

Inequities in exposure to occupational risk factors between Māori and non-Māori workers in Aotearoa New Zealand

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ABSTRACT

Background Health inequities between indigenous and non-indigenous people are well documented. However, the contribution of differential exposure to risk factors in the occupational environment remains unclear. This study assessed differences in the prevalence of self-reported exposure to disease risk factors, including dust and chemicals, physical factors and organisational factors, between Māori and non-Māori workers in New Zealand.

Methods Potential participants were sampled from the New Zealand electoral rolls and invited to take part in a telephone interview, which included questions about current workplace exposures. Logistic regression, accounting for differences in age, socioeconomic status and occupational distribution between Māori and non-Māori, was used to assess differences in exposures.

Results In total, 2344 Māori and 2710 non-Māori participants were included in the analyses. Māori had greater exposure to occupational risk factors than non-Māori. For dust and chemical exposures, the main differences related to Māori working in occupations where these exposures are more common. However, even within the same job, Māori were more likely to be exposed to physical factors such as heavy lifting and loud noise, and organisational factors such as carrying out repetitive tasks and working to tight deadlines compared with non-Māori.

Conclusions This is one of the first studies internationally to compare occupational risk factors between indigenous and non-indigenous people. These findings suggest that the contribution of the occupational environment to health inequities between Māori and non-Māori has been underestimated and that work tasks may be unequally distributed according to ethnicity.

INTRODUCTION

Inequities in health between indigenous and non-indigenous people have been consistently reported worldwide.¹ These arise from a complex interplay of historical, social, economic and political factors which have not supported indigenous rights and where systematic disparities in health and the determinants of health continue to disproportionately impact indigenous peoples.^{1–5} Māori, the indigenous people of Aotearoa/New Zealand, comprise 15% of the total population (4.7 million)⁶ and experience differences in key health and social outcomes including lower life expectancy, increased prevalence of chronic

disease, and lower educational attainment and economic status. They are also more likely to be exposed to risk factors such as tobacco smoke, obesity and poverty.^{7,8}

The work environment is an important contributor to health and social inequities^{9,10}; however, few studies have addressed this in indigenous populations. A survey of 11 326 American Indian and Alaska Native people showed differential occupational exposure patterns for different demographic groups, but no comparison was made with their non-indigenous counterparts.¹¹ Studies in Europe and North America have shown higher exposure prevalence to occupational hazards in migrant and minority populations, including exposure to social hazards such as discrimination and sexual harassment.^{9,12–14}

In New Zealand, Māori are over-represented in low-skilled, manual and therefore often more hazardous jobs,⁶ which contributes to higher work-related injury rates.^{15,16} However, information on risk factors for occupational disease among Māori workers is limited. We previously conducted a general New Zealand Workforce Survey (NZWS)¹⁷ with exploratory analyses suggesting differences in occupational exposure between Māori and non-Māori, but power was low due to the small number of Māori participants (n=272).¹⁸

The current study repeats the NZWS in a large sample of Māori workers, allowing, for the first time, robust comparisons of occupational exposures between Māori and non-Māori workers. This is also one of the first studies internationally to compare these risk factors between indigenous and non-indigenous people.

METHODS

Study sample and recruitment

For the Māori Workforce Survey, we selected a random sample of people aged 20–64 years from the 2008 and 2010 general and Māori Electoral Rolls (Māori can choose to register on either). Potential participants were sent a letter detailing the objectives of the study and information about the telephone interview. Non-responders were contacted by phone, or if no phone number was available, we mailed the invitation up to three times. Interviews took place between 2009 and 2010. All participants provided written consent, and the study conformed to the principles embodied in the Declaration of Helsinki.



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Recruitment to the general NZWS followed the same process and has been described previously.¹⁷

Study questionnaire

The questionnaire used in both surveys included questions about workplace exposures and demographics. Ethnicity was self-identified, which is standard practice in New Zealand. Participants were asked if they identified as Māori, Pacific Islander, European/pākehā or 'other'. Pākehā are non-Māori, usually of European descent (~70% of the New Zealand population). Pacific Islanders comprise people from several Pacific Island states including Fiji, Samoa, Tonga, Cook Islands, Niue and Tokelau (~7% of the New Zealand population). If a participant identified with multiple ethnicities, this was classified into a single ethnicity, which prioritised Māori. For analyses, ethnicity was reduced to Māori and non-Māori (European/pākehā, Pacific Islander, other).

Participants were asked whether the following exposures were present in the current or most recent work environment: dust; smoke, fume or gas; oils or solvents; acids or alkalis; pesticides; and other chemical products (including dyes, inks and adhesives). They were asked how often their job involved exposure to the following physical factors: lifting; loud noise; awkward or tiring positions; awkward grip or hand movements; standing; or using tools that vibrate. Exposure to organisational factors was also queried, including working irregular hours (outside 07:00 to 20:30) and night shifts (00:00 to 05:00) in the previous month, and how often work involved repetitive tasks, working at very high speeds or working to tight deadlines. Participants were also asked whether they used personal protective equipment (PPE) at work, and if so, which types. Lastly, participants were asked how stressful they find their current job (measured on a five-point scale and grouped into two levels).

