

The impact of migration on deaths and hospital admissions from work-related injuries in Australia

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The global migrant population in 2010 was estimated to be 214 million (3% of the world's population).¹ Most migrants cross borders to seek better social and economic opportunities and labour mobility has increased with globalisation. An increasingly ageing population and workforce demand in receiving countries suggests that the need for migrant workers in those countries will not decline in the near future.² Several countries choose to recruit more skilled workers. In 2005/06, one-third of all recent immigrants to Organisation for Economic Co-operation and Development (OECD) member countries were tertiary educated.³

Australia's migrant intake has mirrored the country's industrial and economic development. Nearly six million European migrants arrived in the post-war period up until the 1960s, making a significant contribution to building Australia's manufacturing industries and infrastructure. As the country transitioned in the mid-1970s from a manufacturing and industrial economy to a service-based one, migrants with increased skill and educational levels were sought and it became increasingly difficult to come to Australia as an unskilled worker without family sponsorship.⁴ The requirement for skilled workers tightened further in the mid-1990s. Professionals are now the largest group of recent migrants (40%) followed by technicians and trade workers (19%). In 2008, skilled migrants to Australia came from 180 countries, mainly from the UK, India, China and South Africa.⁵

Every year, more than 2.3 million workers globally die from a work-related injury or

Abstract

Objective: The shift from an industrial to a service-based economy has seen a decline in work-related injuries (WRIs) and mortality. How this relates to migrant workers, who traditionally held high-risk jobs is unknown. This study examined deaths and hospital admissions from WRI, among foreign and Australian-born workers.

Methods: Tabulated population data from the 1991 to 2011 censuses, national deaths 1991–2002 and hospital admission for 2001–10. Direct age standardised mortality and hospital admission rates (DSRs) and rate ratios (RRs) were derived to examine differences in work-related mortality/hospital admissions by gender, country of birth, employment skill level and years of residence in Australia.

Results: DSRs and RRs were generally lower or no different between Australian and foreign-born workers. Among men, mortality DSRs were lower for nine of 16 country of birth groups, and hospital admissions DSRs for 14 groups. An exception was New Zealand-born men, with 9% (95%CI 9–13) excess mortality and 24% (95%CI 22–26) excess hospital admissions.

Conclusions: Four decades ago, foreign-born workers were generally at higher risk of WRI than Australian-born. This pattern has reversed. The local-born comprise 75% of the population and a pro-active approach to health and safety regulation could achieve large benefits.

Key words: work-related injury fatalities, migrants, country of birth, Australia

disease and 317 million accidents occur at work.⁶ Work health and safety legislation and practice differ widely between countries and the heavy burden of accidents and deaths tends to fall on workers in developing countries, where large numbers are employed in the high-risk industries of agriculture, fishing and mining.⁶ Australian states and territories began developing their own occupational health and safety legislation in the 1970s and enacting this legislation from the mid-1980s.⁷ The transition of workers from high-risk industries to the service industry occurred from the 1970s in Australia. During the same time period, road traffic fatalities – estimated to be the cause of up to 30% of all work-related deaths in Australia⁸ declined markedly.⁹ These factors, and the

shift from manual work to automation, has led to a reduction of workers in hazardous conditions and in work-related injuries (WRI) and work-related mortality (WRM).⁷ The work-related injury mortality rate in Australia in 1982–84 was 8.06 per 100,000; 12.05 for men and 1.34 for women.¹⁰ It declined to 3.8 per 100,000 (8.9 for men and 0.7 for women) between 1989–92¹¹ and to 1.93 per 100,000 (3.26 for men and 0.33 for women) in 2010–11.¹²

Deindustrialisation was associated with a 10–15% decline in the incidence of work-related injury mortality in the US between 1980 to 1996.¹³ Yet as WRM for US workers overall reduced between 1996 and 2001, it increased among foreign-born workers from

