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Are Nonrespondents to Health Surveys Less Healthy Than Respondents?

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In health surveys of the elderly the use of a sampling frame linked to the national registration system, enables comparison of the subsequent mortality of respondents and nonrespondents. To the extent that mortality is an indicator of health at the time of the survey such comparison can inform estimates of the nonresponse bias on self-reported health variables.

We describe a 1993 postal survey of an age-stratified sample of 4,869 people aged 55 and over drawn from the Community Health Index in Lothian Region, Scotland, and a follow-up survey about three years later. Mortality up to mid-1998 was significantly higher among nonrespondents to the first survey. Nonresponse to the follow-up was associated with worse self-reported health three years earlier as well as with indicators of low socioeconomic status. After controlling for self-reported health in 1993, respondents and nonrespondents to the 1996 follow-up differed significantly in mortality over the 18 months after the follow-up survey.

Key words: Nonresponse bias; mortality; self-reported health; short form 36; limiting long-term illness.

1. Introduction

Nonresponse bias in surveys arises when the reasons for individuals' failure to respond are related to the survey topics. Health surveys are a good example, where it seems plausible that propensity to respond may be related to health; although whether greater bias arises from a relatively higher response rate among the 'worried well' or a lower response rate from the seriously ill is debatable. Various methods have been used to approach this problem. Comparison of the actual responses of early and late responders is usually possible (Paganini-Hill et al. 1993). Follow-up surveys of nonrespondents, possibly using a shorter questionnaire or a different survey mode, may also provide valuable information (Hoeymans et al. 1998). Where the sampling frame can be linked to the national registration system the subsequent mortality of responders and non-responders can be compared (Paganini-Hill et al. 1993). In surveys of members of private health insurance plans comparison may be made between the health care expenditures claimed by respondents and nonrespondents (Etter and Perneger 1997). Longitudinal studies

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enable respondents and nonrespondents to second or later phases to be compared with respect to health variables recorded at earlier dates (Gray et al. 1996).

Although the extent of evidence is still fairly limited and not always in a consistent direction, most studies seem to indicate that nonrespondents suffer from worse health. For example Paganini-Hill et al. (1993), in a postal survey of relatively well-off elderly Californians, found that late respondents had worse self-reported mental and emotional health and less healthy lifestyles than early respondents. They also found that nonrespondents had higher mortality than respondents in the first three years after the survey. In a follow-up survey of an elderly male cohort in Holland (Hoeymans et al. 1998) nonrespondents had suffered more strokes, experienced greater disabilities in activities of daily living and reported worse self-rated health than respondents. A survey of prescription and over-the-counter drug use among the elderly in Pennsylvania (Grotzinger et al. 1994) found that nonrespondents had spent more time in hospitals and nursing homes and had more home visits by physicians and fewer visits to physicians' offices. A Swiss survey (Etter and Perneger 1997) of adults aged under 46 enrolled in two health insurance plans found that physical health scores were lower among late respondents. But among the nonrespondents there was a marked difference between the refusals, who had higher expenditure than respondents, and those who simply failed to reply, whose expenditure was slightly lower than that of the respondents. In another postal health survey, which was matched with a panel data set, Lamers (1997) also found that utilisation of health care was lower among nonrespondents, after adjustment for demographic correlates of nonresponse, but found no association between response and care related to severe conditions such as in-hospital care. In a follow-up of respondents to a general household survey, conducted by personal interview in both phases, Goddard (1998) found that non-contacts at follow-up had reported poorer health in the initial survey. Between the first survey and follow-up there were fewer deaths than expected among respondents; however, no direct comparison between mortality rates of respondents and nonrespondents to the initial survey was made.

Clearly context is important. A two-phase study in England attempted to ascertain prevalence of physical disability by using a postal survey to screen for disability and then sought to interview a sample of those so identified (Tennant and Badley 1991). In the second phase it was found that early respondents were more dependent than later respondents, possibly because the more disabled were more likely to perceive a benefit to themselves in responding. The contrast with the high health care costs incurred by those refusing to reply to a survey of members of health insurance plans is notable.