Statistical analysis

The New Zealand Standard Classification of Occupations (NZSCO) 1999 was used to code occupation¹⁹; industry was coded using the Australian and New Zealand Standard Industrial Classification 1996 (ANZIC96).²⁰ Socioeconomic status (SES) was assessed using the New Zealand Deprivation Index 2006, which is census-based with a relative deprivation score assigned to each geographical meshblock based on place of residence. The prevalence of physical and organisational exposures (other than irregular hours and night shift) was defined as the proportion of individuals who reported exposure as part of their current job for at least a quarter of the time. The prevalence of all other exposures was defined as the proportion of individuals who reported being exposed (yes/no) as part of their current job at any frequency.

We compared differences in gender, age, SES, occupation and industry between Māori and non-Māori using χ^2 tests, and differences in exposures using logistic regression. The regression analyses were stratified by gender and adjusted for age and SES (OR2) due to significant differences observed between Māori and non-Māori. As they also differed in terms of current employment (table 1), we additionally assessed whether differences in self-reported exposure remained after adjusting for occupational group (using one-digit NZSCO code) and industry group (using one-digit ANZIC code) in addition to age and SES (OR3). In order to achieve full adjustment for differences in occupational distribution between Māori and non-Māori, we conducted conditional logistic regression on pairs of Māori and non-Māori participants matched on gender, 5-year age group, deprivation

and five-digit NZSCO code (1:1) (OR4). Due to different occupational and SES distributions, this could be achieved for only 457 Māori/non-Māori pairs; nonetheless, we consider it as important to present these results to assess the consistency of findings. Analyses were conducted using SAS V.9.4.

RESULTS

Response rates

Details about the response rate for the general NZWS (37%) have previously been reported.²¹ For the Māori Workforce Survey, 9380 potential participants were sent invitations to participate. Of these, 2593 (28%) no longer lived at the address recorded on the Electoral Roll. A further 2903 (31%) did not return a response, and it is unknown if they received the invitation. Of the 3884 people (41%) who did return a response, 2107 (54%) agreed to be interviewed. Assuming that those who did not return a response received the invitation, but chose not to participate, the overall response rate is 31%. Two people had previously taken part in the general NZWS and were removed from the Māori Workforce Survey.

The prevalence of key survey variables was unchanged after standardising to the demographic distribution of the source population as shown in online supplementary figure 1 for the Māori Workforce Survey, and previously for the NZWS,²¹ indicating that significant non-response bias is unlikely.

Demographics and occupation

In total, 5108 people took part across the two surveys. Of these, 54 were excluded due to missing information about ethnicity, occupation and/or SES, leaving 2344 Māori and 2710 non-Māori in the analyses (table 1).

There was a slightly higher proportion of women among Māori (56% vs 52%). The age structures of Māori and non-Māori differed, with Māori participants being slightly older. Māori were also over-represented in the most deprived groups (table 1).

Māori were over-represented in the following occupational groups: service and sales workers; plant and machine operators and assemblers; and elementary occupations (groups 5, 8 and 9). Conversely, Māori were under-represented in the occupational groups: legislators, administrators and managers; professionals; clerks; and trade workers (groups 1, 2, 4 and 7) (table 1). Differences were also seen for employment in current industry (table 1).

Exposure prevalence

Dust and chemical factors

Comparing exposure to dust and chemical factors by ethnicity across occupational group revealed a mixed pattern (figure 1). Exposure to dust and smoke, fume or gas was more common in Māori for some occupational groups and in non-Māori for other occupational groups. Exposure to oils and solvents, acids and alkalis, and pesticides was generally higher among non-Māori across occupational group, whereas exposure to other chemical products was higher for Māori. Among men, Māori were more likely to be exposed to dust (OR 1.26; 95% CI 1.07 to 1.48) and smoke fume or gas (OR 1.26; 95% CI 1.06 to 1.50) than non-Māori (table 2, OR1). The differences were attenuated after adjusting for age and SES, and weakened further after adjustment for occupation and industry. A similar pattern was seen for women, where Māori were more likely to report exposure to dust (OR 1.42; 95% CI 1.18 to 1.70) and smoke fume or gas (OR 1.31; 95% CI 1.06

