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Milner, A;King, T

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Men's work, women's work and suicide: a retrospective mortality study in Australia

Allison Milner,[1] Tania King[1]

Abstract

Objectives: This research sought to investigate the influence of being a in male-dominated occupation on suicide.

Methods: A population-level retrospective mortality study was conducted over the period 2001 to 2015. Data from the Australian Census and the National Coronial Information System were combined. Negative binomial regression was used to assess the relationship between occupational gender ratio and suicide rates, controlling for age, socioeconomic status and year of death. Probabilistic sensitivity analysis accounted for unmeasured confounding due to common mental disorders.

Results: Males in male-dominated occupations had a rate ratio (RR) of 7.50 (95%CI 6.07 to 9.25) compared to males in female-dominated occupations. Females in male-dominated occupations had a RR of 0.13 (95%CI 0.07 to 0.26) compared to females in female-dominated occupations. Results for males were maintained after adjusting for common mental disorders. There was evidence of interaction on both additive and multiplicative scales.

Conclusions: The gendered context of an occupation influences suicide, with varying risks for women and men. More research is needed to understand the mechanisms of this relationship.

Implications for public health: These results suggest the need for targeted suicide prevention activities in male-dominated occupational groups.

Key words: suicide, mental health, gender, occupation, work

Suicide is a gendered behaviour. In high-income areas of the world, the burden of male suicide is three to four times that of female suicide.[1] At the same time, females are much more likely to present to healthcare facilities after engaging in intentional self-harm.[2,3] Explanations for these differences are based on variations in how men and women express suicidal intentions and behaviours. For example, males engage in more highly lethal means, such as hanging; while, females use methods such as drug overdose, which is less likely to result in death.[4]

Gender is also an important influence on labour force participation and, among the employed population, choice of occupation.[5] Across countries, men are much more likely to be employed in male-dominated occupations, such as construction or higher levels of management.[6] Females are predominately employed in professions such as teaching, healthcare work or administration.[6] There are also differences in the working conditions people are exposed to in these jobs. A recent study from Australia shows that those working in male-dominated jobs tend to report higher levels of perceived job insecurity and job demands; while those in female-dominated jobs have reported lower fairness regarding pay equity and lower levels of job control.[7] Across all occupations, females are more likely to be employed part-time while men work full-time.[8]

The gendered nature of an occupation may also influence behaviours related to mental health and suicide. A recent study has shown that males who are employed in male-dominated occupations (where there are a greater number of men employed comparative to women) are much less likely to seek help from a mental health professional, even after considering other individual and structural factors.[9] A past review has documented poor health and lifestyles, unsupportive workplace relationships, job overload and job demands as risk factors for mental health problems in male-dominated occupations.[10] Accompanying this, there is evidence that those employed in male-dominated occupations such as construction, forestry and agriculture have higher rates of suicide than the general employment population.[11,12] Research has also consistently shown that females employed in traditionally male-dominated occupations such as medicine have higher rates of suicide than other employed females.[13-15] Explanations for suicide in these male-dominated occupations have focused on exposure to psychosocial working conditions (explained above)[16] or background factors such as education and personality that may affect the selection of individuals into an occupation.[17] Past research has largely ignored the potential risks associated with female-dominated jobs (where there are a greater number of female employees comparative to men) such as nursing, where both men and women have elevated rates of suicide.[13-15]

In this study, we seek to examine the influence of gendered occupational contexts on suicide at the population level using an objective exposure representing the ratio of males employed to females within an

1. Centre for Health Equity, School of Population and Global Health; University of Melbourne, Victoria

Correspondence to: Dr Allison Milner, Centre for Health Equity; School of Population and Global Health; University of Melbourne; 207 Bouverie Street; Melbourne, VIC 3010; e-mail: Allison.milner@unimelb.edu.au

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occupation. We define gendered occupational contexts in terms of the proportion of males to females employed in a given occupation. We argue that these contexts bring with them a range of exposures that may be relevant to suicide, including differences in psychosocial exposures and gender norms about mental health and accessing mental health. As mentioned above, research to date has suggested that male-dominated occupations may hold the greater risk of suicide and it has largely ignored suicide in female-dominated occupations. Based on the research above, we hypothesise that men and women working in male-dominated occupations have elevated rates of suicide compared to those working in female or gender neutral (e.g. an equal number of males to females employed) occupations. This study is conducted in Australia, where the rate of suicide among men is currently 17.8 per 100,000 persons, while the rate of suicide among women is 5.8 per 100,000 persons.[18]

Method

Study design

We conducted a nationwide study of deaths by suicide between 2001 and 2015 in Australia. The study included all employed adults with a known occupation who were between 15 years and 74 years at the time of death.

