National estimates of occupation-related inequalities in all-cause mortality using linked Census-mortality data

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Abstract

Objective: This report aims to provide national estimates of occupation-related inequalities in all-cause mortality for Australian residents aged 25–64 years.

Method: Data came from the 2016 Census linked to Deaths Registrations, available via the Multi-Agency Data Integration Project. Using negative binomial regression, we estimated age-adjusted relative and absolute inequalities in all-cause mortality rates in the 13 months following Census according to occupation, defined using the Australian and New Zealand Standard Classification of Occupations (eight major groups), using managers as the reference group.

Results: Among 10.8M people, there were 20,987 deaths. Age-adjusted mortality rates were lowest among managers and professionals and were generally highest for manual occupations, for example, among men, relative risks (RR) for labourers ranged across age groups from 1.44 (95% CI 1.19–1.75, age 54–64) to 2.99 (1.93–4.65, age 25–34); among women, the RR for machine operators and drivers were 3.95 (1.39–11.21 in age 25–24 and 2.73 (1.66–4.49) in age 45–54, but there was relatively little variation by occupation in women aged 35–44 and 55–64. Around one in five deaths (23% for men, 17% for women) were associated with being in an occupation other than manager.

Conclusion: These findings highlight that there is benefit in documenting national mortality inequalities according to occupation in addition to other measures of socioeconomic position. They provide further insights into socioeconomic inequalities in mortality.

Implications for public health: Methods that aim to reduce mortality for those in manual occupations, particularly among young men, will reduce inequalities and improve population health.

Key words: occupation, inequalities, socioeconomic, mortality, record linkage

Introduction

There have been large improvements in mortality rates and life expectancy over time in Australia.[1] However, health outcomes are unequally distributed, with studies consistently showing an inverse association between socioeconomic position (SEP) and mortality.[2] There is a need for routine reporting this socioeconomic variation, to inform policies, programmes and practices to improve health equity and the overall health of the population.

Recent innovations in linked, whole-of-population data have enabled mortality inequalities to be measured in relation to individual-level measures of SEP, including education,[3] which are now incorporated into national reporting. However, this has yet to be extended to occupation. Among the working-age population, occupation is a key indicator of SEP, incorporating elements of education through skill level, as well as being directly related to income and material resources.[4] A person's occupation may also be related to ill health through work-related factors such as stress, control, autonomy, and occupational hazards, as well as factors separate to job itself, such as support networks, and social standing or prestige.[5]

The aim of this study was to produce contemporary national estimates of inequalities in all-cause mortality among working-aged adults according to occupation, using whole-of-population-linked Census-mortality data.

Method

We created a cohort study of persons aged 25–64 years using the 2016 Census of Population and Housing linked to Deaths

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Table 1: Relative and absolute inequalities in all-cause mortality by person-level occupation for men and women aged 25–64, separately by sex and age group.