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4.3 in 1998 to 5.7 per 100,000 employed workers in 2001.¹⁴ Similarly, Latino immigrants working in non-agricultural jobs reported a WRI rate that was almost twofold that of the US-born rate.¹⁵ Higher work-related fatalities and injuries in migrant workers have been reported in several other countries, suggesting that migrant workers are likely to be overrepresented in jobs that involve a high risk of injury.¹⁶ In Canada, foreign-born men in their first five years of residence had an increased risk of WRI requiring medical treatment compared with the Canadian-born population.¹⁷ Similarly, WRIs were twice as likely among foreign-born than local-born workers in Germany, the Netherlands, Switzerland and France.¹⁶ In Australia, overall WRM among foreign-born workers were similar to those of Australian-born workers between 1982 and 1984.¹⁸ However foreign-born workers from non-English speaking countries, e.g. Italy, Greece and Germany, working in mining and rural occupations had higher WRM than Australian-born workers, but a general convergence toward the Australian rate was observed with increasing length of residence. This study aimed to examine trends in WRM and in hospital admissions due to WRIs among foreign and Australian-born workers over the past two decades.

Methods

Data sources

This study used national censuses to assess the population at risk, and deaths records and hospital admissions records to determine work-related injuries and deaths. Use of the data sources was limited by potential disclosure but across all three sources we obtained or derived similar categories of age groups, country of birth groupings and length of residence.

Census data

The population at risk of WRI was derived from the 1991, 1996, 2001, 2006 and 2011 censuses. Tabulated population data were provided by the Australian Bureau of Statistics (ABS). At each census the following country birth groupings were used: Australia, United Kingdom and Ireland, New Zealand, Italy, Greece, Germany, Vietnam, India and Sri Lanka, China, Malaysia, the Philippines, South Africa; or region of birth: Americas, North Africa and the Middle East, Southern and Eastern Europe, Sub-Saharan Africa and All other countries. In some of the analyses, these were further aggregated due to potential

disclosure: Australia; NZ; UK and Ireland; Europe main land (Southern and Eastern Europe, Italy, Germany and Greece); Americas; Asia (Vietnam, India and Sri Lanka, China, Philippines, Malaysia); North Africa and the Middle East and Southern Africa and all other countries (South Africa, Sub-Saharan Africa, all other countries). Age was classified in five-year groups (15–24, 2–34, 35–44, 45–54, 55–64), and length of residence in Australia as 0–10 years or 11+ years.

Occupational Skill level was aggregated as per the Australian Standard Classification of Occupations (ASCO) 2nd Edition¹⁹ for the 1991–2001 Census as: Skill Level 1: Managers and Administrators and Professionals; Skill Level 2: Associate Professionals; Skill Level 3: Tradespersons and related workers and advanced clerical and service workers; Skill Level 4: Intermediate clerical, sales and service workers and intermediate production and transport workers; and Skill Level 5: Elementary clerical, sales and service and labourers and related workers. Because of small numbers, skill levels 1–2 and 4–5 were combined (see Supplementary table, available online).

Death records

Anonymised individual-level death records were obtained from the ABS, for the period 1991 and 2002. Information on occupation ceased to be recorded on death certificates thereafter (see Supplementary table, available online).

The main and contributing causes of death were classified by the ABS according to the International Classification of Diseases (ICD) volumes ICD-9 (1979–1998)²⁰ and ICD-10 (1998–2002).²¹ Work-related fatalities were identified from the External codes (E800–E999) from ICD-9 and Chapters V W, X and Y from ICD-10, where a cause of death that was classified as occurring in a workplace, e.g. farm, mine and quarry, industrial place and premises, or ICD-10 trade and service area, industrial and construction area and farm, was included as a WRM. Other E-codes that identified deaths specific to workers were also included, e.g. from ICD-9 E831.2: accident to watercraft causing other injury – occupation of other watercraft – crew²⁰ and from ICD-10 V 83.0: occupant of special vehicle mainly used on industrial premises injured in transport accident – driver of special industrial vehicle injured in traffic accident.²¹ Any death coded as 'working for income' or 'other work' in the activity code on the death certificate,

available from 1998 onwards (ICD-10) was included as a WRM. Other variables available on the death records included country of birth, gender, date of birth, date of death and length of residence in Australia in years.