Table 1 Demographics of study participants

	Total n=5054 (100%)*		Māori n=2344 (46.4%)		Non-Māori n=2710 (53.6%)		χ^2
	n	%	n	%	n	%	P values
Gender							<0.01
Male	2353	46.6	1042	44.5	1311	48.4	
Female	2701	53.4	1302	55.6	1399	51.6	
Age (years)							<0.01
20–34	1042	20.6	464	19.8	578	21.3	
35–44	1283	25.4	548	23.4	735	27.1	
45–54	1373	27.2	577	24.6	796	29.4	
55+	1356	26.8	755	32.2	601	22.2	
Ethnicity							
Māori	2344	46.4	2344	100.0	–	–	
Pākehā	2374	47.0	–	–	2374	87.6	
Pacific Peoples	52	1.0	–	–	52	1.9	
Other	284	5.6	–	–	284	10.5	
Occupation							<0.01
1. Legislators, admin and managers	689	13.6	264	11.3	425	15.7	<0.01
2. Professionals	957	18.9	384	16.4	573	21.1	<0.01
3. Technicians and associate professionals	763	15.1	347	14.8	416	15.4	0.59
4. Clerks	562	11.1	236	10.1	326	12.0	0.03
5. Service and sales workers	671	13.3	349	14.9	322	11.9	<0.01
6. Agricultural and sales workers	303	6.0	134	5.7	169	6.2	0.44
7. Trade workers	392	7.8	161	6.9	231	8.5	0.03
8. Plant and machine operators and assemblers	459	9.1	304	13.0	155	5.7	<0.01
9. Elementary occupations	258	5.1	165	7.0	93	3.4	<0.01
Industry							<0.01
A. Agriculture, forestry and fishing	326	6.5	145	6.2	181	6.7	0.48
B. Mining	18	0.4	8	0.3	10	0.4	0.87
C. Manufacturing	666	13.2	307	13.1	359	13.3	0.88
D. Electricity, gas and water supply	38	0.8	18	0.8	20	0.7	0.90
E. Construction	367	7.3	178	7.6	189	7.0	0.40
F. Wholesale trade	156	3.1	49	2.1	107	4.0	<0.01
G. Retail trade	441	8.7	194	8.3	247	9.1	0.29
H. Accommodation, cafes and restaurants	179	3.5	94	4.0	85	3.1	0.09
I. Transport and storage	220	4.4	125	5.3	95	3.5	<0.01
J. Communication services	100	2.0	56	2.4	44	1.6	0.05
K. Finance and insurance	160	3.2	51	2.2	109	4.0	<0.01
L. Property and business services	481	9.5	169	7.2	312	11.5	<0.01
M. Government administration and defence	323	6.4	169	7.2	154	5.7	0.03
N. Education	585	11.6	289	12.3	296	10.9	0.12
O. Health and community services	637	12.6	318	13.6	319	11.8	0.06
P. Cultural and recreational services	138	2.7	62	2.7	76	2.8	0.73
Q. Personal and other services	219	4.3	112	4.8	107	4.0	0.15
New Zealand Deprivation Index 2006							<0.01
1–2 (least deprived)	1075	21.3	325	13.8	750	27.7	<0.01
3–4	962	19.0	355	15.2	607	22.4	<0.01
5–6	1020	20.2	416	17.8	604	22.3	<0.01
7–8	1004	19.9	540	23.0	464	17.1	<0.01
9–10 (most deprived)	993	19.7	708	30.2	285	10.5	<0.01

*Fifty-four participants (26 males and 28 females) who took part in the surveys were excluded because they either provided no ethnicity information, could not be assigned an occupational group or industry (unemployed, a student, a housewife/husband or did not answer) or if deprivation index could not be classified.

to 1.61) (table 3, OR1) in the unadjusted analyses, but the difference in exposure to smoke, fume or gas weakened in adjusted models. However, associations with dust remained

even after adjustment for age, SES, occupation and industry. In addition, Māori women were less likely to report exposure to oils and solvents.

