Determinants of non-response in an occupational exposure and health survey in New Zealand

Abstract

Objective: Study the determinants of non-response and the potential for non-response bias in a New Zealand survey of occupational exposures and health.

Methods: A random sample of 10,000 New Zealanders aged 20-64 years were invited by mail to take part in a telephone survey. Multiple logistic regression was used to study the determinants of non-response. Whether occupational exposure, lifestyle and health indicators were associated with non-response was studied by standardising their prevalence towards the demographic distribution of the source population, and comparing early with late responders.

Results: The response rate was 37%. Younger age, Māori descent, highest and lowest deprivation groups and being a student, unemployed, or retired were determinants of non-contact. Refusal was associated with older age and being a housewife. Prevalence of key survey variables were unchanged after standardising to the demographic distribution of the source population.

Conclusions: Following up the non-responders to the mailed invitations with telephone calls more than doubled the response rate and improved the representativeness of the sample. Although the response rate was low, we found no evidence of major non-response bias.

Implications: Judgement regarding the validity of a survey should not be based on its response rate.

Key words: survey, response, bias, occupation, health

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Health and exposure surveys are valuable tools for evaluating the health status of the population and identifying determinants of this health status. Unfortunately, such surveys are known to have decreasing response rates,[1,2] which can introduce non-response bias. It is increasingly recognised however, that the non-response rate by itself is not a good predictor of non-response bias.[3,4] There is no minimum response rate below which a survey estimate is necessarily biased and, conversely, no set response rate above which it is never biased. The key parameter determining the connection between non-response rates and non-response bias is how strongly correlated the survey variables of interest are with the likelihood of responding.[3] In addition, each component of non-response (i.e. non-contact, refusal) is likely to have a different association with population characteristics and therefore different consequences.[5] Distinguishing the different components of non-response, and estimating their individual and combined potential to introduce non-response bias, is therefore essential for the interpretation of survey data and will contribute towards a more evidence-based approach to improving response rates.

Here we describe the patterns and determinants of non-response in a telephone survey of a random sample of the New Zealand population. The survey aims were to give a national overview of the prevalence of a range of occupational exposures and health effects in the working population, and to determine the association between occupational risk factors and health outcomes. The first results have been published.[6,7] The aim of the analyses presented here were to identify the determinants of non-response in the survey and to investigate whether non-response bias could have occurred.

Methods

The survey methods and some initial results are described by Eng et al.[6] Here we describe the methods used to optimise response and to study non-response and non-response bias.

The sampling frame

A random sample of 10,000 men and women registered on the New Zealand Electoral Roll, aged 20-64 years, was selected for the study. The Electoral Roll provides a complete sampling frame including all New Zealanders aged 18 years and older; it can be characterised as a rich sampling frame as it provides demographic information such as address, age, Māori descent indicator (Māori are the indigenous population of New Zealand), and the occupation at the time of registration for each potential participant.

The contact method

The study invitation was mailed up to three times, followed by phone calls if we received no reply and the telephone number could be retrieved from the electronic phone book. The invitation letter specified the objectives of the survey, the estimated duration of the interview, and the organisers of the survey (Massey University Centre for Public Health Research). The potential participants were asked to return a consent form in a freepost envelope and to specify the time(s) they preferred the telephone interview to take place. No financial incentives for participation were provided. Ethics approval for the study was obtained from the Massey University Human Ethics Committee (WGTN 03/133).

Statistical analyses

Each potential participant was classified according to their response to the survey (interviewed; refused; not eligible; return to sender; no contact). This response profile was then stratified by the different variables available from the Electoral Roll (sex; age; Māori descent; area-based deprivation index; occupation). Current occupation was coded using the New Zealand Standard Classification of Occupations (NZSCO)[8] and the area meshblock as recorded on the Electoral Roll was translated into a deprivation index using NZDep 2001,[9] which was then grouped into five categories. The index combines nine census variables which reflect aspects of material and social deprivation by meshblock, geographical units defined by Statistics New Zealand containing a median of approximately 90 people in 2001.