Ascertainment of suicide deaths

We identified suicide cases using the National Coronial Information System (NCIS). The NCIS is an internet-based data storage and retrieval system that enables coroners, government agencies, and researchers to monitor external causes of death in Australia and to identify cases for further investigation and analysis. Our study only included persons employed in a known occupation at the time of death. Occupational information was coded according to the Australian and New Zealand Standard Classification of Occupations (ANZSCO) to the two-digit level.[19]

Ascertainment of population data by occupational group

We ascertained population data for employed males and females between the ages of 15 and 74 years by ANZSCO at the two-digit level and by postcode for the 2006 and the 2011 Census. The 2006 Census was used as the referent for suicide cases occurring between 2001 and 2010, while the 2011 Census was used as the referent for suicide cases occurring between 2011 and 2015.

Definition of the exposure: occupational gender ratio

Objective population data by occupation (sourced from the 2006 and 2011 Australian census)[20] was used to create a continuous measure representing a ratio of employed males to females. We extracted population data for 44 occupations, corresponding to the two-digit occupation codes of the ANZSCO.

Because the continuous variable was skewed towards male-dominated occupations, we created a categorical variable based on quartiles of the occupational gender ratio variables: female-dominated (0.01 to 0.45 males to 1 female), gender neutral (0.46 to 1.59 males to 1 female), moderately male-dominated (1.59 to 4.15 males to 1 female), and heavily male-dominated (4.16 and over males to 1 female). We used female-dominated occupations as the reference category in order to assess the effect of an occupation becoming increasingly 'male dominated'. The occupations contained in each of these categories can be seen in Supplementary Table 1.

Adjustment variables

We adjusted for age group, year of death, gender and socioeconomic status (SES), which was based on the Index of Relative Socio-economic Disadvantage (IRSD) produced by the Australian Bureau of Statistics.[21] This data was available for the two census periods, 2006 and 2011, and extracted by age group, ANZSCO level 2, gender and postcode. Postcode level data was needed in order to use the IRSD, which is based on small area levels within Australia, and included items such as percentage of people with stated household equivalised income within a postcode, percentage of people aged 15 years and over whose highest level of education is Year 11 or lower, and percentage of occupied private dwellings paying rent less than $215 per week. As discussed below, we conducted a sensitivity analysis to explore the possible role of unmeasured common mental disorder on the relationship between the occupational gender ratio and suicide.

Statistical analysis

Descriptive analysis and age-standardised suicide rates

Suicide, population counts and suicide rates per 100,000 person-years were calculated by the occupational gender ratio variable and gender. Age-standardised rates were calculated using the 2006 and 2011 Census data using the parameters age (15–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years and 65–74 years), gender, year of death, and the occupational gender ratio variable. These rates were age-standardised to the Australian standard population (2001),[22] restricting the standard population to those aged 15–74 years.

Regression models

We compared rates of suicide by the occupational gender ratio four-level variable in negative binomial regression models. We used the 'female-dominated' group as the reference category. The models controlled for year of death, age, gender and socioeconomic disadvantage (IRSD). We tested for effect modification by gender by including an interaction term in the model and examining the results of the likelihood ratio test comparing a model with the interaction term to a model without the term. We then used the approach to presenting effect modification results recommended by Knol and VanderWeele[23] and present estimates and 95% CI within strata of gender and occupational gender ratio. We computed measures of effect measure modification on the additive scale and multiplicative scale. For all models, coefficients were transformed into incidence rate ratios (IRRs) to aid interpretation. Analysis was undertaken in Stata 14.1. We conducted a sensitivity analysis splitting the female-dominated category into two groups. We used the most female-dominated (where there was between 0.01 and 0.25 males to females) as the reference and then compared this to moderately female-dominated occupations (where there was between 0.26 and 0.43 males to females).

Adjusting for unmeasured confounding due to prior mental health problems

External adjustment was used to account for the possible influence of unmeasured mental illness in confounding this relationship using probabilistic sensitivity analysis.[24,25] This approach allows the application of a variety of plausible probability distributions for bias parameters (i.e. unmeasured confounders), which are then used to simulate distributions for the bias-adjusted exposure-outcome relative risks.[26] This adjustment requires four pieces of information: 1) estimates (or counts

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in a 2*2 table) of the exposure/outcome relationship; 2) probability densities (based on prior estimates) of the unmeasured confounder in the non-exposed population (e.g. those in non-male-dominated occupations); 3) probability densities (based on prior estimates) of the unmeasured confounder in the exposed population (e.g. those in heavily male-dominated occupations) and; 4) probability densities (based on prior estimates) of the association between the unmeasured confounder and the outcome (suicide).

