Postal survey on airborne occupational exposure and respiratory disorders in Norway: causes and consequences of non-response

Per Bakke, Amund Gulsvik, Peer Lilleng, Olaf Overå, Rolf Hanoa, Geir E Eide

Abstract

Study objective—The aim was to examine causes for non-response in a community survey, and how non-response influences prevalence estimates of some exposure and disease variables, and associations between the variables.

Design—This was a cross sectional questionnaire study with two reminder letters. The questionnaire asked for information on smoking habits, occupational airborne exposure and respiratory disorders.

Setting—A random sample of 4992 subjects from the general population aged 15-70 years of Hordaland County, Norway.

Main results—The overall response rate was 90%, with a 63% response to the initial letter. The response rates to the first and second reminder letters were 56% and 36% respectively. In 20% of the non-respondents an uncompleted questionnaire was returned for non-response; in two thirds of these the cause for non-response was that the subject was not resident at the mailing address. A home visit to a random sample of 50 urban non-respondents provided further information on 29 subjects. A wrong address at the Central Population Registry and the subject's feeling of lack of personal benefit from a postal survey were the major reasons for non-response. Smokers were late respondents and subjects with respiratory disorders tended to be early respondents.

Conclusion—The main reasons for non-response were a wrong mailing address and a feeling of lack of personal benefit from responding. Using only the initial letter would have changed the estimated prevalence of smokers from 39% to 35%. Otherwise, the estimated prevalence of the exposure and disease variables as well as the associations between them were only slightly changed after including the respondents to the first and second reminder letters.

Since 1960, several population surveys on cardiovascular and pulmonary disorders have been conducted in Norway. Only one survey has so far taken occupational exposure into account. Some surveys have been performed using interviews while others were organised with a postal questionnaire only. Many surveys were connected with mass x ray screenings. The response rate of these surveys varied from 62% to 90%. Limited information is available on causes of non-response in initial postal surveys on cardiopulmonary disorders. A relevant study of the non-participation group was done in a health examination survey of a random sample of 50 year old men in Gothenburg. The main reason for non-participation was a negative attitude towards medical care in general. Non-respondents to a postal questionnaire following a mass screening tended to be unmarried smokers who reported respiratory symptoms more often than respondents. The effects of non-response on associations between occupational exposures and respiratory disorders have not previously been studied in general population surveys.

In a postal survey on airborne occupational exposures and lung disorders in Hordaland county, Norway, we examined the causes for non-response, and the characteristics of respondents and non-respondents. We also wished to investigate how non-response rates may change (1) the estimated prevalences of exposures (smoking and airborne occupational exposure) and lung disorders, and (2) the associations between these exposures and disorders.

Methods

STUDY POPULATION

The survey population comprised 267 304 inhabitants aged 15 to 70 years in Hordaland county, Norway, on the 31st of December 1984. The sampling frame was a list of names with addresses in the Central Population Registry. All persons located permanently in a Norwegian municipality must by law register themselves in the Local Population Registry. Information on new permanent residents and new addresses is sent regularly to the Central Population Registry which updates its register at intervals from 14 days to three months.

A random sample of 4992 subjects of the survey population and with updated addresses on April 29th, 1985, was obtained with a pseudorandom number generator. The Central Population Registry delivered a data file on magnetic tape identifying the individuals by the 11 digit national identification number with names and addresses.

PROCEDURE

A self administered questionnaire with an accompanying letter was sent by post to the random sample of 4992 persons on the 2nd of September 1985. The single sheet two paged questionnaire comprised 40 questions, including questions on smoking habits, occupational dust or gas exposure, respiratory symptoms and diseases, and further questions on occupational exposure to asbestos and quartz, and previous history of allergic and heart disorders. The questions on respiratory disorders,
Non-response in a postal survey

smoking habits, and asbestos exposure have been evaluated previously.

The accompanying letter explained the purpose of the survey, which was to examine the prevalence of asthma and bronchitis in the population of Hordaland county. The letter further stressed that participation was voluntary and that all answers would be kept strictly confidential. The recipient was invited to return the questionnaire within 14 days even if the recipient did not want to answer the questions. Reminder letters with different wording were sent five and 10 weeks after the initial letter if the questionnaire had not been returned. A stamped, addressed reply envelope was always enclosed. The local newspapers and radio provided favourable publicity on the survey.

Clerks were recruited through the local Asthma and Allergy Association to record the number of questionnaires returned and to check them for completeness. Non-respondents returning the questionnaires uncompleted were categorised according to sex and age for not responding. All questions were preceded. Ambiguous answers were reviewed and coded by two physicians. The data were punched, and all data for one individual were linked to his/her national identification number. A computerised system for on-line data registering and validation was developed to check for and remove gross errors and inconsistencies. The study was approved by the Regional Ethics Committee at the University of Bergen and the Norwegian Data Inspectorate, Oslo.

