Journal of Epidemiology and Community Health 1992; **46**: 617–619

Baseline characteristics are not sufficient indicators of non-response bias in follow up studies

Jørgen Vestbo, Finn Vejlø Rasmussen

Abstract

***Study objective*—The aim was to examine whether baseline characteristics from a cross sectional survey provided sufficient information regarding non-response bias in a follow up study when compared with information on hospital admissions in the intervening years.**

***Design*—This was an 11 year follow up study of a cohort selected in 1974 with register information on hospital admissions during follow up.**

***Setting*—The study was based on a sample of cement workers from a particular Portland cement factory with suitable controls from other occupations.**

***Participants*—A total of 1404 men participated in the first survey in 1974, including a questionnaire and lung function tests. In 1985 1070 men were alive and of these, 928 men (87%) responded to a postal questionnaire.**

***Main results*—Non-responders in 1985 did not differ markedly from responders when smoking habits, respiratory symptoms, and lung function were examined in 1974. During follow up, non-responders had twice as high rates of hospital admission due to respiratory diseases as responders. These differences remained present after adjusting for minor differences in age and smoking habits.**

***Conclusions*—Equal distributions of baseline characteristics among responders and non-responders in a follow up study do not preclude non-response bias.**

J Epidemiol Community Health 1992; **46**: 617–619

Non-response in epidemiological surveys is a well known source of selection bias.[1] Several approaches using alternative information on non-responders in postal questionnaire surveys have been used, often showing marked differences in both population characteristics and indirect health measurements. Generally, poor response is associated with advancing age, low educational level, semi-skilled or unskilled manual occupations, and poorer health status, although examples of the opposite can easily be found.[2–7]

Baseline information can be used to elucidate differences between responders and non-responders in follow up studies. No studies have been published comparing baseline information with alternative information on disease in the intervening years. In general, few studies have been published using alternative information about sickness/sickness absence during follow up.[2 4 5]

We decided to examine whether baseline information provided sufficient information on differences between responders and non-responders in a later follow up when compared with information on hospital admissions in the intervening years.

Methods

In 1974–75 a total of 1404 men aged 46–69 years was examined with interview and lung function tests. The main purpose of the study was to assess the effects of inhaled cement dust on lung function. Results of the study have been published earlier.[8]

All men were interviewed using the British Medical Research Council (BMRC) questionnaire on respiratory symptoms[9] together with questions on smoking habits, occupational, and residential histories. Cough was recorded if the subject answered affirmatively to either of the two BMRC questions on cough, and phlegm was recorded similarly. Chronic bronchitis was recorded if the subject reported cough and phlegm lasting three months or more for at least two years. Men who smoked more than 10 g of tobacco daily in 1974 were classified as heavy smokers whereas men smoking 10 g or less were classified as light smokers. Men who had spent most of their working life in a particular Portland cement factory were classified as cement workers; the others were classified as blue collar workers, white collar workers, or others according to the occupational category in which they had spent most of their working life.

Spirometry was performed using a Godart Expirograph type 16 000 (Bilthoven, Holland); all indices were reported at BTPS as mean value of three measurements. A chest x ray with antero-posterior and left lateral projection was done in all subjects.

According to the Danish National Board of Health, 334 of the men in the study had died by 27 October 1985. On 3 November 1985 all living members of the cohort received a postal questionnaire containing 41 questions and a post-paid envelope for the return of the questionnaire. Two reminders were sent to initial non-responders after intervals of two to three weeks.

Information on hospital admissions was obtained from the National Patient Register which is a nationwide register of all admissions to somatic hospital wards. The register was established in 1977 and is administered by the Danish National Board of Health. In this study, only admissions of 24 h duration or more were included. Hospital admissions were registered in two periods: from 1 January 1977 to 31 October 1985, and from 1 November 1985 to 3 September 1986.

Medical Department P, Bispebjerg Hospital, Bispebjerg Bakke 23, DK-2400 Copenhagen NV, Denmark
J Vestbo
Medical Department B, Hillerød Hospital, Hillerød, Denmark
F V Rasmussen

Correspondence to:
Dr Vestbo

Accepted for publication
May 1992

Causes of admission were classified using the WHO *International classification of diseases*, 8th revision.[10] They were divided into admissions due to respiratory disease in general (ICD 460–519) and admissions due to chronic obstructive pulmonary disease (COPD, ICD 492–493 or 519).