Hospital admissions data

The Australian Institute for Health and Welfare (AIHW) provided anonymised individual level hospital admission records for any WRI that was paid for by workers' compensation for the period of financial year 2001/02 to 2009/10. The data provided were by gender and country of birth groupings as per the census records. The data was also aggregated by age (15–24, 25–34, 35–44, 45–54 and 55–64 years).

Statistical analysis

The censuses provided only a snapshot of the population at the 1991, 1996, 2001, 2006 and 2011 censuses, while the mortality and hospital admissions were continually recorded. Annual estimation of the population at risk was derived using linear interpolation applied to population totals in consecutive censuses. Deaths, hospital admissions and population at risk were then summed over five-year periods due to small numbers of events.

Gender-specific WRM rates and hospital admission rates by country of birth were directly standardised (DSR) using the age structure of the World Standard Population²² to allow the examination of absolute country differences in WRM.

Negative binomial regressions were used to compare the country-specific WRM rates of the foreign-born workers with those of Australian-born workers, and to account for over dispersion. The regression models were stratified by gender and adjusted for age, census period and employment skill level. The same approach was used to compare hospital admission rates but the models were adjusted for only age and census period. The effect of length of residence among foreign-born workers was examined using the rates of Australian-born workers as the reference category.

Results

There were 5,156 WRM between 1991 and 2002 and 659,563 hospital admissions between 2001 and 2010 due to a work-related injury or illness. Death rates and hospital admission rates were far higher in

men than women (Table 1).

Among men, death rates were lower for nine country of birth groupings than for those born in Australia. Men born in UK and Ireland, Southern and Eastern Europe, North Africa and the Middle East, Vietnam, Americas, India and Sri Lanka, Malaysia, South African and Sub-Saharan Africa all had lower rates. There was a consistent pattern of lower admission rates for all groups except for those born in NZ. The lowest rates were observed for Vietnam, China and Malaysia.

Among women, death rates did not differ significantly and small numbers of deaths may have limited significance for the generally low mortality pattern. Hospital admissions were less likely for 12 country or region of birth groupings than for those born in Australia. The rates were higher for those born in the UK and Ireland, and in NZ. The lowest rates were for those born in Vietnam, China and Malaysia (Table 1).

Table 2 shows the distributions by skill level and country of birth grouping. In 2001, compared with the Australian-born, the proportion in the top employment skill level was either similar or higher for 10 of 17 country of birth groupings among males, 9 among females. At both Census points, workers from the Philippines had the most disadvantaged distribution. Only small changes occurred in employment skill level among Australian, NZ, Indian and Sri Lankan, Philippines and Sub-Saharan African-born men over the period 1991 and 2001. In contrast, among men born in China, 16% more were working in employment skill level 1 occupations in 2001 compared with 1991. Similar – although not as marked – increases were also observed among men born in Germany, Greece, Italy and Vietnam. Among women, there were marked increases in those employed in employment skill level 1 occupations between 1991 and 2001 in all country of birth groupings (Table 2).

Figure 1 shows mortality rate ratios (MRRs) adjusted for census time point, employment skill level and age, by regional groupings (a higher level aggregation due to potential disclosure). Adjusted MRRs among men were significantly lower among workers born elsewhere than those born in Australia (Figure 1). Among women, the confidence intervals were wide, reflecting imprecision of the MRRs, but lower MRRs for those from Europe mainland and Asia were of borderline significance. For both men and women, the time trend reflected general improvement

Table 1: Directly standardised work-related mortality and hospital admission rates per 100,000 for males and females by country of birth, 1991–2002 (mortality) and 2001–2010 (morbidity), Australia.

