. AV, Mean of 10 occupations; CA, Canada; JA, Japan; LT, long term; M, moderate strength; NCP, no comparison population; S, strong strength; ST, short term; US, United States; W, weak strength. * Significant at 0.05. † Not significant. ‡ Not able to be tested.

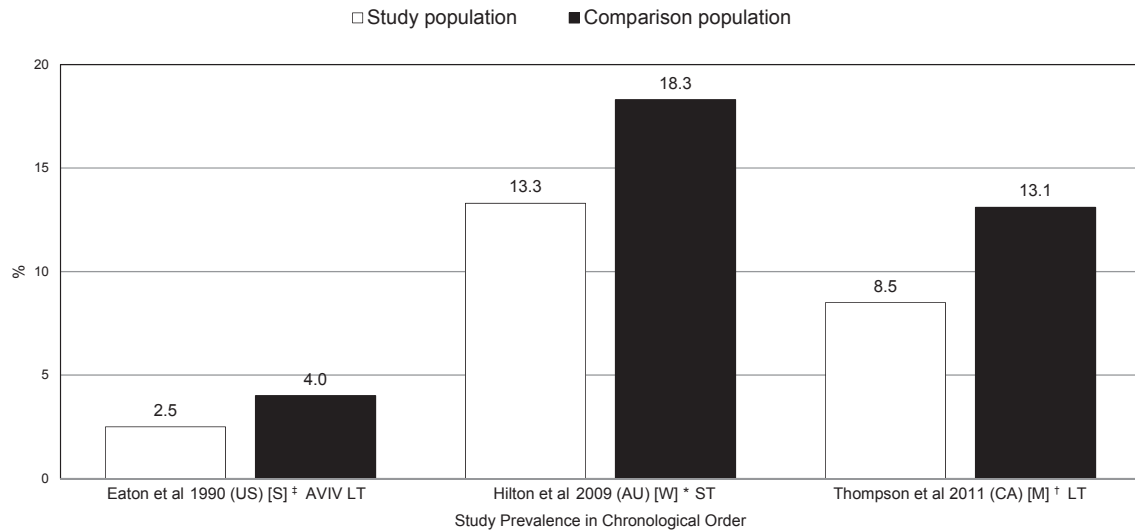


Fig. 5. Prevalence of depression in transportation. AU, Australia; AVIV, mean of six occupations; CA, Canada; LT, long term; M, moderate strength; S, strong strength; ST, short term; US, United States; W, weak strength. * Significant at 0.05. † Not significant. ‡ Not able to be tested.

also lower than the comparison population (25.7%) (data not shown).

3.2.7. Manual occupations

Depression among manual workers was examined in three studies (Fig. 6). Methodological rigor varied: one study was strong [58], one was moderate [57], and one was weak [56]. The prevalence of depression ranged from 4.4% to 12.6%, and in all studies was higher among manual workers than comparison populations.

3.3. Variations according to measures used

Twelve different measures were used to assess the prevalence of depression (Table 4). Sixteen studies used short-term measures and

five used long-term measures (some studies used both). The most common measure used was the Center for Epidemiologic Studies Depression Scale (n = 4), followed by the Depression, Anxiety, and Stress Scale (n = 2), General Health Questionnaire (n = 2), Kessler 6/10 (n = 2), International Classification of Disease (n = 2), and the Mini International Neuropsychiatric Interview (n = 2). The remaining studies each used different instruments to measure prevalence.

Prevalence rates of depression were found to vary among the same occupational groups according to the assessment tool utilized, and whether short- or long-term measures were used. For example, depending on the type of instrument used, rates of depression among farmers ranged from 0% to 17.3%. Similarly, depression among truck drivers ranged from 3.3% to 13.7%, again depending on the measurement tool used.