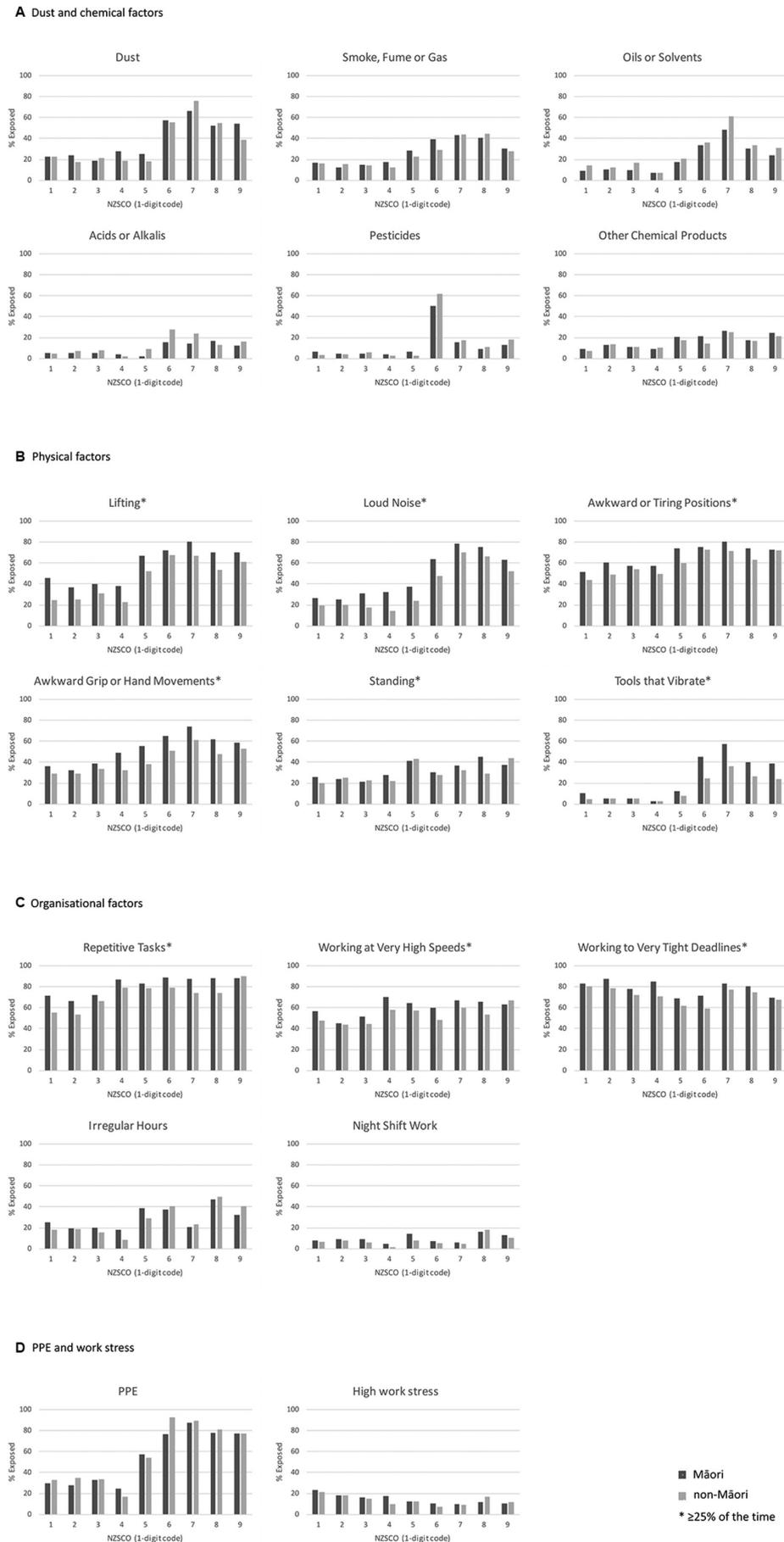


Figure 1 Self-reported exposure prevalence by current job (using New Zealand Standard Classification of Occupations (NZSCO) one-digit code).

Table 2 Differences in occupational exposure prevalence between Māori and non-Māori men