Country/Region of birth	Mortality (1991–2002)			Morbidity (2001–2010)		
	N Fatalities	Person years	DSR (95%CI)	N Hospital admissions	Person years	DSR (95%CI)
Males						
Australia	3,489	50,213,390	6.97 (6.74–7.20)	366,031	27,653,171	1,333.29 (1,328.97–1,337.62)
UK & Ireland	265	4,886,981	5.60 (4.76–6.60)	28,482	2,404,641	1,132.85 (1,116.72–1,149.22)
Southern & Eastern Europe	112	1,888,993	4.28 (3.41–5.51)	12,341	956,168	1,156.78 (1,132.7–1,181.35)
New Zealand	115	1,496,619	7.27 (5.95–8.85)	15,564	907,575	1,682.62 (1,656–1,709.57)
North Africa & the Middle East	31	992,477	3.08 (1.99–4.72)	6,547	596,831	1,077.67 (1,051.01–1,104.89)
Italy	56	972,546	4.34 (2.85–10.3)	5,268	411,268	1,088.11 (1,026.6–1,154.23)
Vietnam	28	749,037	4.42 (2.83–6.73)	2,216	398,822	528.22 (505.71–551.62)
Americas	26	709,580	3.53 (2.26–5.37)	4,635	410,555	1,096.26 (1,064.54–1,128.73)
India & Sri Lanka	13	622,787	2.42 (1.22–4.49)	3,916	479,974	817.47 (792.04–843.53)
Greece	29	566,238	3.65 (2.08–10.6)	2,104	239,764	813.96 (751.44–882.52)
China	27	513,706	5.86 (3.63–9.22)	1,399	393,535	344.39 (326.35–363.19)
Germany	36	496,993	7.18 (3.86–13.5)	2,363	239,445	895.67 (844.46–950.05)
Philippines	13	286,990	4.46 (2.17–9.06)	1,698	194,274	879.2 (836.52–923.87)
Malaysia	9	364,721	2.35 (1.07–4.77)	851	207,446	416.23 (388.62–445.36)
South Africa	9	285,267	2.89 (1.29–5.78)	1,768	214,635	801.05 (763.91–839.61)
Sub-Saharan Africa	8	275,432	2.55 (1.01–5.86)	2,061	189,255	1,042.8 (997.33–1,089.92)
All other countries	160	2,741,638	5.60 (4.76–6.56)	28,457	1,631,587	1,731.93 (1,711.78–1,752.26)
All foreign-born	937	17,850,006	5.03 (4.68–5.40)	119,670	9,875,775	1,169.57 (1,162.59–1,176.58)
Females						
Australia	545	50,697,763	1.09 (1.00–1.18)	127,804	28,211,821	463.14 (460.6–465.69)
UK & Ireland	62	4,643,013	1.17 (0.82–1.69)	12,785	2,313,117	488.35 (478.38–498.53)
Southern & Eastern Europe	15	1,761,235	0.88 (0.39–1.89)	4,997	951,970	439.33 (426.04–453.06)
New Zealand	14	1,443,694	1.16 (0.62–2.02)	4,472	889,959	491.06 (476.65–505.82)
North Africa & the Middle East	4	875,890	0.40 (0.11–1.34)	1,537	532,462	269.52 (256.09–283.51)
Italy	17	857,613	0.84 (0.47–8.05)	1,543	376,601	344.48 (313.88–380.31)
Vietnam	6	749,337	0.98 (0.32–2.41)	670	437,107	150.53 (139.04–162.86)
Americas	7	733,830	0.75 (0.30–1.81)	2,065	437,524	450.9 (431.53–470.97)
India & Sri Lanka	3	565,057	0.71 (0.11–2.62)	1,410	408,044	334.56 (317.23–352.62)
Greece	2	558,813	0.27 (0.03–8.08)	1,054	246,671	370.63 (335.82–411.29)
China	6	537,678	1.29 (0.41–3.44)	633	470,048	140.9 (129.98–152.53)
Germany	9	471,239	1.35 (0.50–5.58)	961	237,063	342.57 (315–372.72)
Philippines	2	597,417	0.50 (0.05–2.13)	1,692	382,548	402.33 (382–61,422.9)
Malaysia	2	416,768	0.43 (0.05–2.10)	525	247,180	207.55 (190.04–226.3)
South Africa	2	292,313	0.75 (0.08–2.98)	697	221,616	310.7 (287.94–334.84)
Sub-Saharan Africa	2	262,732	1.31 (0.16–4.73)	773	184,989	410.16 (381.37–440.7)
All other countries	32	2,869,573	1.11 (0.76–1.59)	10,244	1,792,520	565.58 (554.68–576.65)
All foreign-born	185	17,636,201	0.99 (0.84–1.17)	46,058	10,129,419	413.83 (409.94–417.76)