INTERVIEW SURVEY OF NON-RESPONDENTS

A medical student (PL) conducted a door to door survey of a random sample of 50 non-respondents living in the city of Bergen. At least two attempts were made to reach each non-respondent at his/her registered address. The Local Population Registry was contacted for updated addresses and in some cases the local police or social insurance office was approached to get further information on their addresses. The interviewer handed out the self-administered questionnaire to the non-respondents with whom he met. Three peak expiratory flow rates were measured with a Wright peak flow meter. The highest value was recorded. The subject was asked about reason for non-participation in the postal survey. The Local Revenue Office and the General Insurance Office provided information on income and property in 1985, and sickness allowance during 1984–86 in the 50 non-respondents and in a random sample of 50 urban respondents.

STATISTICAL ANALYSES

Statistical computations were carried out by standard computer programs. Sex and age standardisation of rates was performed with the direct method using the population of Norway at the end of 1985. Indirect standardisation was used for rates of subjects participating in the interview survey, using the rates of respondents to the present postal survey. To evaluate the effect of several factors on a dichotomous outcome variable, the method of stepwise multiple logistic regression analysis was applied. For outcome variables with more than two categories the method of backwards stepwise selection of log linear models was applied. An all significant effects model was defined as a model in which only terms were retained that had a significant effect on the outcome at the 0·01 level. The nominal significance level of 0·01 was chosen to adjust for multiple significance testing.

Results

RESPONSE TO POSTAL SURVEY

The overall response rate (table I) to the postal questionnaire after two reminder letters was 90%. The overall rate was slightly higher in women (91%) than in men (88%). The response rate was lowest (87%) in the age group 15–19 years and highest (93%) in those aged 50–59 years, while those aged 60 years or more had a response rate of 91%. In both men and women the response rate was lower in the urban areas (88%) than in rural areas (91%). The overall response rate was as high as 93% in rural women and as low as 87% in urban men. In a backwards fitting procedure of log linear models to the four way contingency table between response status, sex, age and residence, the only associations retained at the 0·01 level were between sex and response status (p = 0·0003), between age and response status (p < 0·0001), and between residence and response status (p = 0·0012).

The questionnaire was either not returned or not properly completed by 523 subjects of the random sample. However, from 20% (105/523) further information on the cause of non-response was available, mostly due to a notice written on the returned questionnaire or envelope (table II). Such

<table>
<thead>
<tr>
<th>Table I</th>
<th>Response status to a postal questionnaire survey by sex, age and residence in a random sample of 4992 individuals from the population of the county of Hordaland, Norway, 1985</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Respondents</td>
</tr>
<tr>
<td></td>
<td>Total sample (n = 4 992)</td>
</tr>
<tr>
<td></td>
<td>Initial questionnaire (n = 3 147)</td>
</tr>
<tr>
<td></td>
<td>First reminder letter (n = 1 030)</td>
</tr>
<tr>
<td></td>
<td>Sex</td>
</tr>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>Age group (15–19)</td>
</tr>
<tr>
<td></td>
<td>15–19</td>
</tr>
<tr>
<td></td>
<td>20–29</td>
</tr>
<tr>
<td></td>
<td>30–39</td>
</tr>
<tr>
<td></td>
<td>40–49</td>
</tr>
<tr>
<td></td>
<td>50–59</td>
</tr>
<tr>
<td></td>
<td>60+</td>
</tr>
<tr>
<td></td>
<td>Residence (urban/rural)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Blank questionnaire returned with cause
† Blank questionnaire returned without cause, or not returned at all
information was given as often by women as by men. It was, however, more frequently written by those in the oldest age group (55+ years) than in the youngest (15-34 years) (p = 0.0011). This additional information was just as often given by people in urban as in rural areas. The causes for non-response were death (5%), serious diseases (4%), not resident at mailing address (64%), and unwillingness (28%). In a log linear analysis of the 105 non-respondents with known cause, non-response due to lack of an up to date address in the Central Population Registry was more often the cause in the younger than in the older age groups, while unwillingness, death, or illness was more often the cause in the older than in the younger age group (table II).