Exposure	Māori	Non-Māori	Unadjusted (n=2353)		Adjusted for age and SES (n=2353)		Adjusted for age, SES, occupation (1st digit) and industry (n=2353)		Matched by 5-year age group, deprivation group and five-digit occupation NZSCO code§ (n=384)	
	n=1049 (%)	n=1315 (%)	OR1† (95% CI)	P values	OR2‡ (95% CI)	P values	OR3 (95% CI)	P values	OR4 (95% CI)	P values
Dust/chemical factors										
Dust	45.5	39.9	1.26 (1.07 to 1.48)	<0.01*	1.16 (0.98 to 1.38)	0.09	1.12 (0.92 to 1.37)	0.25	1.23 (0.79 to 1.92)	0.37
Smoke/fume/gas	34.0	29.1	1.26 (1.06 to 1.50)	0.01*	1.17 (0.98 to 1.41)	0.09	1.11 (0.91 to 1.35)	0.30	1.40 (0.88 to 2.24)	0.16
Oils and solvents	28.3	30.2	0.92 (0.79 to 1.10)	0.36	0.88 (0.73 to 1.06)	0.17	0.84 (0.68 to 1.03)	0.09	0.97 (0.60 to 1.57)	0.90
Acids and alkalis	13.9	13.8	1.01 (0.80 to 1.28)	0.93	0.98 (0.77 to 1.25)	0.87	0.95 (0.73 to 1.23)	0.70	0.91 (0.50 to 1.67)	0.76
Pesticides	14.0	14.5	0.96 (0.76 to 1.21)	0.74	0.90 (0.71 to 1.15)	0.42	0.80 (0.61 to 1.06)	0.13	1.18 (0.62 to 2.25)	0.62
Other chemical products	15.6	13.8	1.13 (0.90 to 1.43)	0.28	1.09 (0.86 to 1.39)	0.50	1.06 (0.82 to 1.36)	0.67	1.35 (0.78 to 2.41)	0.31
Physical factors										
Lifting‡	61.9	41.8	2.26 (1.91 to 2.67)	<0.01*	2.06 (1.73 to 2.46)	<0.01*	2.08 (1.71 to 2.54)	<0.01*	2.00 (1.24 to 3.23)	<0.01*
Loud noise‡	56.5	39.5	1.99 (1.69 to 2.35)	<0.01*	1.78 (1.50 to 2.12)	<0.01*	1.69 (1.38 to 2.06)	<0.01*	2.83 (1.66 to 4.85)	<0.01*
Awkward or tiring positions‡	69.3	53.6	1.97 (1.66 to 2.34)	<0.01*	1.84 (1.54 to 2.20)	<0.01*	1.71 (1.42 to 2.07)	<0.01*	1.53 (1.00 to 2.33)	0.05
Awkward grip or hand movements‡	56.3	39.4	1.97 (1.67 to 2.32)	<0.01*	1.84 (1.55 to 2.19)	<0.01*	1.82 (1.51 to 2.19)	<0.01*	2.04 (1.28 to 3.26)	<0.01*
Standing‡	33.8	26.2	1.41 (1.18 to 1.69)	<0.01*	1.35 (1.12 to 1.63)	<0.01*	1.32 (1.09 to 1.60)	<0.01*	1.46 (0.91 to 2.37)	0.12
Tools that vibrate‡	33.2	16.8	2.45 (2.02 to 2.98)	<0.01*	2.29 (1.86 to 2.80)	<0.01*	2.35 (1.87 to 2.95)	<0.01*	2.87 (1.59 to 5.16)	<0.01*
Organisational factors										
Repetitive tasks‡	80.0	63.7	1.00 (0.83 to 1.21)	0.98	0.96 (0.78 to 1.17)	0.65	1.98 (1.60 to 2.44)	<0.01*	1.93 (1.22 to 3.04)	<0.01*
Working at very high speeds‡	58.4	46.4	0.81 (0.68 to 0.97)	0.02*	0.79 (0.65 to 0.95)	0.01*	1.63 (1.36 to 1.96)	<0.01*	1.49 (0.99 to 2.23)	0.06
Working to tight deadlines‡	80.5	74.6	0.80 (0.68 to 0.94)	<0.01*	0.71 (0.60 to 0.85)	<0.01*	1.72 (1.38 to 2.14)	<0.01*	2.05 (1.22 to 3.45)	<0.01*
Irregular hours	35.1	29.2	1.10 (0.93 to 1.30)	0.25	1.03 (0.87 to 1.23)	0.71	1.11 (0.90 to 1.36)	0.32	1.33 (0.79 to 2.26)	0.29
Night shift	13.5	10.0	2.27 (1.88 to 2.75)	<0.01*	2.07 (1.69 to 2.52)	<0.01*	1.18 (0.88 to 1.57)	0.27	1.80 (0.83 to 3.90)	0.14
Personal protective equipment										
Respiratory	23.9	23.8	1.63 (1.38 to 1.92)	<0.01*	1.67 (1.40 to 1.99)	<0.01*	0.88 (0.70 to 1.10)	0.27	1.93 (1.04 to 3.61)	0.04*
Hearing	26.9	31.2	1.40 (1.15 to 1.71)	<0.01*	1.61 (1.31 to 2.00)	<0.01*	0.65 (0.52 to 0.81)	<0.01*	0.55 (0.32 to 0.94)	0.03*
Gloves/clothing	39.2	44.4	1.30 (1.10 to 1.56)	<0.01*	1.23 (1.02 to 1.49)	0.03*	0.57 (0.47 to 0.69)	<0.01*	0.81 (0.51 to 1.27)	0.35
Impact	50.5	47.9	1.40 (1.08 to 1.82)	<0.01*	1.39 (1.06 to 1.82)	0.02*	0.89 (0.73 to 1.08)	0.25	1.19 (0.74 to 1.92)	0.47
Stress										
Very/extremely¶	12.4	15.2	0.79 (0.62 to 1.00)	0.05	0.80 (0.62 to 1.03)	0.08	0.80 (0.62 to 1.04)	0.1	0.65 (0.36 to 1.21)	0.1

*Statistically significant $p < 0.05$.

†OR for Māori compared with non-Māori.

‡ $\geq 25\%$ of the time.

§ Conditional logistic regression.

¶Very/extremely stressed compared with not at all/mildly/moderately stressed.

NZSCO, New Zealand Standard Classification of Occupations; SES, socioeconomic status (assessed using the New Zealand Deprivation Index 2006).