in WRM over time, irrespective of region or country of birth, age and employment skill level, (MRR 0.90, 95%CI 0.89–0.91 and MMR 0.83, 95%CI 0.81–0.86) respectively.

Table 3 shows MRRs (death rate for Australian born as the reference) by duration of residence among men. Apart from NZers who had lived in Australia for less than 11 years, there was a broad pattern of lower mortality for most regional grouping, regardless of

length of residence. The small number of deaths among most of the groups for women prevented any reliable interpretation (data not shown). The only notable results were for women from the United Kingdom and Ireland. MRRs for those who had been resident for more than 11 years were lower (MRR 0.71, 95%CI 0.50–99, n=37), and not significant for those who had lived there for fewer years (MRR 2.17, 95%CI 0.49–3.63, n=15).

Figure 1: Mortality rate ratios for deaths from work-related injuries by region of birth and sex, adjusted for age, census time point and employment skill level.

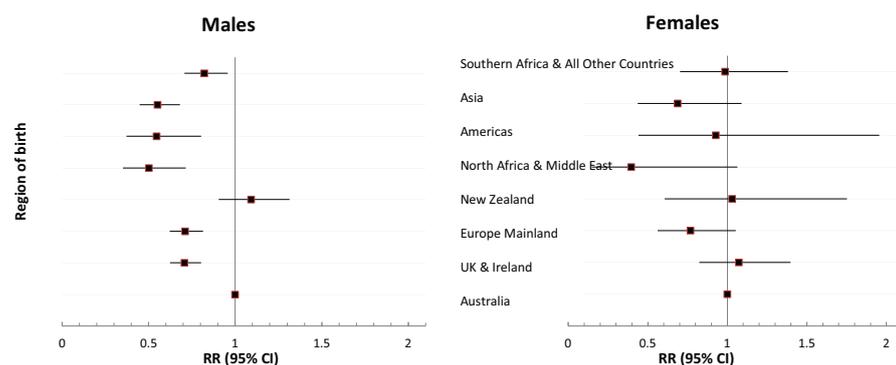


Table 2. Change in employment skill level+ between 1991 and 2001 for males and females by country or region of birth.

	Skill level	Males		Females	
		1991 %	Difference	1991 %	Difference
Australia	1	37.8	+2.1%	33.3	+5.8%
	3	39.9	-1.6%	59.3	-8.8%
UK & Ireland	1	42.5	+5.7%	35.3	+8.6%
	3	34.8	-3.7%	57.5	-12.2%
South & East Europe	1	24.4	+5.9%	23.1	+8.2%
	3	46.3	-3.1%	69.4	-10.5%
New Zealand	1	33.7	+2.8%	32.0	+6.6%
	3	42.5	-0.4%	60.3	-9.1%
N Africa & Mid East	1	33.5	+5.1%	29.4	+8.9%
	3	46.4	-4.4%	63.3	-12.2%
Italy	1	27.5	+7.5%	22.4	+6.5%
	3	42.6	-5.9%	66.9	-11.3%
Vietnam	1	21.8	+9.1%	19.1	+10.9%
	3	59.0	-6.9%	71.1	-10.2%
Americas	1	44.6	+4.7%	43.1	+4.3%
	3	36.6	-2.4%	50.9	-6.3%
India & Sri Lanka	1	49.7	+2.6%	33.6	+8.1%
	3	37.6	+0.1%	59.8	-9.9%
Greece	1	24.1	+8.9%	19.6	+9.8%
	3	53.5	-8.9%	72.7	-13.2%
China	1	30.2	+16.0%	25.0	+13.6%
	3	43.8	-8.5%	66.7	-13.8%
Germany	1	40.8	+6.2%	35.2	+8.7%
	3	30.3	-0.9%	56.0	-11.7%
Philippines	1	24.7	+3.5%	23.5	+3.3%
	3	56.8	-1.7%	71.7	-4.7%
Malaysia	1	59.8	+5.6%	51.2	+6.5%
	3	29.0	-3.5%	43.5	-8.7%
South Africa	1	56.2	+6.0%	42.1	+10.0%
	3	25.4	-3.7%	50.6	-13.1%
Sub-Saharan Africa	1	44.8	+3.9%	34.6	+7.6%
	3	39.7	-2.1%	58.7	-10.9%
All other Countries	1	39.9	+4.9%	36.5	+3.9%
	3	38.6	0%	56.3	-5.9%