Data on 1) was established from the original data used in the study, while that required for 2) and 3) was drawn from the Household Income and Labour Dynamics (HILDA) survey.[27] Estimates for 2) and 3) represented the proportion of men and women reporting that they had sought mental treatment for depression in the past year (measured in 2013) by the occupational gender ratio variable. We estimated *a priori* probability distribution for the unmeasured confounder-suicide relationship, based on a study by Singhal et al.,[28] as lognormal with confidence intervals of ln(5) and ln(15). Analysis was conducted using the 'stata' package 'EPISENS'[26] through a two-stage procedure. First, a random sample was drawn from the specified probability density function of the bias parameters. Second, back-calculated bias adjusted RR were calculated from drawn parameters. This procedure was repeated several times to obtain a distribution of the bias-adjusted RRs.

Ethics approval

The study was approved by the Justice Human Research Ethics Committee (reference, CF/15/13534) and the Human Ethics Advisory Group, School of Population and Global Health, University of Melbourne.

Results

Table 1 shows age-standardised rates of suicide by occupational gender ratio and gender. This shows that suicides rates were highest for women in occupations that were non-male-dominated (i.e. female-dominated) but the wider 95% confidence intervals mean that this difference is likely to be non-significant from women in gender neutral and male-dominated occupations. Suicide rates for males were lowest in non-male-dominated occupations but were markedly higher in the most male-dominated occupations.

Results of the main effects negative binominal regression can be seen in Table 2. As can be seen in the adjusted model, those persons in moderately male and heavily male-dominated occupations had a RR of suicide that was 2.15 times (1.81 to 2.56, p<0.001) and 3.83 times (3.26 to 4.50, p<0.001) that of those who were in female-dominated occupations. Results were also significant when the gender ratio variable was examined as a continuous variable (IRR 1.01, 95%CI 1.01 to 1.02, p<0.001). (Note: this variable is strongly skewed.) There was a dose–response relationship between socioeconomic disadvantage and suicide, with low disadvantage being associated with lower suicide rates. Suicide rates tended to be higher in mid-life (between 35 and 54 years) compared to in the youngest age group. There was a decrease in suicide over time. Results of our sensitivity analysis further investigating a breakdown within female-dominated occupations revealed a RR of 1.42 (95%CI 1.07 to 1.89) in moderately female-dominated compared to the most female-dominated occupations.

There was a significant interaction between gender and occupational gender ratio (LR $x^2(3) = 286.22$, p<0.001). Results in Table 3 suggest effect modification on both the additive and multiplicative scale. However, the interaction is largely driven by the results of males, which increase markedly in moderately and heavily male-dominated occupations compared to males in non-male-dominated occupations. Female suicide does not pattern by the occupational gender ratio variable to the same degree. However, as can be seen, there was a slightly lower risk for females in male-dominated occupations compared to those in female-dominated occupations. Interaction was apparent when measured on both the additive and multiplicative scale.

Results of the sensitivity analysis for mental illness suggested that the association between being in a moderate and heavily male-dominated occupation attenuated after adjusting for likely presence of depression. However, this was not enough to remove the association altogether. After adjustment, results for the moderately male-dominated occupation were a RR of 1.95 (95%CI 1.51 to 2.53), while results for the most heavily male-dominated occupation was a RR 2.50 (95%CI 1.98 to 3.18). Results for women dropped out of significance.

Discussion

The findings of this paper suggest that males in male-dominated occupations had a significantly higher suicide rate compared to males in female-dominated occupations. There was a slightly elevated risk of suicide for women in female-dominated occupations compared to those in male-dominated occupations. Our results also indicate that the risks of male suicide in male-dominated occupations held after adjusting for socioeconomic status and the possible confounding influence of common mental

Table 1: Suicide and population counts, with age-standardised rates, by the occupational gender ratio, 2001 to 2015, Australia.