Physical factors

Māori workers in all occupational groups were more commonly exposed to physical risk factors (other than for standing where the pattern was reversed for some occupational groups) (figure 1). This higher prevalence of exposure remained for both men and women after adjustment for age and SES, and occupation and industry. For example, Māori men were more than twice as likely to report heavy lifting even after adjustment for age, SES, occupation and industry (OR 2.08; 95% CI 1.71 to 2.54). Only standing among women did not show a difference by ethnicity. The differences in physical factor exposure were confirmed by the matched analyses, although the smaller sample size reduced statistical power.

Organisational factors

Across all occupational groups, the proportion of Māori reporting exposure to high-risk organisational factors was greater (other than for irregular hours where the pattern was

reversed for some occupational groups) (figure 1). This was also demonstrated in the regression analyses (tables 2 and 3), where both Māori men and women were more likely to report exposure to all organisational factors across levels of adjustment. For example, after adjustment for age, SES, occupation and industry, Māori men were twice as likely to report carrying out repetitive tasks at least a quarter of the time (OR 1.98; 95% CI 1.60 to 2.44) and Māori women were almost twice as likely to work night shifts (OR 1.73; 95% CI 1.19 to 2.52). Only the difference in irregular hours and night shift work among men attenuated after adjustment for occupation and industry. The matched analysis confirmed the pattern of higher exposure to organisational factors for Māori.

Personal protective equipment

Māori and non-Māori reported very similar levels of PPE use within occupational groups, other than agricultural and fishery workers where non-Māori reported greater use of PPE (figure 1).

Table 3 Differences in occupational exposure prevalence between Māori and non-Māori women

Exposure	Māori n=1309 (%)	Non-Māori n=1408 (%)	Unadjusted (n=2701)		Adjusted for age and SES (n=2701)		Adjusted for age, SES, occupation (1st digit) and industry(n=2701)		Matched by 5-year age group, deprivation group and five-digit occupation NZSCO code§ (n=530)	
			OR1† (95% CI)	P values	OR2† (95% CI)	P values	OR3† (95% CI)	P values	OR4† (95% CI)	P values
Dust/chemical factors										
Dust	25.2	19.1	1.42 (1.18 to 1.70)	<0.01*	1.40 (1.15 to 1.70)	<0.01*	1.37 (1.12 to 1.69)	<0.01*	1.21 (0.82 to 1.78)	0.33
Smoke/fume/gas	17.3	13.8	1.31 (1.06 to 1.61)	<0.01*	1.20 (0.96 to 1.51)	0.11	1.13 (0.90 to 1.43)	0.29	1.10 (0.67 to 1.78)	0.71
Oils and solvents	10.5	12.8	0.79 (0.62 to 1.00)	0.05	0.78 (0.60 to 1.00)	0.05	0.72 (0.55 to 0.93)	0.01*	0.62 (0.35 to 1.12)	0.11
Acids and alkalis	4.7	6.3	0.72 (0.51 to 1.00)	0.06	0.85 (0.60 to 1.21)	0.37	0.77 (0.54 to 1.12)	0.17	1.50 (0.61 to 3.67)	0.37
Pesticides	6.2	5.0	1.26 (0.91 to 1.75)	0.17	1.31 (0.93 to 1.86)	0.13	1.35 (0.91 to 2.00)	0.13	1.20 (0.52 to 2.78)	0.67
Other chemical products	16.2	13.7	1.22 (0.99 to 1.50)	0.07	1.20 (0.95 to 1.50)	0.12	1.14 (0.90 to 1.44)	0.27	1.68 (1.02 to 2.76)	0.04*
Physical factors										
Lifting‡	48.3	34.4	1.79 (1.53 to 2.08)	<0.01*	1.68 (1.42 to 1.98)	<0.01*	1.68 (1.41 to 2.00)	<0.01*	2.28 (1.47 to 3.52)	<0.01*
Loud noise‡	33.5	19.3	2.09 (1.75 to 2.49)	<0.01	1.93 (1.60 to 2.32)	<0.01*	1.79 (1.47 to 2.18)	<0.01*	2.39 (1.51 to 3.77)	<0.01*
Awkward or tiring positions‡	62.3	56.7	1.26 (1.08 to 1.47)	<0.01*	1.31 (1.11 to 1.54)	<0.01*	1.27 (1.07 to 1.51)	<0.01*	1.27 (0.87 to 1.84)	0.22
Awkward grip or hand movements‡	43.6	34.9	1.44 (1.23 to 1.68)	<0.01*	1.37 (1.16 to 1.61)	<0.01*	1.37 (1.15 to 1.62)	<0.01*	1.30 (0.90 to 1.88)	0.16
Standing‡	30.2	28.3	1.09 (0.92 to 1.29)	0.31	1.03 (0.87 to 1.23)	0.71	0.97 (0.81 to 1.18)	0.80	0.86 (0.57 to 1.29)	0.47
Tools that vibrate‡	10.2	5.5	2.00 (1.49 to 2.67)	<0.01*	1.73 (1.27 to 2.36)	<0.01	1.49 (1.07 to 2.08)	0.02*	0.93 (0.45 to 1.93)	0.85
Organisational factors										
Repetitive tasks‡	78.3	71.2	0.89 (0.68 to 1.18)	0.43	0.85 (0.63 to 1.15)	0.28	1.51 (1.24 to 1.83)	<0.01*	2.13 (1.38 to 3.29)	<0.01*
Working at very high speeds‡	59.1	54.7	1.17 (0.80 to 1.70)	0.43	1.25 (0.84 to 1.87)	0.27	1.21 (1.02 to 1.43)	0.03*	1.41 (0.97 to 2.06)	0.07
Working to tight deadlines‡	77.9	71.4	1.06 (0.90 to 1.25)	0.50	1.00 (0.84 to 1.19)	0.96	1.82 (1.49 to 2.22)	<0.01*	1.81 (1.17 to 2.80)	<0.01*
Irregular hours	23.6	16.5	1.20 (0.97 to 1.47)	0.09	1.21 (0.97 to 1.51)	0.09	1.36 (1.09 to 1.68)	<0.01*	1.75 (1.01 to 3.03)	0.05
Night shift	7.8	4.1	1.46 (1.22 to 1.73)	<0.01*	1.48 (1.23 to 1.79)	<0.01*	1.73 (1.19 to 2.52)	<0.01*	1.88 (0.80 to 4.42)	0.15
Personal protective equipment										
Respiratory	7.4	8.3	1.20 (1.03 to 1.40)	0.02*	1.22 (1.04 to 1.44)	0.02*	0.74 (0.53 to 1.02)	0.07	0.56 (0.25 to 1.27)	0.17
Hearing	4.5	3.8	1.43 (1.20 to 1.70)	<0.01*	1.72 (1.42 to 2.08)	<0.01*	1.09 (0.70 to 1.70)	0.70	0.88 (0.32 to 2.41)	0.80
Gloves/clothing	31.2	29.9	1.57 (1.28 to 1.90)	<0.01*	1.45 (1.18 to 1.79)	<0.01*	0.87 (0.71 to 1.07)	0.18	0.69 (0.44 to 1.09)	0.11
Impact	17.3	14.8	2.01 (1.43 to 2.83)	<0.01*	1.79 (1.25 to 2.58)	<0.01*	1.10 (0.88 to 1.41)	0.39	0.78 (0.42 to 1.45)	0.44
Stress										
Very—extremely¶	17.2	14.2	1.26 (1.02 to 1.55)	0.03*	1.24 (1.00 to 1.55)	0.05	1.29 (1.03 to 1.62)	0.03*	1.20 (0.77 to 1.88)	0.43