+Employment Skill Level coded from the Australian Standard Classification of Occupations 2nd Edition (ASCO).

1=Managers and Administrators, Professionals and Associate Professionals.

3=Intermediate and elementary clerical, sales, transport and production workers, labourers and related workers.

The pattern of lower hospital admission rates among men for all country or region of birth groupings compared with Australian-born workers remained the same after adjusting for age and census time point (Figure 2). These adjustments did not remove the excess hospital admissions for NZ men or those born in 'All Other Countries'. The lowest rate ratios were observed for workers born in China, Vietnam and Malaysia. The pattern was similar for women although women born in 'All Other Countries', NZ and the United Kingdom and Ireland had higher rate ratios for hospital admission. The lowest rate ratios were observed for workers born in China, Vietnam and Malaysia. For both men and women, adjusted for region of birth and age, the risk of admissions for a WRI increased across time (RR 1.324, 95%CI 1.323-1.326 and RR 1.323, 95%CI 1.321-1.326), respectively.

Discussion

This study is the first examination of deaths and hospital admissions due to WRI among foreign and Australian-born workers after the transition to a service-based economy and the consequent demand for more skilled migration. A consistent pattern was lower mortality and likelihood of hospital admissions for foreign-born workers, including workers from countries historically thought to be at greater risk. For example, both men and women from the Eastern Asian countries had lower hospital admissions than Australian-born workers. Men from NZ, on the other hand, appeared to be at greater risk of hospital admissions due to WRI. Overall, the rates of WRM fell in Australia from the 1990s.

Studies from other countries have found disparities in fatal²³⁻²⁶ and non-fatal work-related injuries^{15,17,27,28} among migrants compared with native-born populations, in contrast to this current study. In those other studies, migrants or foreign-born workers tended to work in agriculture and construction and were often temporary and unskilled workers.^{15,24,28} This is not the case in Australia. From the 1970s, it became increasingly difficult for unskilled migrants to enter Australia other than on a humanitarian or family reunion basis,⁴ and from the mid-1990s Australia has specifically encouraged skilled migration.²⁹ Most migrants to Australia come as permanent migrants. Participation in the labour force (75%) and unemployment (6.3%) is higher compared with 68% and 3.2% respectively for

the Australian-born population.³⁰ Working in jobs below their qualification level is an issue, with 29% of professionals being employed as professionals in their first job, increasing to 39% in a subsequent job.^{5,31} Illegal migration is not a significant problem and was estimated to be 60,900 at June 2012.³² Substantial changes in migrant stock to Australia and the industry they work in after arrival may explain why this study did not find an excess risk of WRM.