Occupation	Rate ratio (95% CI)	Age-adjusted mortality rates (per 100,000 persons)	Rate difference[a]	Excess deaths[a]
Men				
Aged 25–34 years				
Managers	Ref.	21.82		
Professionals	1.02 (0.64 – 1.63)	22.34	0.52	2
Technicians and trades workers	1.72 (1.12 – 2.63)	37.47	15.65	61
Community and personal service workers	1.68 (0.98 – 2.88)	36.58	14.76	15
Clerical and administrative workers	1.29 (0.73 – 2.31)	28.24	6.42	6
Sales workers	1.30 (0.72 – 2.34)	28.40	6.58	6
Machinery operators and drivers	2.21 (1.39 – 3.54)	48.31	26.49	38
Labourers	2.99 (1.93 – 4.65)	65.26	43.44	74
Unemployed	7.29 (4.77 – 11.15)	159.12	137.30	141
Not in labour force	15.55 (10.49 – 23.03)	339.20	317.38	617
Aged 35–44 years				
Managers	Ref.	45.21		
Professionals	1.03 (0.77 – 1.38)	46.53	1.32	4
Technicians and trades workers	1.46 (1.10 – 1.92)	65.89	20.68	62
Community and personal service workers	1.83 (1.27 – 2.64)	82.76	37.54	28
Clerical and administrative workers	1.33 (0.91 – 1.95)	60.13	14.92	13
Sales workers	1.77 (1.22 – 2.58)	80.24	35.03	25
Machinery operators and drivers	2.29 (1.71 – 3.07)	103.70	58.49	85
Labourers	2.37 (1.76 – 3.20)	107.17	61.95	78
Unemployed	4.95 (3.70 – 6.63)	223.85	178.64	127
Not in labour force	15.04 (11.84 – 19.11)	680.04	634.83	1,009
Aged 45–54 years				
Managers	Ref.	106.87		
Professionals	1.01 (0.83 – 1.22)	107.42	0.55	1
Technicians and trades workers	1.22 (1.01 – 1.46)	129.94	23.07	61
Community and personal service workers	1.54 (1.19 – 1.98)	164.46	57.59	39
Clerical and administrative workers	1.11 (0.85 – 1.45)	118.82	11.96	10
Sales workers	1.35 (1.03 – 1.77)	144.13	37.26	24
Machinery operators and drivers	1.58 (1.30 – 1.91)	168.90	62.03	104
Labourers	1.69 (1.38 – 2.07)	180.16	73.29	93
Unemployed	2.99 (2.43 – 3.67)	319.02	212.15	144
Not in labour force	11.17 (9.64 – 12.95)	1194.01	1087.14	2,172
Aged 54–64 years				
Managers	Ref.	224.95		
Professionals	0.97 (0.80 – 1.17)	217.60	-7.34	- 13
Technicians and trades workers	1.20 (1.00 – 1.44)	269.80	44.85	79
Community and personal service workers	1.25 (0.98 – 1.59)	280.25	55.31	25
Clerical and administrative workers	1.16 (0.92 – 1.45)	259.90	34.96	22
Sales workers	1.09 (0.85 – 1.40)	246.09	21.15	10
Machinery operators and drivers	1.36 (1.13 – 1.65)	307.04	82.09	108
Labourers	1.44 (1.19 – 1.75)	324.93	99.98	100
Unemployed	2.17 (1.78 – 2.64)	488.06	263.12	160
Not in labour force	6.66 (5.70 – 7.80)	1498.86	1273.92	4,885
Aged 25–64 years				
Managers	Ref.	96.01		
Professionals	0.97 (0.85 – 1.11)	93.23	-2.78	- 30
Technicians and trades workers	1.27 (1.11 – 1.44)	121.75	25.74	288
Community and personal service workers	1.45 (1.23 – 1.71)	139.04	43.03	124
Clerical and administrative workers	1.18 (1.00 – 1.39)	113.50	17.49	59
Sales workers	1.28 (1.08 – 1.52)	123.05	27.04	75

(continued)

Table 1. Continued

Occupation	Rate ratio (95% CI)	Age-adjusted mortality rates (per 100,000 persons)	Rate difference[a]	Excess deaths[a]
Machinery operators and drivers	1.64 (1.43 – 1.87)	157.03	61.02	360
Labourers	1.79 (1.56 – 2.05)	171.59	75.58	393
Unemployed	3.28 (2.86 – 3.77)	315.06	219.05	660
Not in labour force	10.18 (9.06 – 11.45)	977.81	881.80	8,328
Women				
Aged 25–34 years				
Managers	Ref.	12.88		
Professionals	1.28 (0.68 – 2.40)	16.49	3.61	16
Technicians and trades workers	2.14 (0.97 – 4.68)	27.51	14.63	10
Community and personal service workers	1.87 (0.96 – 3.62)	24.06	11.18	23
Clerical and administrative workers	1.97 (1.04 – 3.71)	25.33	12.45	32
Sales workers	1.68 (0.81 – 3.49)	21.63	8.75	11
Machinery operators and drivers	3.95 (1.39 – 11.21)	50.84	37.97	5
Labourers	1.38 (0.57 – 3.39)	17.83	4.95	3
Unemployed	3.43 (1.72 – 6.83)	44.21	31.33	28
Not in labour force	6.84 (3.83 – 12.21)	88.10	75.22	314
Aged 35–44 years				
Managers	Ref.	34.80		
Professionals	0.81 (0.55 – 1.18)	28.17	-6.62	- 25
Technicians and trades workers	1.06 (0.59 – 1.89)	36.77	1.97	1
Community and personal service workers	0.97 (0.63 – 1.49)	33.74	-1.05	- 2
Clerical and administrative workers	0.93 (0.63 – 1.37)	32.31	-2.48	- 7
Sales workers	0.92 (0.56 – 1.52)	31.95	-2.84	- 3
Machinery operators and drivers	1.63 (0.73 – 3.64)	56.62	21.82	3
Labourers	1.28 (0.78 – 2.12)	44.66	9.87	7
Unemployed	2.17 (1.41 – 3.35)	75.63	40.83	30
Not in labour force	6.39 (4.63 – 8.83)	222.47	187.67	682
Aged 45–54 years				
Managers	Ref.	45.61		
Professionals	1.32 (0.96 – 1.81)	60.25	14.64	44
Technicians and trades workers	2.14 (1.43 – 3.22)	97.65	52.04	26
Community and personal service workers	1.62 (1.17 – 2.26)	74.08	28.48	51
Clerical and administrative workers	1.70 (1.25 – 2.30)	77.44	31.83	97
Sales workers	1.33 (0.91 – 1.94)	60.51	14.91	16
Machinery operators and drivers	2.73 (1.66 – 4.49)	124.35	78.75	16
Labourers	2.62 (1.87 – 3.68)	119.70	74.09	70
Unemployed	3.51 (2.48 – 4.97)	160.22	114.61	72
Not in labour force	11.52 (8.73 – 15.20)	525.34	479.73	1,642
Aged 54–64 years				
Managers	Ref.	133.08		
Professionals	1.02 (0.81 – 1.29)	135.81	2.73	5
Technicians and trades workers	0.91 (0.61 – 1.36)	121.36	-11.72	- 3
Community and personal service workers	1.09 (0.85 – 1.41)	145.70	12.61	15
Clerical and administrative workers	1.10 (0.87 – 1.38)	145.84	12.76	27
Sales workers	1.01 (0.76 – 1.35)	134.44	1.35	1
Machinery operators and drivers	0.73 (0.40 – 1.33)	96.83	-36.25	- 5
Labourers	0.94 (0.70 – 1.26)	125.02	-8.07	- 6
Unemployed	1.32 (0.96 – 1.82)	175.36	42.27	17
Not in labour force	5.24 (4.27 – 6.42)	696.86	563.78	3,280
Aged 25–64 years				
Managers	Ref.	55.69		
Professionals	1.06 (0.88 – 1.27)	58.93	3.24	43
Technicians and trades workers	1.35 (1.05 – 1.74)	75.25	19.57	39