Results

The response rate at follow up was 87%. The distributions of population characteristics, smoking habits, respiratory symptoms, and spirometric measurements in 1974 for responders, non-responders, and non-survivors are shown in table I. No significant differences were found between responders and non-responders. When comparing FEV_1 values in the same breathlessness category, both non-responders and non-survivors tended to have lower values than responders. No differences between responders and non-responders were found concerning cardiac enlargement on the *x* ray or symptoms of heart disease. In the period 1977–85 a total of 46 responders (5·0%) and 14 non-responders (9·9%) had been admitted to hospital because of respiratory disease in general. Of these, a total of 25 responders (2·7%) and nine non-responders (6·3%) had been admitted because of chronic obstructive pulmonary disease ($p < 0.05$, χ^2 test).

Table I Baseline characteristics in 1974 for responders, non-responders, and non-survivors in the cohort.

	Responders (928 men)	*Non-responders (142 men)*	*Non-survivors (334 men)*
Mean age (years)	55·1	56·1	57·3
Heavy smokers (%)	46·1	52·8	58·4†
Cement workers (%)	21·0	16·9	17·4
Blue collar workers (%)	38·8	48·6	43·4
Cough (%)	26·5	31·7	34·1*
Phlegm (%)	20·4	21·1	26·6*
Dyspnoea grade 3 or worse (%)	13·0	15·1	20·3†
Dyspnoea grade 4 or worse (%)	6·3	7·2	14·2†
Chronic bronchitis (%)	9·2	8·5	11·4
FEV_1 (mean, litres)	3·06	2·95	2·65
FVC (mean, litres)	4·22	4·13	3·81
FEV_1 (mean) for men with dyspnoea grade 3 or worse (litres)	2·44	2·28	2·29
FEV_1 (mean) for men with dyspnoea grade 4 or worse (litres)	2·19	2·04	2·08

FEV_1 = Forced expiratory volume in 1 s; FVC = Forced vital capacity.
*$p < 0.05$, †$p < 0.005$ *v* responders (χ^2 test)

For the purpose of adjusting for minor differences in baseline characteristics between responders and non-responders, multivariate logistic regression analyses with the two categories of hospital admission as dependent variables and age and smoking habits in 1974 as covariates were performed. Non-response was entered as an independent variable. Results are given in table II; odds ratios (OR) and 95% confidence intervals (CI) are shown. Non-response was significantly related to hospital admission both in general and due to chronic obstructive pulmonary disease, OR = 2·0 (95% CI 1·1–3·8) and OR = 2·2 (1·0–4·9), respectively, after controlling for age and smoking habits.

Table II Determinants of hospital admission due to respiratory disease in general and admissions due to chronic obstructive pulmonary disease (COPD) estimated using multivariate logistic regression analyses.

Variable	*Hospital admission due to respiratory disease (Odds ratios with 95% CI)*	*Hospital admissions due to COPD (Odds ratios with 95% CI)*
Age (per 10 years)	1·2 (0·8–1·8)	1·5 (0·8–2·6)
Light smokers[a]	1·1 (0·5–2·5)	1·4 (0·4–4·7)
Heavy smokers[a]	1·6 (0·8–3·1)	3·0 (1·1–7·9)
Non-response	2·0 (1·1–3·8)	2·2 (1·0–4·9)

[a] In contrast to never smokers and ex-smokers
95% CI = 95% confidence interval

In the 10 month period following the questionnaire survey two non-responders (1·4%) and four responders (0·4%) were admitted to hospital because of respiratory disease in general. Both the non-responders, but only one responder, were admitted because of chronic obstructive lung disease.

Discussion

Non-response is a threat to both cross sectional surveys and follow up studies. In a hypothetical study, Greenland has stressed that risk ratios from studies with non-response evenly distributed with respect to the exposure or the outcome can be altered due to non-response.[11] Although this could also be the case when comparing baseline information among responders and non-responders in a follow up, such comparisons are made in epidemiological studies of respiratory disease.[12 13] This is probably due both to the lack of other ways of estimating the effect of non-response and to the fact that baseline information is often readily available. In other studies the association between non-response and physical health status has not been overwhelming. Trent and Ames,[14] summarising earlier studies on non-response, found no consistent relationship between participation and objective measures of health status whereas several studies have found an association between self reported symptoms and participation.[15–17]

We found an increased number of admissions to hospital due to respiratory disease in general and chronic obstructive lung disease among non-responders when comparing with responders. Similarly, Cobb *et al*[4] found a threefold increase in the proportion of men who had had three or more hospital admissions in the preceding five years. Our register data on hospital admissions were obtained from the Danish National Patient Register which was started in 1977 for administrative purposes. For this reason information regarding number of admissions, duration, and registration of ward/hospital is accurate. The validity of the diagnosis in the register is probably more dubious, as pointed out by Jürgensen *et al*.[18] Some overlap between respiratory diseases and, for example, cardiovascular diseases is bound to occur but is not ruinous to this study.