In this present study, Australian-born workers have higher rates of WRM and WRI than foreign-born workers. The findings correspond with recent analyses of the national multi-purpose household surveys conducted in 2005–06 and 2009–10 that showed higher rates of WRI among Australian-born compared with foreign-born workers. Australian-born workers were more likely to work in agriculture (4.2% vs. 1.2%) and construction (8.3% vs. 7.1%), and less likely to work in the service industry (46.4% vs. 48.9%) than foreign-born workers.³³ Transport, agriculture, mining, manufacturing and construction industries consistently have the highest WRM in Australia.^{34,35} Australian-born workers were also more likely to work without paid leave entitlements (17.3%) than foreign-born workers (16.2%), but other conditions of shift work, working fixed term or contracts and working longer than 38 hours per week did not differ between Australian or foreign-born workers.³³ Foreign-born workers who have migrated to Australia as skilled migrants based on their educational qualifications, work experience and skills and English language proficiency are more likely to work in the services (48.9%), manufacturing (10.8%) and hospitality (5.9%) industries compared with Australian-born workers.³³ NZ workers were an exception, and their generally greater mortality risks compared to the Australian-born workers might be related to their greater likelihood to work in high-risk industries, such as construction and manufacturing)³⁶ NZ males are more likely to work in construction (21%) and manufacturing (13%) than the Australian population (15% and 12% respectively). Of those working in construction 46%, were technicians or trade workers and 28% were labourers, while those in manufacturing were technician or trade workers (29%), machinery operators or drivers (20%), managers (19%) and labourers (18%). NZ women tend to work in manufacturing, retail and health care and social assistance.³⁶ These occupational disparities may explain why NZers have a

Table 3: Mortality rate ratios (MRRs) for males 1991–2002 by country or region of birth and duration of residence, adjusted for age, employment skill level and census time point.

Country/Region of birth	Males	
	N	IRR (95%CI)
Deaths		
Duration of residence in Australia ≤10 years		
Australia	3,489	1.00 (Ref)
UK and Ireland	34	0.69 (0.50-0.97)
Europe main land	15	0.54 (0.32-0.90)
New Zealand	54	1.25 (0.95-1.63)
North Africa and the Middle East	6	0.35 (0.16-0.78)
Americas	9	0.59 (0.31-1.14)
Asia	51	0.64 (0.48-0.84)
Southern Africa and all other Countries	44	0.57 (0.43-0.77)
Duration of residence in Australia 11+ years		
Australia	3,489	1.00 (Ref)
UK and Ireland	231	0.71 (0.62-0.81)
Europe main land	218	0.72 (0.63-0.83)
New Zealand	61	0.98 (0.76-1.27)
North Africa and the Middle East	25	0.56(0.38-0.83)
Americas	17	0.52 (0.33-0.84)
Asia	39	0.47 (0.34-0.64)
Southern Africa and all other Countries	133	0.95 (0.80-1.14)

higher risk of hospitalisation for work-related injuries and a suggestion of a higher risk of work-related injury fatalities than Australian-born workers.³⁷

Australia ranked seventh among 10 European countries and NZ in a comparison of WRM based on data from 1998–99 and 2000–01, after standardising for differences in industrial sector.³⁴ Only Belgium and Germany (3.0 per 100,000) and NZ (3.6 per 100,000) had higher WRM than Australia (2.8 per 100,000). The UK and Sweden had the fewest fatalities at 1.7 per 100,000.³⁴ Other work showed higher WRM rates for NZ (4.9 per 100,000) compared with Australia (3.8 per 100,000) and the US