The contact rate was calculated as those contacted (interviewed+refused) as a percentage of all eligible potential participants (interviewed+refused+non-contact). The interview rate was calculated as all those interviewed as a percentage of all those contacted. The overall response rate was calculated as all those interviewed as a percentage of all eligible potential participants. Those 'returned to sender' were classified as not eligible, as were all participants known to no longer live at the address recorded on the Electoral Roll. Whether the variables available from the Electoral Roll were determinants of non-response and its two main components (non-contact, refusal) was studied through multiple logistic regression, adjusting for all variables available from the Electoral Roll, comparing the non-contact group, refusal group and overall non-response group with the group of participants.

To study the potential effects of non-response on the survey results (i.e. prevalence of key survey outcomes such as occupational exposure, lifestyle factors and health), weights were constructed accounting for the differences in response propensities associated with the list of Electoral Roll variables, aiming to standardise the sample towards the source population. For all the categories of each Electoral Roll variable, the weight was based on the ratio of the number of expected interviews (based on the distribution of the total sample) and the number of actual interviews completed within that category. Weighted prevalences for the three main self-reported exposures variables (dust, oils/solvents, pesticides), three lifestyle characteristics (ever smoker, having children 12 years or younger, working after midnight), and three self-reported health indicators (ever asthma, sleep problem, lower back pain) were compared with crude prevalences from the survey.

Because information on self-reported exposures, lifestyle and health was not available for the non-responders, we also studied whether late responders differed from early responders in terms of self-reported exposure, lifestyle factors and health outcomes, under the assumption that late responders are more similar to non-responders, as has been observed in a survey that compared characteristics of early responders, late responders and non-responders.[10] Early responders were defined as those consenting to be interviewed by mail (before any telephone contact) and late responders were defined as those who did not respond to the mailed invitations but consented after being contacted by phone. The prevalence of the key survey outcomes including occupational exposure, lifestyle factors and health of late responders were compared with those of early responders, through Chi-square tests.

Figure 1: Recruitment flow chart of the survey.
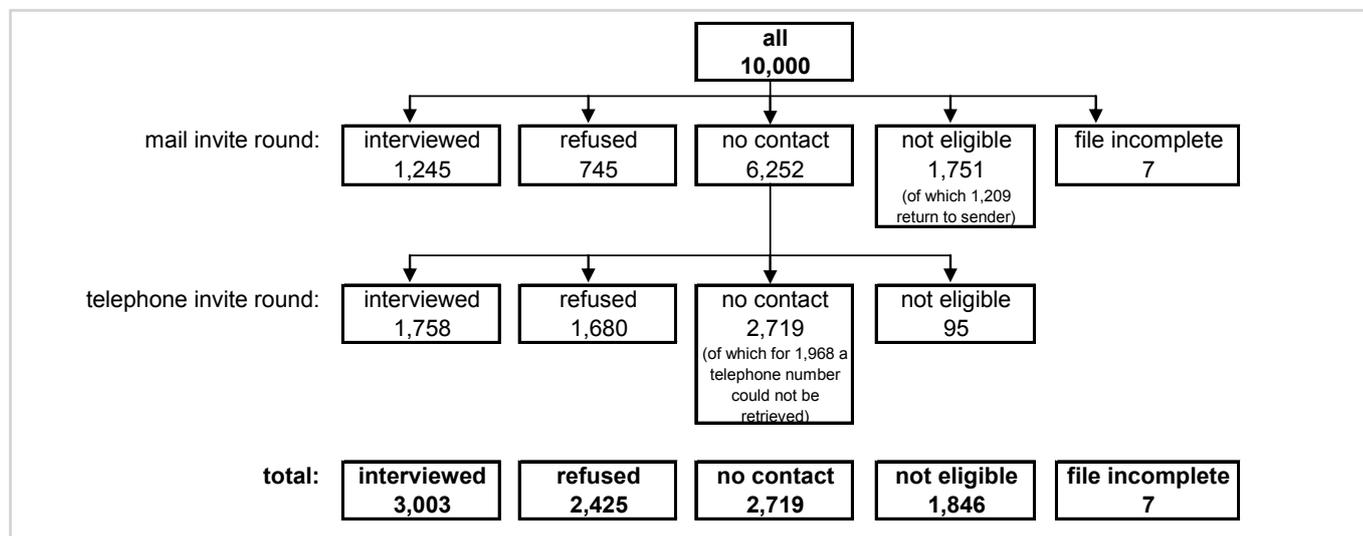
Results

Response profile

Figure 1 represents the recruitment flow chart of the survey. Of the 10,000 potential participants sampled from the Electoral Roll, 3003 (30%) were interviewed, 2425 (24%) refused, 2719 (27%) could not be contacted either by mail or by phone, 637 (6%) were not eligible (e.g. never worked in New Zealand, deceased, no longer living in New Zealand), and for 1,209 (12%) the invitation was returned to sender indicating the individual had moved (also considered not eligible). The contact rate was therefore 67%, the interview rate 55% and the overall response rate was 37%. Non-contact accounted for 53% of the overall non-response and refusal accounted for 47%.