It is interesting that the 142 men who are characterised by their non-response in a follow up survey and who have experienced more hospital admissions are roughly comparable with responders when looking at respiratory symptoms at the time of the initial survey. A marked underrating of symptoms among later non-responders could explain the seemingly equal prevalences of respiratory symptoms. We have tried to evaluate this by looking at FEV_1 values among responders and non-responders with the same grade of breathlessness. Our results, shown in the lower part of table I, only provide very limited support for this hypothesis and cannot solely explain our findings.

In conclusion, equal distributions of baseline characteristics among responders and non-

responders in a follow up study do not preclude non-response bias.

This study was supported by grants from The Danish Medical Research Council (12–5877) and The Knud Højgaard Foundation (7818).

1 Alderson M. *An introduction to epidemiology*. London: Macmillan, 1976.
2 Sheikh K. Predicting risk among non-respondents in prospective studies. *Eur J Epidemiol* 1986; **2**: 39–43.
3 Jooste PL, Yach D, Steenkamp HJ, Botha JL, Rossouw JE. Drop-out and newcomer bias in a community cardiovascular follow-up study. *Int J Epidemiol* 1990; **19**: 284–9.
4 Cobb S, King S, Chen. Differences between respondents and nonrespondents in a morbidity survey involving clinical examination. *J Chron Dis* 1957; **6**: 95–108.
5 Bergstrand R, Vedin A, Wilhelmsson C, Wilhelmsen L. Bias due to non-participation and heterogeneous sub-groups in population surveys. *J Chron Dis* 1983; **36**: 715–8.
6 Sonne-Holm S, Sørensen TI, Jensen G, Schnohr P. Influence of fatness, intelligence, education, and sociodemographic factors on response rate in a health survey. *J Epidemiol Community Health* 1989; **43**: 369–74.
7 Bakke P, Gulsvik A, Lilleng P, Overå O, Hanoa R, Eide GE. Postal survey on airborne occupational exposure and respiratory disorders in Norway: causes and consequences of non-response. *J Epidemiol Community Health* 1990; **44**: 316–20.
8 Rasmussen FV, Borchsenius L, Holstein B, Sølvsteen P. Lung function and long-term exposure to cement dust. *Scand J Resp Dis* 1977; **58**: 252–64.
9 Medical Research Council's committee on the aetiology of chronic bronchitis. Standardized questionnaires on respiratory symptoms. *BMJ* 1960; ii: 1665.
10 World Health Organization. *International classification of diseases*, 8th revision. Geneva: WHO, 1977.
11 Greenland S. Response and follow-up bias in cohort studies. *Am J Epidemiol* 1977; **106**: 184–7.
12 Beck GJ, Doyle CA, Schachter EN. A longitudinal study of respiratory health in a rural community. *Am Rev Respir Dis* 1982; **125**: 375–81.
13 Olofson J, Bake B, Svärdsudd K, Skoogh B-E. The single breath N_2-test predicts the rate of decline in FEV_1. The study of men born in 1913 and 1923. *Eur J Respir Dis* 1986; **69**: 46–56.
14 Trent RB, Ames RG. Respiratory health as a predictor of questionnaire return in a sample of United States underground coalminers. *Br J Ind Med* 1987; **44**: 407–11.
15 Abramson JH, Kark SL, Epstein LM, Hopp C, Peritz E, Makler A. A community health study in Jerusalem. *Isr J Med Sci* 1979; **15**: 725–31.
16 Forthofer RN. Investigation of nonresponse in NHANES II. *Am J Epidemiol* 1983; **117**: 507–15.
17 Wiley JA. Camacho TC. Life-style and future health: Evidence from the Alameda County Study. *Prev Med* 1980; **9**: 1–21.
18 Jürgensen HJ, Frølund C, Gustafsen J, Mosbech H, Guldhammer B, Mosbech J. Registration of diagnoses in the Danish National Registry of Patients. *Methods Inf Med* 1986; **25**: 158–64.