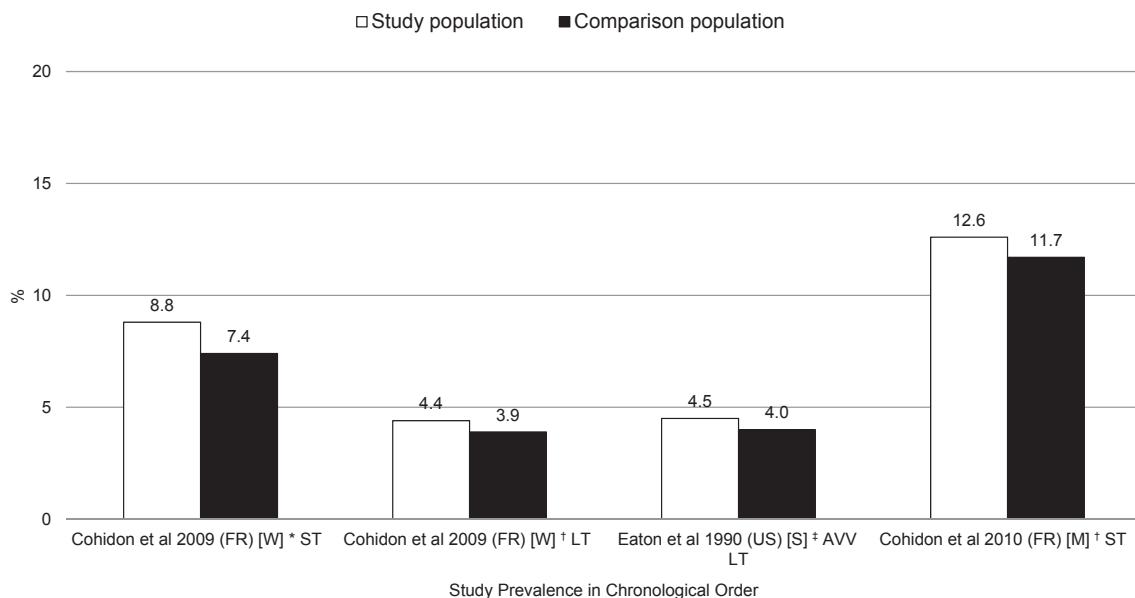


Fig. 6. Prevalence of depression in manual occupations. AVV, mean of two occupations; CA, Canada; FR, France; LT, long term; M, moderate strength; NCP, no comparison population; S, strong strength; ST, short term; US, United States; W, weak strength. * Significant at 0.05. † Not significant. ‡ Not able to be tested.

Table 4
Depression measures administered by included studies

Prevalence measure	Measure abbreviation	Measure time period	No. of Studies	Studies
Center for Epidemiologic Studies Depression Scale	CES-D	Past fortnight	4	Cohidon et al 2010 [57]; Scarth et al 2000 [70]; Inoue & Kawakami 2010 [65]; Niedhammer et al 1998 [68]
Clinical Interview Schedule	CIS-R	Past wk	1	Stansfeld et al 2011 [39]
Depression, Anxiety, & Stress Scale	DASS 21	Past wk	2	Hilton et al 2009 [63]; Velandar et al 2010 [72]
National Institute of Mental Health Diagnostic Interview Schedule	DIS	Past y	1	Eaton et al 1990 [58]
General Health Questionnaire	GHQ-12	Past few wk	2	Bültmann et al 2001 [55]; Hounsome et al 2012 [64]
Goldberg Anxiety & Depression Scale	GADS	“Recent” symptoms	1	Gann et al 1990 [61]
Hospital Anxiety & Depression Scale	HADS	Past wk	1	Sanne et al 2004 [69]
Kessler 6/10	K6/10	Past 4 wk	2	Fragar et al 2010 [60], [K10]; Hilton et al 2008 [17], [K6]
Zung Self-rating Depression Scale	SDS	Past several d	1	Kawakami et al 1995 [67]
International Classification of Disease	ICD	Past 15 y	2	Wieclaw et al 2005 [40], [ICD10]; Joensuu et al 2010 [73], [ICD9]
Mini International Neuropsychiatric Interview	MINI	Lifetime	2	Cohidon et al 2009 [56]; Thompson et al 2011 [76]
Single item: “Has a doctor ever told you that you had emotional, nervous, or psychiatric problems?”	–	Lifetime	1	Petersen & Zwerling 1998 [75]

4. Discussion

This study systematically reviewed relevant research in order to identify the prevalence of depression among workers in male-dominated industries and occupations, and to assess whether: (1) depression among male workers is greater than the national average/total workforce/all male workers; and (2) depression was more prevalent in particular male-dominated industry/occupational groups.

A total of 20 studies were reviewed. Studies were undertaken in 10 different countries, mostly during the past decade, and were typically strong or moderate in methodological quality. When prevalence of depression in male-dominated industries was compared to within-study comparison groups, results were mixed. In some male-dominated industries the rates of depression were higher than within-study comparators, while in other industries rates were lower.

However, where possible, data from the published studies were supplemented with additional data regarding national prevalence levels of depression. This additional comparison yielded interesting and important findings, and revealed a higher degree of consistency among the results of the 20 studies. Specifically, the majority of studies found higher levels of depression among workers in male-dominated workforce groups than was apparent in the general population data.