*Statistically significant p<0.05.

†OR for Māori compared with non-Māori.

‡≥25% of the time.

§ Conditional logistic regression.

¶Very/extremely stressed compared with not at all/mildly/moderately stressed.

NZSCO, New Zealand Standard Classification of Occupations; SES, socioeconomic status (assessed using the New Zealand Deprivation Index 2006).

When splitting the PPE data into four categories, there were no statistically significant differences between Māori and non-Māori women. However, among men, Māori were less likely to use hearing protection and gloves/protective clothing. This was observed across all regression models, although the association in the matched analysis was non-significant for gloves/protective clothing, likely due to low statistical power. In addition, the matched analysis indicated that Māori men were more likely to use respiratory PPE than non-Māori men.

Stress prevalence

Across most occupational groups, Māori were more likely to report high work stress than non-Māori, although this was reversed for plant and machine operators and assemblers and those in elementary occupations (figure 1). Māori women were more likely to report being very or extremely stressed, even after adjusting for SES and occupation (OR 1.29; 95% CI 1.03 to 1.62). The differences in stress for men were not significant,

although ORs suggested Māori men were less likely to be highly stressed than non-Māori men.

DISCUSSION

This study has shown that Māori are more likely to be exposed to several occupational risk factors than non-Māori. For dust and chemical exposures, the differences were generally not significant after adjusting for SES among men, and after matching on job title for women. This suggests that the differences are mainly due to Māori being more likely to work in occupations where these exposures are more common.

However, a higher prevalence of exposure to physical workplace exposures was consistently evident for Māori, even after taking into account gender, age, SES and occupation. This indicates that Māori workers are more likely to carry out physical tasks than non-Māori, even within the same job. For example, both Māori men and women were twice as likely to perform heavy lifting, Māori women were twice as likely and Māori men

three times more likely to be exposed to loud noise, and Māori men were also almost three times more likely to regularly use tools that vibrate.