The response profile is represented in Figure 2, stratified by the Electoral Roll variables. There was very little difference in response profile between men and women. There were large differences in response profile between the different age groups: the contact rate increased from 46% in the 19-25 age group to 82% in the 56-65 age group. In addition, the return to sender rate was much higher in the youngest age group (19%) than in the oldest age group (6%). In contrast, the younger age groups were less likely to refuse to be interviewed than the older age groups (interview rate decreasing with age group from 60% to 48%).

Differences in response profile were also apparent for different ethnic groups, deprivation groups and occupational groups (Figure 2). Because these differences could in part be due to differences in

Figure 2: Response profile of the 10,000 potential participants in relation to the variables available on the Electoral Roll.
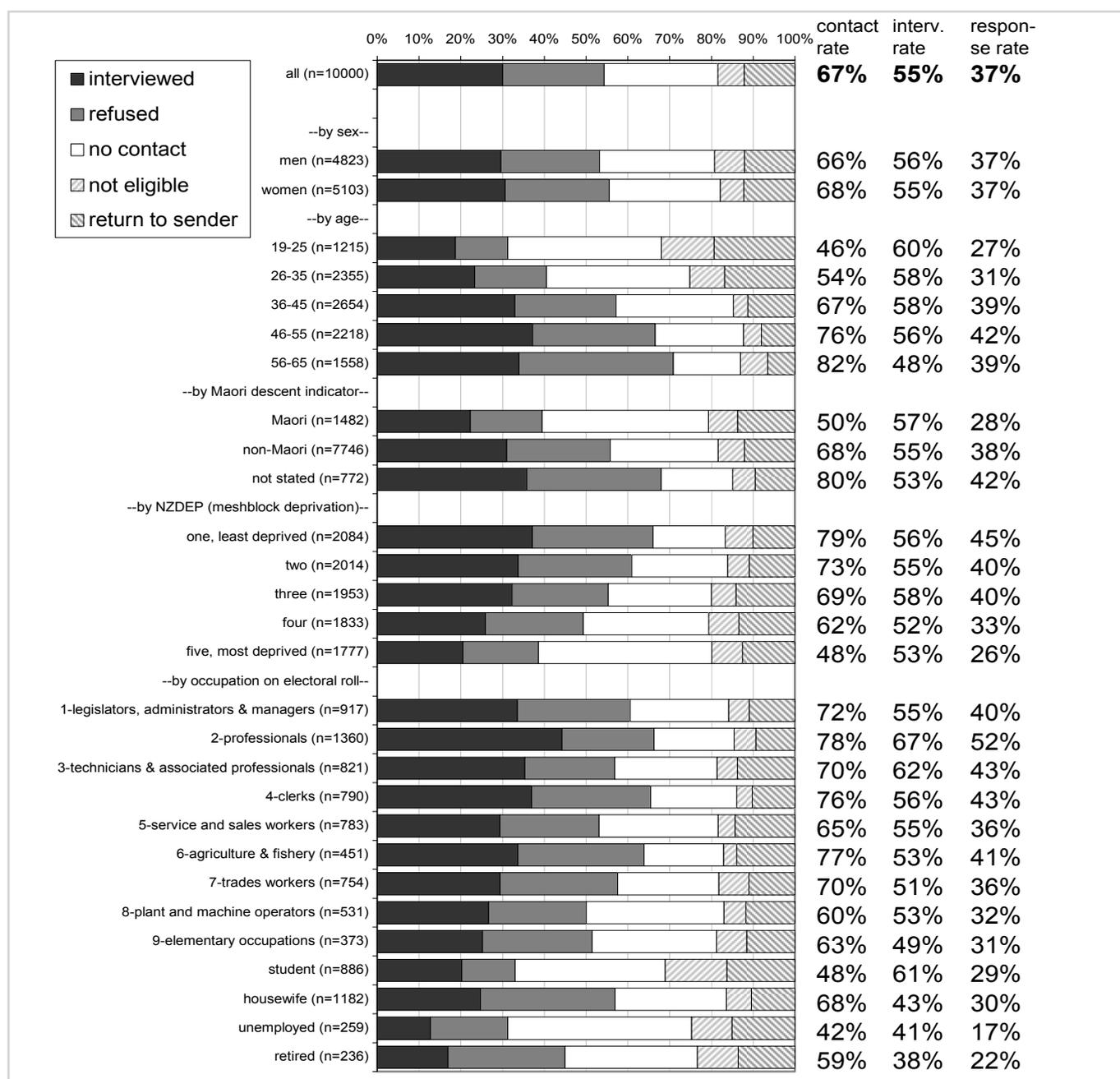
Table 1: Demographic determinants of non-response and its main components (non-contact and refusal).