Table II Causes of non-response to postal questionnaire by sex, age and residence in 105 individuals where the information was obtained during the survey of the county of Hordaland, Norway, 1985

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Total</th>
<th>15-34</th>
<th>35-54</th>
<th>55-70</th>
<th>Men</th>
<th>Urban residence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Serious diseases</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Unwilling</td>
<td>29</td>
<td>6</td>
<td>5</td>
<td>18</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Not resident at address of Central Population Registry</td>
<td>67</td>
<td>47</td>
<td>13</td>
<td>7</td>
<td>41</td>
<td>35</td>
</tr>
</tbody>
</table>

CHARACTERISTICS OF RESPONDENTS BY READINESS TO RETURN QUESTIONNAIRE

The responses to the first and second reminder letters were 56% and 36% (table I). The average age of the respondents to the initial letter compared with those who responded to the second reminder letter decreased from 40 years to 35 years. Only small differences were observed in the distribution of sex and urban-rural area of residence in the respondents to the initial letter compared to those who responded to the second reminder letter. Smokers were late respondents (p < 0.001), while a history of occupational dust or gas exposure did not differ significantly between early and late respondents (table III). Subjects with chronic cough or a physician's diagnosis of asthma, bronchitis, or emphysema tended to be early respondents; however the relationships were only of borderline significance (0.01 < p < 0.05).

EXPOSURE-DISORDER ASSOCIATIONS BY READINESS TO RETURN QUESTIONNAIRE

To evaluate the impact of the response rate on the estimates of exposure-disorder associations, identical analyses were performed for respondents to the initial letter only, aggregated respondents after the first reminder letter, and to all respondents. A stepwise multiple logistic regression analysis was performed for each of the following dependent variables: months per year, breathlessness on climbing two stairs, and physician's diagnosis of asthma and bronchitis. As independent variables we used: sex, age, smoking habits, a history of occupational dust or gas exposure, hay fever, and urban-rural area of residence.

Using no reminder letters would have resulted in the loss of dusty occupation as a significant predictor for asthma and for breathlessness on climbing two stairs (table IV). However, using only one reminder letter would have identified the same significant exposure variables as using two reminder letters.

The strength of the exposure-disorder associations were reflected by the adjusted odds ratios. Comparing the exposure-disorder associations for the respondents to the initial letter with the corresponding associations for all the respondents, no overt differences were evident for the associations with the exception of smoking versus breathlessness on climbing two stairs. Age interacted with smoking habits in the relationship with breathlessness on climbing two stairs, and the association between smoking habits and breathlessness is thus only given for the age of 40 years (table IV). The adjusted odds ratio for breathlessness in smokers of more than 20 cigarettes per day fell from 5.6 to 3.8 when using the data from all respondents compared to the data from the respondents to the initial letter.

NON-RESPONDENTS WITH CAUSE UNKNOWN

Altogether 255 non-respondents with cause unknown had an urban address (table I). Out of the random sample of 50 from these non-respondents, 11 subjects were never found and were definitely not at the address given by the Central Population Registry. Thirty nine subjects were seen. Only 10 of these did not want to give further information. The remaining 29 (16 men and 13 women) were interviewed. Eight subjects seen were located at addresses different from those in the Central Population Registry. The main reasons for not returning the postal questionnaire were: no personal benefit from a postal survey (n = 13), would never participate in postal surveys (n = 4), not present at the address in the Central Population Registry during the survey (n = 4), address in the Central Population Registry wrong or denied receiving the questionnaire (n = 5), questionnaire was returned but not received by the survey team (n = 3).
smoking habits nor prevalences of respiratory symptoms or diseases differed substantially between non-respondents and respondents to the postal questionnaire (Table IV). None of the 29 had a clinical diagnosis of emphysema or asthma, and the mean and SD of the peak expiratory flow rate was 103% and 12% of the predicted values19 respectively. No overt differences were seen between non-respondents and respondents with respect to income, property, sickness periods, and days with sickness allowances.

Discussion
A high response rate in population surveys is desirable in estimating the prevalence rates of risk factors and disorders. The trends of response rate by sex and age and the causes for non-response were in agreement with previous Norwegian surveys with repeated mailings in 196226 and in 1972.6 In northern Norway a higher rural than urban response rate was also observed in a heart disease screening, which included 6595 men aged 20-49 years.5 Our finding that the Norwegian general population responds favourably to a mail questionnaire is in agreement with experience from the census of 1980.21 Other factors that might have contributed to the high response rate are the limited extent of the questionnaire, the simple and non-sensitive questions, and the publicity of the survey in local radio and newspapers. High response rates to mail surveys on respiratory disorders are also seen in Sweden22 and Finland.23

Incorrect addresses in the Central Population Registry of subjects in the sample frame was the major cause of non-response to the postal questionnaire. Problems arose due to unmarried persons who, because of education or military service, were not staying in their parental or family home where they are registered. Further problems arose due to persons who were staying in hospital, rehabilitation centres, and prisons. Some people lived away from home due to work (eg, seamen). Some individuals never notify the Local Population Registry when changing addresses (H Hammer, Central Bureau of Statistics of Norway, 1989, personal communication). Four months passed from the time when the addresses were updated in the Central Population Registry to the date of mailing the questionnaire. This delay may have increased the number of subjects with wrong addresses. Illegible names on the letter boxes and human errors in the Norwegian post office system may cause non-response to a mailed, self-administered questionnaire.