Occupational gender ratio	Gender	Suicides	Pop (000)	ASR	Lower 95% CI	Upper 95% CI
Female-dominated (0.01 to 0.45 M to 1 F)	Females	945	12,392	6.2	2.5	10
Female-dominated (0.01 to 0.45 M to 1 F)	Males	988	12,562	6.6	3.9	9.3
Gender neutral (0.46 to 1.59 M to 1 F)	Females	559	9,627	4.1	3.3	4.9
Gender neutral (0.46 to 1.59 M to 1 F)	Males	1,672	13,845	7.2	6.4	8
Moderately male-dominated (1.59 to 4.15 M to 1 F)	Females	326	5,613	4.2	3.1	5.3
Moderately male-dominated (1.59 to 4.15 M to 1 F)	Males	2,719	12,099	11.9	11.3	12.5
Heavily male-dominated (4.16 and over M to 1 F)	Females	87	1,338	4.2	2.9	5.5
Heavily male-dominated (4.16 and over M to 1 F)	Males	4,757	12,136	20.7	19.9	21.4

Notes:
ASR= age standardised rates; Lower 95% CI= Lower confidence intervals at 95% significance; Upper 95% CI= Upper confidence intervals at 95% significance; M to F= Males to females

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disorders, while results dropped out of significance for women.

In terms of limitations, we must acknowledge problems related to the under-reporting of suicide in the National Coroners Information System. It is also possible that occupation may have been misreported in police reports or miscoded by our research team, which may have occurred despite the use of a structured approach to classification. Our main exposure represented the gendered environment of an occupation, rather than a workplace specifically; however, we would argue that this holds merit, given past evidence regarding the difference in suicide between occupational groups.[11] It is also worth noting that the exposure was measured at the two-digit level (44 occupations) and may be less precise than a more detailed level of occupational coding. Our probabilistic sensitivity analysis was conducted in regard to depression only, which was mainly because high-quality information was not available in HILDA on other mental disorders or substance use problems. In stating this, it is important to highlight that depression is a major contributor to the disability-adjusted life years (DALYs) and the fourth-highest cause of disability in Australia.[29] A major strength of the exposure is that it is completely objective from suicide cases, being drawn from national census data. Other strengths of our study include the use of the best available individual-level data on suicide and coverage across an entire national population over a 12-year period. We were able to control for major confounders influencing the relationship between exposure and outcome using probabilistic sensitivity analysis. At the same time, it is important to acknowledge the fact that this approach to assessing the possible contribution of mental health problems was relatively crude, being conducted based on aggregate data. Likewise, our assessment of socioeconomic status was based on area-level socioeconomic status and thus will not be as sensitive as individual level measures.

There may be a number of explanations for elevated suicide rates in male-dominated occupations. One explanation is connected to psychosocial (and other) job stressor exposures occurring within an occupation. Past research suggests that males in 'blue collar' (i.e. manual) occupations have greater exposure to job strain, defined as a combination of low job control and high job demands,[30] than those working in 'white collar' occupations. However, not all male-dominated high-risk occupations can be defined as blue collar (Table 1); i.e. chief executives, general managers and legislators are classified as moderately male-dominated. Because of this, we would argue that there must be other factors contributing to suicide risk in these jobs. These factors may include long working hours, high psychological demands and work-family imbalance, all of which have been associated with mental health problems in previous research.[31-33] Another occupational based risk factor may

Table 2: Negative binomial model, the relationship between employment in a male-dominated occupation and risk of suicide, by gender, 2001 to 2015, Australia.

	Unadjusted			Adjusted		
	RR	Lower and Upper 95% CI	*P* value	RR	Lower and Upper 95% CI	*P* value
Occupational gender ratio						
Female-dominated	1			1		
Gender neutral	1.41	1.18–1.68	<0.001	1.44	1.20–1.71	<0.001
Moderately male-dominated	2.18	1.84–2.59	<0.001	2.15	1.81–2.56	<0.001
Heavily male-dominated	3.82	3.25–4.48	<0.001	3.83	3.26–4.50	<0.001
Gender						
Female	1			1		
Male	5.12	4.45–5.90	<0.001	5.12	4.45–5.90	<0.001
SES (IRSD score)						
1 (most disadvantaged)	1			1		
2	0.93	0.79–1.10	0.411	0.96	0.81–1.14	0.664
3	0.87	0.74–1.03	0.105	0.92	0.78–1.09	0.330
4	0.80	0.67–0.94	0.009	0.88	0.74–1.04	0.143
5 (least disadvantaged)	0.66	0.56–0.79	<0.001	0.74	0.62–0.88	0.001
Age group						
15–24 years	1			1		
25–34 years	1.47	1.22–1.77	<0.001	1.50	1.24–1.81	<0.001
35–44 years	1.66	1.38–1.99	<0.001	1.68	1.40–2.02	<0.001
45–54 years	1.61	1.34–1.94	<0.001	1.69	1.40–2.03	<0.001
55–64 years	1.25	1.01–1.56	0.043	1.23	0.98–1.53	0.068
65–74 years	1.07	0.67–1.71	0.771	0.93	0.58–1.48	0.753
Year	0.93	0.92–0.95	<0.001	0.94	0.92–0.96	<0.001

Notes:
RR= relative risk; Lower and Upper 95% CI= Lower and upper confidence intervals at 95% Significance; p value= significance at 95% significance.