	Non-contact (vs interviewed)		Refusal (vs interviewed)		Overall non-response (vs interviewed)	
	OR	95%CI (p-value)	OR	95%CI	OR	95%CI (p-value)
by sex						
women	1.00	Reference	1.00	Reference	1.00	Reference
men	1.10	0.98-1.24	0.95	0.84-1.08	1.08	0.97-1.20
		(0.10)		(0.46)		(0.17)
by age						
56-65	1.00	Reference	1.00	Reference	1.00	Reference
46-55	1.23*	1.01-1.49	0.81*	0.69-0.84	0.87	0.75-1.00
36-45	1.68*	1.40-2.01	0.77*	0.66-0.90	1.01	0.88-1.17
26-35	2.12*	1.76-2.56	0.65*	0.55-0.77	1.47*	1.26-1.71
19-25	1.98*	1.58-2.48	0.53*	0.41-0.69	1.58*	1.28-1.96
		(<0.0001)		(<0.0001)		(<0.0001)
by Māori descent indicator						
non-Māori	1.00	Reference	1.00	Reference	1.00	Reference
Māori	1.35*	1.17-1.55	0.87	0.73-1.03	1.18*	1.03-1.37
		(<0.0001)		(0.20)		(0.02)
by NZDEP (meshblock deprivation)						
one, least deprived	1.00	Reference	1.00	Reference	1.00	Reference
two	0.53*	0.40-0.70	0.89	0.65-1.24	0.66*	0.50-0.86
three	0.50*	0.38-0.66	0.77	0.55-1.07	0.62*	0.47-0.82
four	0.66*	0.50-0.87	0.89	0.64-1.25	0.81	0.62-1.08
five, most deprived	1.00	0.75-1.32	0.81	0.57-1.14	1.01	0.76-1.35
		(<0.0001)		(0.33)		(<0.0001)
by occupation on Electoral Roll						
1-legislators, administrators & managers	1.00	Reference	1.00	Reference	1.00	Reference
2-professionals	0.66*	0.53-0.83	0.64*	0.51-0.79	0.62*	0.52-0.74
3-technicians & assoc.professionals	0.80	0.63-1.02	0.80	0.62-1.02	0.79*	0.64-0.98
4-clerks	0.75*	0.58-0.97	1.03	0.81-1.31	0.81	0.66-1.01
5-service and sales workers	1.02	0.80-1.31	1.08	0.84-1.40	1.03	0.82-1.28
6-agriculture & fishery	0.67*	0.49-0.91	1.21	0.91-1.60	0.89	0.69-1.14
7-trades workers	0.94	0.73-1.22	1.18	0.92-1.51	1.08	0.87-1.35
8-plant and machine operators	1.19	0.90-1.56	1.12	0.84-1.49	1.13	0.88-1.45
9-elementary occupations	1.10	0.80-1.50	1.28	0.93-1.75	1.24	0.94-1.65
student	1.27	0.98-1.64	0.74	0.54-1.00	1.27	0.99-1.63
housewife	1.21	0.95-1.54	1.49*	1.18-1.88	1.49*	1.21-1.83
unemployed	1.78*	1.25-2.55	1.28	0.84-1.96	2.41*	1.61-3.61
retired	1.62*	1.10-2.38	1.37	0.93-2.02	2.17*	1.48-3.17
		(<0.0001)		(<0.0001)		(<0.0001)

*OR= Odds Ratio; 95%CI= 95% Confidence Interval; * p<0.05*

The models simultaneously include sex, age, Māori descent, NZDEP and occupation as explanatory variables.

age between the groups, multiple logistic regression was applied to study the determinants of non-response, mutually adjusting for all Electoral Roll variables.