Among male-dominated industry groups, an elevated prevalence of depression was found for workers in agriculture, construction, and mining. Among male-dominated occupational groups, elevated levels of depression were found for farmers, machine operators, laborers, and unskilled manual workers.

Results of the current review indicate that, overall, those working in male-dominated industries are at higher risk than the general population for symptoms of depression. Furthermore, it is likely that subgroups within these industries are particularly vulnerable. For example, Joensuu et al [73] found that within the Finnish agriculture industry, blue collar workers were significantly more likely to be diagnosed with a mental disorder compared with other occupations in the agriculture industry. Similarly, Inoue and Kawakami [65] found that low SES workers in the Japanese manufacturing industry reported higher prevalence rates of depression than high SES manufacturing workers.

This review additionally found important differences in levels of depression according to the country in which the study was conducted. For example, French and Canadian farmers were found to have similar or lower levels of depression than comparison groups. By contrast, farmers in the UK and Norway reported higher levels of depression/psychological distress than comparison groups [56,57]. These variations highlight the potential role played by cultural and contextual factors found in different countries. As such, cautious interpretation must be applied when examining this data.

Many of the more rigorous studies also found that physical and psychosocial working conditions accounted for much of the variation in rates of depression [33,40,55,57,69,76]. Factors which were found to influence prevalence of depression in male-dominated industries and occupations in these studies included: work hours, level of physical activity, income, time pressure, job demands, job security, job discretion, effort-reward imbalance, role conflict, job value, emotional demands, exposure to violence/threats, social support, and job status [33,40,55,57,69,76]. This is consistent with research concerning the relationship between the workplace psychosocial environment and workers' mental health [28,33], and indicates that working conditions associated with different industries and occupations explain much of the variation in mental disorder prevalence rates.

However, specific occupational and/or industry working conditions are still likely to influence levels of depression, over and above the role played by psychosocial and demographic factors. For example, after controlling for demographic and workplace psychosocial factors, Bültmann et al [55] found occupational category still accounted for at least some of the variance in psychological morbidity prevalence levels.

These results highlight the importance of identifying “at risk” workforce groups by examining variations in mental disorder prevalence by industry and occupation. Workplace factors associated with poor mental health are likely to cluster within particular industries and occupations, and the identification of high risk workforce groups allows for the development of tailored and targeted prevention and intervention strategies. Our recent systematic review identified the main risk factors for depression in male-dominated industries as poor health and lifestyles, unsupportive workplace relationships, job overload, and job demands [28]. These

risk factors appear relevant to the male-dominated occupations found to have significantly elevated prevalence levels identified in the current review.

4.1. Implications

While the current study represents the first systematic review of the prevalence of mental disorders in male-dominated industries and occupations, it is not without limitations. One such limitation is the relatively small number of studies that examined the prevalence rates of depression, or related disorders among male-dominated workforce groups. Of 20 studies that were identified, 13 compared male-dominated occupation/industry prevalence rates with other workforce groups, and ten utilized nationally representative samples. Many focused on single industries, workplaces, or companies. There is a need for further research that examines prevalence rates across a range of industries and occupational settings in order to identify occupational groups at a comparatively higher risk of mental disorders. Moreover, eight of the 20 studies reviewed were assessed as methodologically weak. Future research needs to adopt more rigorous methodologies that control for demographic and workplace factors which may contribute to elevated prevalence rates. Such an approach will allow for the identification of factors that may contribute to increased risk of mental disorders among vulnerable workforce groups.

In addition, there is a need for consistency in the assessment tools used to examine mental disorder prevalence rates among the workforce. The assessment tools used in the reviewed studies varied widely. While all these tools may be reliable and valid indicators of clinically relevant mental disorders, they may not be directly comparable. For example, the Center for Epidemiologic Studies Depression Scale [86] focuses on depression symptoms that occurred in the past week, while the Mini International Neuropsychiatric Interview [87] assesses major depressive disorder symptoms that occurred in the past 2 weeks.

Variations in the industry and occupation classification and coding systems utilized by different countries may also account for some of the differences in prevalence rates. While the industry and occupation classification systems used by different countries are often based on international classification systems, variations between countries may restrict the reliability of international comparisons of data categorized according to occupation or industry [88].

4.2. Conclusion

Assessing and addressing the prevalence of depression among workers is increasingly important. The present study highlights that there is a particular need to target these mental health issues among men working in male-dominated industries. The workplace offers an opportunity to develop tailored strategies that target specific high risk industries and occupations. To date, this opportunity has been largely overlooked. Specific industry and occupational groups warrant focused attention through tailored interventions addressing salient workplace issues.

Conflicts of interest

All authors have no conflicts of interest to declare.

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