Table 3: Effect measure modification by gender, results from negative binomial model, the relationship between employment in a male-dominated occupation and risk of suicide, by gender, 2001 to 2015, Australia.

	Female-dominated RR (95% CI)	Gender neutral RR (95% CI)	Moderately male-dominated RR (95% CI)	Heavily male-dominated RR (95% CI)	Within gender strata, gender neutral RR (95% CI)	Within gender strata, moderately male-dominated RR (95% CI)	Within gender strata, heavily male-dominated RR (95% CI)
Gender							
Female	1	0.78 (0.58–1.04)	0.44 (0.30–0.64)	0.13 (0.07–0.26)	0.78 (0.58–1.04)	0.44 (0.30–0.64)	0.13 (0.06–0.26)
Male	1.01 (0.77–1.32)	2.11 (1.67–2.66)	3.89 (3.11–4.86)	7.57 (6.12–9.35)	2.09 (1.65–2.64)	3.86 (3.09, 4.81)	7.50 (6.07–9.25)
RR for gender within strata of occupational gender ratio	1.01 (0.77–1.32	2.72 (2.11–3.50)	8.82 (6.25–12.44)	57.99 (30.22–111.27)			
Interaction on the additive scale		1.33 (0.94–1.71)	3.44 (2.76–4.12)	7.43 (6.01–8.84)			
Interaction on multiplicative scale		2.69 (1.85–3.90)	8.73 (5.63–13.55)	57.43 (28.33–116.40)			

Notes:
Adjusted for SES (IRSD), age-group, and year; RR= relative risk; Lower and Upper 95% CI= Lower and upper confidence intervals at 95% Significance; Measure of interaction on additive scale: Synergy index (95%CI); Measure of interaction on multiplicative scale: Ratio of RRs (95%CI)

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be access to lethal suicide means; however, many of the occupations classified as either moderately or heavily male-dominated do not have any greater exposure to lethal suicide methods than the general population.[34] Another possible explanation concerns the expressed norms and cultural factors within an occupational group, including attitudes toward treatment seeking. As mentioned above, recent research[9] suggests that men in male-dominated occupations are also much less likely to seek treatment compared to non-male-dominated occupations. There is also research suggesting that males in male-dominated occupations are more likely to endorse male gender norms such as self-reliance[35] and stigma in relation to mental health problems, which have been shown to be risk factors for suicide.[36] Alcohol and drug use, which are recognised risk factors for suicide, are thought to be higher in many male-dominated occupations.[10]

It is also necessary to comment on the finding that females in female-dominated occupations had a slightly elevated risk of suicide compared to those in male-dominated occupations. There has been much less attention paid to female suicide by occupation.[37] This is likely because the low base rate of female suicide obscures the ability to observe statistically large effects. The small amount of existing (Australian) research in the area has highlighted elevated rates in female-dominated occupations such as nursing.[15,38] There are also elevated rates among some female doctors (general practitioners)[13-15] and this may explain the observed slightly elevated rates. There is a need for a greater amount of research on the experience of female suicidal behaviours across different occupation groups, particularly as the risks seem to be different to those that affect men. We would recommend more work on both the epidemiology and risk factors among employed females to help inform future prevention efforts.

Conclusion

In conclusion, it is apparent that the gender ratio of an occupation has varying gender-specific effects on suicide among the employed population. The greatest risk of suicide is for males in male-dominated occupations. Our results also suggest that females in female-dominated occupations had slightly elevated rates comparative to those in male-dominated occupations. There is a need for more research on the mechanisms through which the gendered environment influences suicide, but we would suggest that gendered norms and attitudes towards suicide, mental health and help-seeking may be possible explanations. Prevention initiatives need to recognise the potential influence of gendered working environments on suicide.

Acknowledgements

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional guides on the care and use of laboratory animals.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Supplementary Table 1: Details on the ratio of males to females in occupations included in the occupational gender context.

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