Determinants of non-response and its two main components

The Electoral Roll variables as determinants of non-response and its two main components (non-contact and refusal) are listed in Table 1.

Sex was not a significant determinant of non-contact or refusal. The likelihood of non-contact decreased steadily with age, with the youngest age groups being two times less likely to be contacted compared to the oldest age group. On the other hand, refusal increased steadily with age, with the oldest age group being most likely to refuse. These opposite effects balanced each other out to some extent, resulting in a 58% higher likelihood of non-response for the 19-25 year olds compared to the older age groups.

Potential participants who had indicated on the Electoral Roll that they are of Māori descent were less likely to be contacted, but also slightly less likely to refuse to participate. Therefore overall Māori were only 18% more likely to be a non-respondent.

The trend for non-response in the different deprivation groups as evident in Figure 1 was no longer clear after adjusting for the other Electoral Roll variables. Both the lowest and the highest deprivation group were less likely to be contacted compared to the middle deprivation groups. The refusal rate was highest in the least deprived group, but the differences were not statistically significant.

Occupational group 2 (professionals, i.e. teachers) was the least likely to belong to the non-response group (OR 0.62; 95%CI 0.52-0.74), due to both a low risk of non-contact and low risk of refusal. Group 9 (elementary occupations) did not have a statistically significant increased risk of belonging to the non-

Figure 3: Potential effect of non-response on survey prevalence data (3 exposures, 3 lifestyle factors, 3 health outcomes), by comparing the crude prevalence with prevalence weighted towards the sex, age, ethnicity, deprivation and occupational profile of the source population.

response group compared to group 1 (legislators, administrators and managers) after adjusting for the other Electoral Roll variables. The unemployed and the retired were less likely to be contacted and housewives were more likely to refuse to participate. As a result, housewives, the unemployed and the retired had an increased likelihood of belonging to the non-response group.

Potential effect of non-response on survey prevalence data

Weighted prevalence for three self-reported exposures variables, lifestyle characteristics, and self-reported health indicators were compared with crude prevalence from the survey (Figure 3). Only minimal differences between the crude survey prevalence and standardised survey prevalence were observed.

Early (mail) responders and late (telephone) responders

Of the 3,003 people who consented to be interviewed, 41% (n=1,245) consented via mail, as a reaction to the mailed invitation (early responders). An additional 1,758 consented after establishing phone contact (the late responders). The response rate when relying exclusively on mail contact would therefore have been 15%.

The determinants of non-response if we had only relied on mail contact with the potential participants (counting all those who were contacted only via telephone as non-responders) are listed in Table 2. Men would have been under-represented in the study population if participants had only been contacted by mail and comparing Table 1 with 2 further indicates that the under-representation of younger age groups and Māori would have been approximately twice as large.

The early and late responders were compared in terms of their self-reported occupational exposures, lifestyle factors and health outcomes, based on the questionnaire they completed by phone (Figure 4). Late responders reported less exposure to dust (28.6% vs. 30.6%) and pesticides (8.9% vs. 10.5%) and more exposure to oils and solvents (21.8% vs. 19.8%), compared to early responders, but these differences were not statistically significant. The prevalence of smoking appeared very similar in early and late responders (*p*=0.98). Those with young children were significantly more likely to be a late responder (*p*<0.0001), and this difference was present for both men and women (both *p*<0.0001). Those reporting night shifts were somewhat more likely to be a late responder but this difference was not statistically significant (*p*=0.25). There was no difference in any of the three reported health indicators between late and early responders (Figure 4).