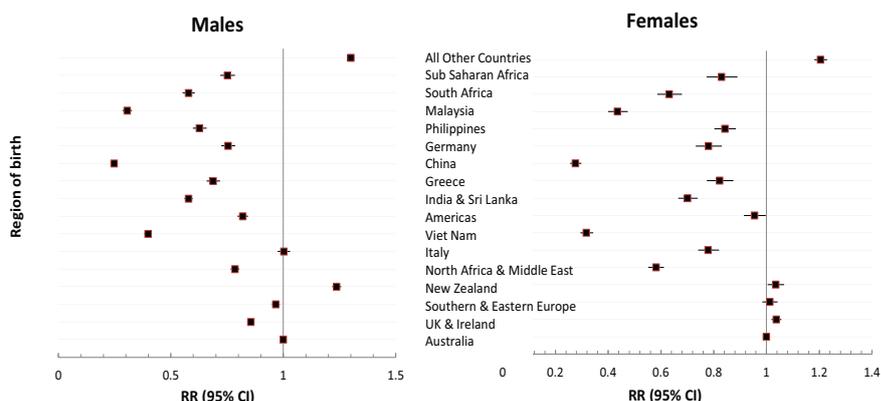
(3.2 per 100,000)³⁸ between 1989–92. Our findings suggest that without migration and the attenuating impact of migrant workers on work-related injury statistics, Australia may fare worse internationally in terms of injury rankings.

Limitations and strengths

A limitation of this study is that in Australia, hospital admissions for work-related injury or illness can only be identified if the payment status for the admission was workers' compensation. Other work has shown that this method of capturing is associated with an underestimate in the number of WRI. For the state of New South Wales, 69% of all WRI hospital admissions^{39,40} were identified using this method and undercounting was greater among persons from non-English speaking backgrounds than English speaking, where 60% and 71% of hospital admissions for WRI were identified respectively.³⁹ Differential access to workers compensation could depress the hospital admissions for WRI among foreign-born compared to Australian-born workers, but this issue has not been examined in Australia.^{41,42}

Another limitation refers to the use of death certificates as a source of WRM as Australian death certificates do not specifically identify WRM. We used the External Cause codes in the relevant ICD volumes. The major cause of WRM is traffic accidents, e.g. driving as part of the job and commuting to/from work. Half of all WRM in Australia in 2010–2011 were the result of a traffic incident.⁴³ However, we were unable to examine traffic incidents as they are not coded in the ICD volumes if they are work-related or not. There is little information on whether the incidence of traffic fatalities differs by migration status, but Factor et al. (2008) reported an increased risk of

Figure 2: Rate ratios for admissions for work-related injuries by country and region of birth and sex, adjusted for age and census time point.



involvement in fatal or severe traffic accidents among people from Africa or Asia compared with Europe or the US. Excluding traffic accidents may have underestimated the risk of WRM among foreign-born workers.⁴⁴

We found that the risk of hospital admission for a work-related injury or illness increased over time in contrast to WRM, which decreased. There are several possible explanations for this disparity. First, hospital admissions data capture all hospital admissions paid for by workers compensation, including illness as well as injury. So admissions for occupational cancers (e.g. mesothelioma) or other work-related illnesses such as asthma would be included in our data. It has been estimated that 5,000 invasive cancers and 34,000 non-melanoma skin cancers per year in Australia are caused by occupational exposure to carcinogens.³⁷ In addition, work-related injuries resulting from road traffic accidents will have been included in the hospital admissions data, but not included in the mortality records.

The remainder group 'All other countries' had a greater likelihood of hospital admissions but not of mortality than the Australian-born. We were unable to examine this group in detail due to disclosure. However, further analysis of the 2001 Census showed that 30% of males from this group worked as tradespersons and related workers and 24% worked as labourers and related workers, suggesting that they may be working in the more risky occupations. Sixty-two per cent were aged less than 45 years. Among females, 65% were aged less than 45 years, and 52% worked as intermediate clerical, sales and service workers and 21% as labourers.

There are two key strengths of this study. It is based on national data over a 16-year time span, and covers both hospital admissions and mortality from WRIs. It is one of a few studies to examine WRM and hospital admissions among all foreign-born workers across different occupations, not limited to those who work in the high risk industries.

Conclusion

The rates of WRM have fallen since the 1990s, but Australian-born workers appear to be at a greater risk than foreign-born workers. These findings signal the need to continue to promote occupational health and safety in all industries, and specifically high-risk industries, to further reduce the risk of work-

related accidents and injuries to all workers in Australia.

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Supporting Information

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

Supplementary Table 1: Description of data sources for hospital admissions and deaths from work related injuries and for denominators.