(continued)

Table 1. Continued

Occupation	Rate ratio (95% CI)	Age-adjusted mortality rates (per 100,000 persons)	Rate difference[a]	Excess deaths[a]
Community and personal service workers	1.26 (1.04 – 1.53)	70.15	14.46	96
Clerical and administrative workers	1.28 (1.06 – 1.53)	71.04	15.35	160
Sales workers	1.12 (0.90 – 1.40)	62.60	6.91	27
Machinery operators and drivers	1.55 (1.11 – 2.17)	86.41	30.72	20
Labourers	1.46 (1.18 – 1.81)	81.50	25.81	79
Unemployed	2.22 (1.79 – 2.74)	123.40	67.71	179
Not in labour force	6.99 (5.93 – 8.26)	389.50	333.81	5,709

Notes.
CI = Confidence interval.
Ref. = Reference category
n.p. indicates that the number is <10 and has been suppressed.
1. Occupational-related mortality rates, rate differences and excess deaths are estimated by applying relative rates to the population mortality rate. Number of excess deaths are based on numbers of people in occupational groups at the time of Census and have been estimated using the estimated resident population on 30 June 2016.
[a]Rate difference is per 100,000 population. Difference in relation to managers

Registrations in 2016 and 2017 via the Multi-Agency Data Integration Project (MADIP).[6]

We estimated all-cause mortality rates by occupation as recorded on the Census, which is the person's main occupation held in the past week from Census night, coded according to the Australian and New Zealand Standard Classification of Occupations (ANZSCO) version 1.3.[7] ANZSCO is a skill-based classification and incudes eight major groups based on skill level and skill specialisation (see Table 1).

We used negative binomial regression to quantify relative rates (RRs) for each occupational grouping using managers as the reference category. For each person, we calculated person-years-at-risk from the day of the Census (9 August 2016) to the date of death or end of the study period (31 August 2017, as Deaths Registrations were complete up until this time). We performed analyses separately for men and women, by 10-year age group, adjusting for age using 5-year age groups.

Previous research using linked Census and Death Registrations, available through the MADIP, found that mortality rates are underestimated by up to 20% for younger and middle-aged adults.[8] For this reason, we estimated absolute inequalities (rate differences) by applying the estimated RRs to age-sex-specific national mortality rates in 2016 from the MADIP (unlinked) Death Registrations file. We estimated number of excess deaths associated with being employed in occupations other than managers by multiplying rate differences by the estimated resident population in 2016 for each age and sex group.