Discussion

In this study of occupational risk factors and health we achieved a response rate of 37%. Our main interest in the current paper was to study whether this relatively low response rate could affect the study results and introduce non-response bias, and to see what we could learn from this survey for the benefit of future surveys.
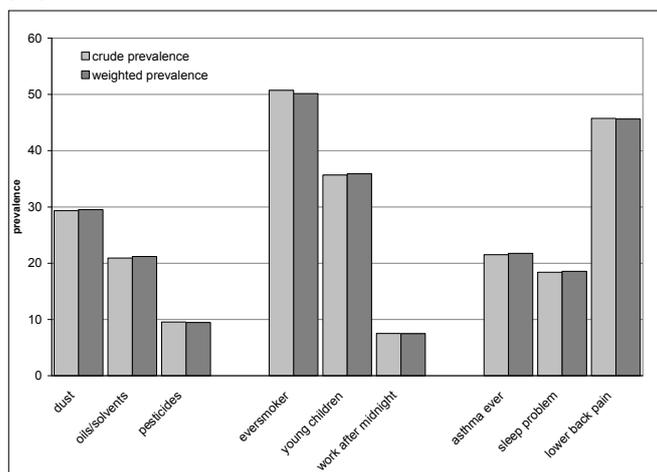
We found that some groups were under-represented in our study sample, in particular the younger age groups, Māori, housewives, the unemployed and retired people. Two occupational groups appeared to be over-represented (2-Professionals and 3-Technicians & associate professionals). The sample was, however, representative of the source population in terms of sex and for most occupational groups.

In our survey non-contact and refusal were almost equal contributors to the overall non-response rate, although it is likely that some of the non-responders would have refused. For example, in a Norwegian survey of a small group of non-responders that was investigated, 26% reported unwillingness to participate as the reason for non-response.[11] In our survey, the non-contact group and refusal group were shown to be different groups in terms of composition, with non-contact having a larger negative impact on the representativeness of the study sample than refusal. Non-contact was significantly associated with younger age, Māori descent, deprivation, and several occupational groups, while refusal was only associated with older age and being a housewife. This suggests that efforts to lower the non-contact rates would improve both the response rate and the representativeness of the study sample, while efforts to lower the refusal rate would only improve the response rate. Focusing on reducing non-contact rates would therefore benefit the validity of the survey more than focusing on reducing refusal rates.

In this survey we aimed to reduce the non-contact rate by contacting the potential participant via mail as well as by telephone. This mixed mode approach has also been used in other surveys[12-14] to increase response and reduce non-response bias. If we had only relied on mail invitations, our overall response rate would have been only 15%, and following up non-responders with telephone calls more than doubled our overall response rate to 37%. It also improved the representativeness of the study population, as it removed the under-representation of men, and some of the under-representation of Māori and the younger age groups.

Figure 4: Survey prevalence data for early (mail) responders, compared with those of late (telephone) responders.
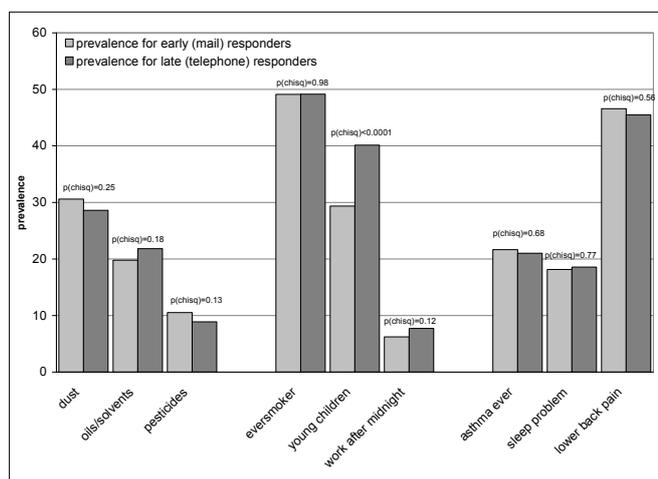
Table 2: Demographic determinants of non-response to mail invitations (i.e. non-response if we had only relied on mail invitations without telephone follow-up).

	Overall non-response (vs interviewed) when counting the telephone responders among the non-responders	
	OR	95%CI (p-value)
by sex		
women	1.00	Reference
men	1.30*	1.13-1.50
		(0.0001)
by age		
56-65	1.00	Reference
46-55	1.09	0.91-1.30
36-45	1.62*	1.35-1.95
26-35	2.47*	1.99-3.05
19-25	3.05*	2.17-4.30
		(<0.0001)
by Māori descent indicator		
non-Māori	1.00	Reference
Māori	1.48*	1.19-1.85
		0.0008
by NZDEP (meshblock deprivation)		
one, least deprived	1.00	Reference
two	0.67*	0.45-0.98
three	0.76	0.51-1.12
four	0.82	0.55-1.22
five, most deprived	1.04	0.70-1.57
		0.0003
by occupation on Electoral Roll		
1-legislators, administrators & managers	1.00	Reference
2-professionals	0.54*	0.43-0.68
3-technicians & associated professionals	0.80	0.61-1.05
4-clerks	0.77	0.58-1.01
5-service and sales workers	1.08	0.80-1.46
6-agriculture & fishery	0.96	0.69-1.34
7-trades workers	1.25	0.91-1.72
8-plant and machine operators	1.22	0.85-1.75
9-elementary occupations	0.98	0.66-1.44
student	1.23	0.83-1.83
housewife	1.94*	1.44-2.62
unemployed	3.27*	1.56-6.86
retired	1.61	0.96-2.69
		(<0.0001)