Organisational factors were also more likely to be reported by Māori. Among both men and women, Māori workers were twice as likely to be carrying out repetitive tasks and be working to tight deadlines. The proportion of Māori women working night shifts was almost double that of non-Māori (7.8% vs 4.1%), and this relationship remained after adjustment. This is suggestive of worse working conditions for Māori.

This study suggests that there is little difference in PPE use among Māori and non-Māori females, but that Māori men are less likely to use hearing protection and gloves/protective clothing, even after adjustment for occupation. The reasons for this are unclear. This is concerning since Māori men more commonly report being exposed to loud noise, although findings may be related as less hearing protection results in greater perceived noise exposure.

Māori women were more likely to be highly stressed at work, although no significant differences were seen among men. The ethnic differences in workplace stress may, at least partially, be influenced by societal expectations and gender roles in the home environment where women typically continue to hold more responsibilities. Māori women are more likely to look after those in their own home with an illness or disability as well as care for children outside of the household than non-Māori women.²² As chronic stress at work can have serious long-term health consequences,²³ specific attention should be paid to indigenous women with regards to stress-reducing interventions in the workplace.

International research documenting ethnic patterning of risk factors for occupational disease is limited and mainly historical.^{24,25} A questionnaire survey in the USA among workers from four industry groups showed differences in occupational exposure by race/ethnicity.²⁶ For example, black participants reported more shoulder strain than white participants; Latino participants reported more exposure to noise, shoulder and back strain than white participants; and white participants reported more exposure to dust and chemical exposures than all minority racial/ethnic groups. Similar to our study, some disparities in exposure were explained by the jobs held by different groups, but some remained after controlling for job.

The European Working Conditions Survey (EWCS) found that migrant workers were more likely to be exposed to occupational risk factors such as working at very high speeds and carrying heavy loads,²⁷ which is consistent with the findings of our study. The EWCS analysis did not adjust for job role; therefore, the differences could be due to migrants occupying more hazardous jobs than non-migrants. However, qualitative work provides evidence that migrant workers have worse working conditions than non-migrant workers even within the same job.^{28,29}

Variations in occupational health by ethnicity could, to some extent, be explained by social gradients in employment patterns, socioeconomic circumstances or workplace exposure to risk factors. This study has enabled assessment of these differential influences and has shown that ethnicity is related to risk factor exposure independently of SES and employment patterns. This may suggest that Māori are given more risky tasks at work. Numerous studies have shown that institutional discrimination operates within many social and political institutions, including the criminal justice system, the housing sector and healthcare environments.^{30–33} Institutional discrimination within occupational environments has been less well studied, although Māori report disproportionately

greater racial discrimination which has been linked to a range of adverse health outcomes.^{34,35}

A limitation of this study is that data are self-reported. A review of occupational exposure assessment³⁶ reported significant associations between self-reported exposures and industrial hygiene measurements of exposure, but stressed the quality of self-reported data can be highly variable. The review found people are better able to estimate exposure to agents which they can easily sense, such as solvents they can smell and dusts with larger particle sizes. Previous research has suggested that ethnic differences in environmental risk perception can occur, and that, generally speaking, those with more power and greatest socio-economic advantage (white men) are less likely to see the world as dangerous than are others.³⁷ Other hypothesised reasons for ethnic differences in risk perception include prior sociocultural experiences, value and belief differences, and greater vulnerability of particular groups to the consequences of risk.^{38,39} Although differing perception of exposure to risk factors between ethnicities may exist, it is unlikely to fully explain the results of this study as we have also demonstrated differences in very obvious exposures, such as night shift work.

Although the overall response rate was low (31%), we explored the influence of non-response on the data and found it made little difference to prevalence estimates, suggesting that response bias, if present, is minor.

A further limitation is our focus on current or most recent job, so lifetime occupational exposure to risk factors, which is likely more relevant, as has been documented for health effects generally relating to the accumulation of disadvantage over the life course,⁴⁰ could not be assessed.

In summary, Māori workers were more likely to report exposure to physical factors and organisational factors in their current job compared with non-Māori workers with the same job title, even after adjustment for SES. This suggests that work tasks may be unequally distributed according to ethnicity. This study is one of only a few that has investigated differences in work-related exposures between indigenous and non-indigenous populations. Given the adverse health effects associated with these exposures, it is plausible that inequitable exposure to occupational risk factors is contributing, at least in part, to health inequities between indigenous and non-indigenous people.

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Contributors LE-L, A'tM, NP and JD devised the idea for and designed the study. LE-L, AE and KH coordinated the fieldwork including participant recruitment and data collection. HJD, LAB and SC conducted data cleaning and analysis, with statistical advice provided by A'tM and NP. HJD prepared the manuscript with input from LE-L, AE, A'tM, JD and LAB. All authors approved the final manuscript.

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