Analyses were conducted through the ABS virtual DataLab using Stata 15.[9]

Results

There were 12,372,124 Census records for Australian residents aged 25–64. We sequentially excluded records that did not link to the spine (n=1,395,253), duplicate records (n=589) and persons whose labour force status was not stated and/or for whom occupation was not stated or inadequately described (n=199,279). The final study population included 10,777,003 adults (87% of in-scope Census records), and among this population, 20,987 deaths (from all causes) occurred (74% of deaths in this age group).

Age-adjusted mortality rates varied substantially by occupation, particularly among men (Table 1). Among employed men, age-adjusted mortality rates were lowest among managers and professionals and highest among machinery operators and drivers and labourers, for example, RRs for labourers were between 1.4-fold (54–64 years: RR=1.44, 95% CI 1.19–1.75) and 3-fold (25–34 years: RR=2.99, 1.93–4.65) those of managers. Next highest were community and personal service workers, and in the youngest age group (25–34 years), technicians and trades workers. The number of excess deaths was highest among machinery operators and drivers, labourers and technicians and trades workers, but low among community and personal service workers, reflecting the relatively low proportion of men in this occupational group. The estimated number of excess deaths in relation to being employed in an occupation other than managers was 1,269, 23.4% of total deaths in men aged 25–64 in 2016.

Among employed women, all-cause mortality rates were also lowest among managers and professionals and were highest among machinery operators and drivers (overall [RR=1.55, 1.11–2.17], and among ages 25–34 [RR=3.95, 1.39–11.21] and 45–54 years [RR=2.73, 1.66–4.49]); however, in those aged 35–44 and 55–64 years, there was relatively little variation in rates by occupation. The number of excess deaths was highest among clerical and administrative workers, reflecting the high proportion of women in this occupational group (across all age groups). The estimated number of excess deaths in relation to being employed in lower occupation than managers was 464, 17.3% of total deaths in women aged 25–64 in 2016.

Mortality rates for persons unemployed and not in labour force categories were higher than rates for people in all occupation groups for both men and women across all age groups and substantially so for those not in the labour force.

Discussion

We found that age-adjusted mortality rates were higher for all occupations compared with managers, with the exception of

professionals and generally increased with decreasing occupational group. The largest inequalities were observed among machinery operators and drivers and labourers, where mortality rates were between 60% and 80% higher compared to managers.

Our estimates of occupational inequalities in mortality are broadly consistent with earlier studies.[10] They are also consistent with findings from international studies which generally report higher mortality in lower compared to higher skilled occupational groups[5], and relative and absolute inequalities based on occupation being greater for men than for women.[11]

The smaller inequalities (in absolute and relative terms) for women compared to men may partly reflect differences in life course trajectories for women compared with men.[12] The higher relative inequalities in younger age groups may reflect smaller absolute numbers of death among these age groups, as well as potential cohort effects whereby younger cohorts over time are increasingly in professional and other more skilled occupational groups.[13] As a result, disadvantage is likely to be more concentrated in lower skilled occupational groups.

This is the first whole-of-population study to quantify occupational-related inequalities in mortality using linked Census-mortality data in Australia. Limitations include potential bias due to incomplete linkage and lack of precision due to small numbers of deaths occurring in the younger age groups, particularly for women. A longer follow-up period would include more deaths and therefore more precise estimates. One of the key limitations of using occupation as recorded on the Census is that it excludes those not currently in formal employment. Approximately 24% of the sample were not in the labour force or unemployed. Interpretation of these groups is limited due to their heterogeneity, as they include those not in formal employments, students and retired people, including retired due to poor health. This latter reason likely explains in part the relatively high rates of mortality in this group, and similarly among the unemployed.[14] Furthermore, as occupation can change over time, occupation recorded on the Census may not reflect a person's lifetime occupation, particularly for younger age groups.

Conclusion

We observed occupational inequalities in all-cause mortality in the Australian resident population aged 25–64, a finding broadly consistent with international studies. We observed high relative risks for men in low-skilled occupations, particularly in the younger age groups. Further analysis by cause of death may enhance the usefulness of these measures to identify areas for improvement of health equity and the overall health of the population.

Ethics statement

Ethics approval for this study was granted by the Australian National University Human Research Ethics Committee (reference 2016/666).

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Data sharing and data accessibility

Data as part of the Multi-Agency Data Integration Project are available for approved projects to approved government and non-government users. https://www.abs.gov.au/websitedbs/D3310114.nsf/home/Statistical+Data+Integration+-+MADIP.

Conflicts of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Rosemary J Korda reports financial support was provided by National Health and Medical Research Council.

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