OR= Odds Ratio; 95%CI= 95% Confidence Interval; * p<0.05

The models simultaneously include sex, age, Māori descent, NZDEP and occupation as explanatory variables.

Age was a particularly strong predictor of non-contact, with younger ages being two times less likely to be contacted than the oldest age group. Mobility is the likely reason behind the high non-contact rates in the younger age groups, considering that the return to sender rates were also higher in this group. Because a structural update of the Electoral Roll only takes place before each election or referendum, more mobile people are more likely to be registered with an out of date address. The lower refusal rate in younger ages however cancelled out their high non-contact rate to some extent, resulting in only a moderately higher non-response rate in the younger age groups.

Because occupational exposures were the variables of interest in this survey, it was of particular benefit that occupation was available on the Electoral Roll so that differences in response between occupational groups could be studied. Other studies have indicated that employees in higher occupational social classes are more likely to respond to health surveys.[15] In our study there appeared to be small differences in response between the different occupational groups (NZSCO group 1 to 9), with group 2 forming a notable exception. Group 2 (professionals) represented the occupational group most likely to respond to the survey, due to both low non-contact rates and low refusal rates. The low non-contact rate was likely caused by professionals such as teachers being more likely to respond to the mailed invitation compared to the other occupational groups. Their low refusal rate may be due to their interest in the research topic, their greater willingness to participate in health research in general, or because the survey was organised by a research and education institution (Massey University). The high participation rate of professionals could therefore be specific to this study, but could also represent a finding that can be generalised to other surveys. The elevated refusal rates in housewives, and to a lesser extent the unemployed and retired, are likely due to the topic of the survey as these groups regularly indicated to the interviewers that they did not feel this study was relevant to them.

The under-representation in our sample of the younger age groups, Māori, and some occupational groups raised the question as to whether any post-survey adjustment of the results was warranted. For this purpose we compared the observed prevalence of self-reported exposure, lifestyle factors and health effects, with these prevalences standardised towards the characteristics of the source population. This showed negligible differences, suggesting that the sample survey estimates are generalisable to the source population and that adjusting the study results through standardisation is not necessary or appropriate as it makes little change to the prevalence estimates but widens the confidence intervals.

This conclusion was, however, reached under the assumption that the Electoral Roll variables are the only explanatory variables influencing non-response, while other factors such as personal health and interest in the topic may also contribute. Information on these factors was, however, not available for the non-responders, and we were therefore limited to comparing self-reported exposure, lifestyle factors and health effects between early and late responders, under the assumption that late responders would be more similar to non-responders than the early responders. In other surveys, early responders have been shown to be older,[1,16] more likely to be female[1,2] and less likely to be smokers.[1,2,10-12,16-18] In our survey, early responders were also more likely to be older and female, but smoking was not associated with a delay in response. The reason may be that the survey focused on occupational exposures rather than health, thus not deterring smokers to participate.

There was no indication of a structural over- or under-report of occupational exposure in the early responders, suggesting that perceived occupational exposure was neither a motivation nor a deterrent to participate. Having young children was strongly associated with being a late responder for both men and women, indicating that people in busy households are much less likely to respond to mailed and more likely to respond to telephone survey invitations.

Poorer health status has been associated with earlier response in some studies,[10,11,14,16] while in other studies it had no impact on response rates[1,2,12,18] or was associated with worse response.[19-21] In our study, there was no evidence of difference in health status between early and late responders, at least not for the health information collected in the survey, indicating that people's health status did not stop or stimulate them to participate.

In conclusion, this study showed that, although the survey had a low response rate, the results of the survey can be generalised to the target population and that non-response adjustment of the survey results is not warranted. This study once again indicated that judgement regarding the validity of a survey should not be based on its response rate.

Acknowledgements

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