Lack of any obvious benefit to the respondents by answering the postal questionnaire was a further cause of non-response. Also, the accompanying letters might have stressed more firmly why the recipient should take more trouble to reply. A clinical examination or remuneration for the completed and returned questionnaire might have increased the participation rate. The class of the postage and the colour of the envelopes used have only minor effects on the response rate.24 It has been speculated that mass media discussion on the degree of confidentiality of computer based health registers may impair the response rate in population surveys.25 However, the present study yielded a response rate of 90% and only one third of those not responding did so because of unwillingness. On the other hand, unwillingness to participate was the main reason for returning uncompleted questionnaires in the age group 55+ years. This is in agreement with a recent Swedish study25 on cardiovascular and respiratory diseases in 621 men aged 68 years, the main reason for non-attendance to a clinical examination was a negative attitude towards health surveys.

The respondents to the postal survey are well representative of the sample with regard to age, sex, and geography. The prevalence of respiratory disorders and smoking habits did not differ significantly between respondents and non-respondents. This suggests that the observed prevalences in the postal respondents will give
satisfactory information on the survey population. However, interpretation of the comparison between respondents and non-respondents should be cautious for the following reasons: non-respondents were followed up, due to long and expensive travel distances. The respondents received the questionnaire by post, the non-respondents through personal delivery. Of the 29 persons followed up, at least 64% would have to have been smokers for this smoking rate to have been different from the 39% in the postal respondents, using a one sided test with significance level 0.05 and power of 80%.

Non-respondents to a questionnaire on heart diseases in northern Norway reported respiratory symptoms more often than respondents. This is in contrast to our finding that subjects with respiratory disorders tended to be early respondents. The difference may be explained by subjects with pulmonary disorders feeling less personal benefit by responding to a survey on heart disease than to a survey on lung disease. The accompanying letter stated that the objective of the survey was to examine the occurrence of asthma and chronic bronchitis. This may have contributed to the early response of subjects with physician's diagnosis of these diseases.

Our finding that smokers respond slower to a postal questionnaire than non-smokers is in agreement with findings of a mail survey to male veterans in Boston, Massachusetts, which observed that the heavier smokers were the slowest to respond. The health hazards of smoking are well known. Receiving a questionnaire on smoking habits may be an unpleasant reminder of this fact and thereby rejected. Furthermore, smoking is more prevalent in lower than higher socioeconomic classes, and one could speculate that subjects with low socioeconomic status are late respondents.

The ethics committee of the Norwegian Research Council for Science and Humanities has recommended that only one reminder letter should be used in population surveys. The Norwegian Data Inspectorate deviated from this recommendation in the present survey because the results were to be compared with a similar postal survey in 1972 using two reminder letters. In the present study, using only one reminder letter would have reduced the response rate from 90% to 84%. The estimated prevalences of exposures and disorders were only slightly changed after including the respondents to the second reminder letter. However, using only the initial questionnaire would have changed the estimated prevalences of smokers from 39% to 35% and the estimated prevalence of physician's diagnosis of emphysema from 0.5% to 0.7%. The associations between smoking and airborne occupational exposure on the one hand and respiratory disorders on the other were only slightly changed when initial respondents were compared to all respondents. However, a response rate of only 63% to a postal survey of a Norwegian population would have excluded occupational dust or gas exposure as a significant predictor of asthma and breathlessness.

A major advantage of the postal survey is that it is inexpensive. The cost of the present survey was £14.00 in postage. In fact, money saved in the first phase could well be used to increase final response by other means; for instance, by employing interviewers or telephone operators to trace the non-respondents. Combinations of survey methods can thereby reduce non-response bias at a reasonable cost. In the present survey the overall response would have been 94%, if interview inquiry had been applied to all postal non-respondents. If a subject's interest in the matter depends on his own health status, follow up of non-respondents to a postal inquiry may be further justified.

We thank Valborg Baste who provided expert data analysis. The study was funded by the Royal Norwegian Council for Scientific and Industrial Research and the Norwegian Asthma and Allergy Society.

3 Hanszel W, Hourgen A. Prevalence of respiratory symptoms in University J Chronic Dis 1972; 5: 519-44.
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