In this article we describe a postal health survey of the elderly which achieved a high response rate, and where linkage to the British National Health Service Central Register enabled tracing of the subsequent mortality of both respondents and nonrespondents. This was with the aim of inference regarding the relative health status of respondents and nonrespondents at the time of the survey, and hence at least qualitative judgments on the effects of nonresponse bias on our estimated health measures. We also conducted a follow-up survey of respondents to the initial survey a little over three years after the initial survey. This enabled us to study, among surviving respondents of the first survey, the associations between response to the follow-up and self-reported health three years earlier, and between response to the follow-up and subsequent mortality. Finally, since

self-reported health is known to be strongly associated with future mortality, it was of interest to investigate the hypothesis that, conditional on health at the first survey, mortality subsequent to the follow-up was the same for respondents and nonrespondents to the follow-up. Under this hypothesis, to the extent that mortality over a short period of 18 months was a good proxy for health at the time of the second survey, nonresponse to the second survey might be considered non-informative (Little 1996; Diggle and Kenward 1994).

2. Methods

In May 1993 a large postal health survey commissioned by the Lothian Health Board was carried out in Lothian Region in south-east Scotland (population 750,000). The sampling frame was the Community Health Index, a file of all residents registered with a general practitioner. A non-proportional stratified sampling design was used with equal samples of 2,500 selected from age groups 16–44, 45–64, 65–74 and 75 and over. Two reminders were sent approximately two and four weeks after the initial mailing. Letters were also sent to 'the occupier' at addresses from which questionnaires had been returned undelivered, asking for the current address of the sample member recorded as living at that address; and questionnaires and reminders were sent to the new addresses so obtained. Since the Community Health Index is linked to the NHS central register it was possible to follow up both respondents and nonrespondents to ascertain their mortality over the subsequent five years. Kaplan-Meier life tables and proportional hazards regression were used to compare the survival experience of respondents and nonrespondents aged 55 and over at mid-1993.

A follow-up survey was carried out in November 1996 of all 3,515 respondents to the 1993 survey who were aged 55 and over at the time of the first survey and were not known to have died or migrated out of the region by mid-1996. Two reminders were sent, as before, but no letter to ''the occupier.'' Self-reported health was measured in the first survey using the 1991 census question on limiting long-term illness (Charlton et al. 1994) and the eight dimensions of the short form 36 (SF 36) health survey (Ware and Sherbourne 1992). Scores on each dimension are scaled from 0 (worst health) to 100 (best health). We used logistic regression to examine the association between nonresponse to the second survey and socioeconomic and health variables measured at the first survey; and to analyse the mortality status at mid-1998 of respondents to the first survey in terms of health status in 1993 and response status in 1996.

3. Results

After exclusion of questionnaires that were returned undelivered, and persons who were found to be deceased, abroad or otherwise ineligible, there were 4,869 people aged 55 and over on 30 June 1993 who either responded (82.1%), explicitly declined to respond, e.g., by returning a blank questionnaire (2.7 %) or simply failed to respond (15.2 %) to the first survey. It is presumed that the latter did in fact receive the questionnaire.

Table 1 shows the numbers in each response category by age group and sex, and the corresponding five-year mortality rates up to mid-1998. In addition to the expected age and sex effects within each response category it is clear that within each age-sex group

Table 1. Five-year mortality (1993–98) of respondents and nonrespondents to 1993 Lothian Health Survey, by sex and age group

	Male				Female			
	55–64	65–74	75–84	85+	55–64	65–74	75–84	85+
5-year mortality rates (%)								
Responders	8.7	20.3	39.2	67.2	3.6	12.6	27.3	38.6
Nonresponders	5.9	21.3	51.0	78.6	6.7	19.2	32.0	53.7
Total sample	8.1	20.5	41.3	69.4	4.3	13.6	28.2	43.1
Sample sizes								
Responders	346	797	472	58	386	1,018	761	158
Nonresponders	85	141	102	14	104	182	178	67
Total sample	431	938	574	72	490	1,200	939	225
Response rate (%)	80	85	82	81	79	85	81	70

(except for the youngest males) nonresponders had higher mortality than responders, the discrepancy increasing markedly for males over age 75 and females over age 65. Figure 1 shows Kaplan-Meier survival curves by response status and sex in the age group 75–84, and demonstrates clear differences by response status in both sexes.

Using a stratified log rank test, with eight age-sex strata as in Table 1, the difference in distribution of survival times between respondents and nonrespondents was highly significant ($X^2 = 14.9$, $df = 1$ $p < .0001$). Using a sex-stratified proportional hazards model and including a response by age interaction gave the following estimates of the relative risk of mortality for nonrespondents as compared to respondents: 1.07 (95% confidence interval 0.57 to 2.03), 1.28 (0.98 to 1.67), 1.30 (1.05 to 1.60) and 1.58 (1.10 to 2.24) for the age groups 55-64, 65-74, 75-84 and 85+, respectively.

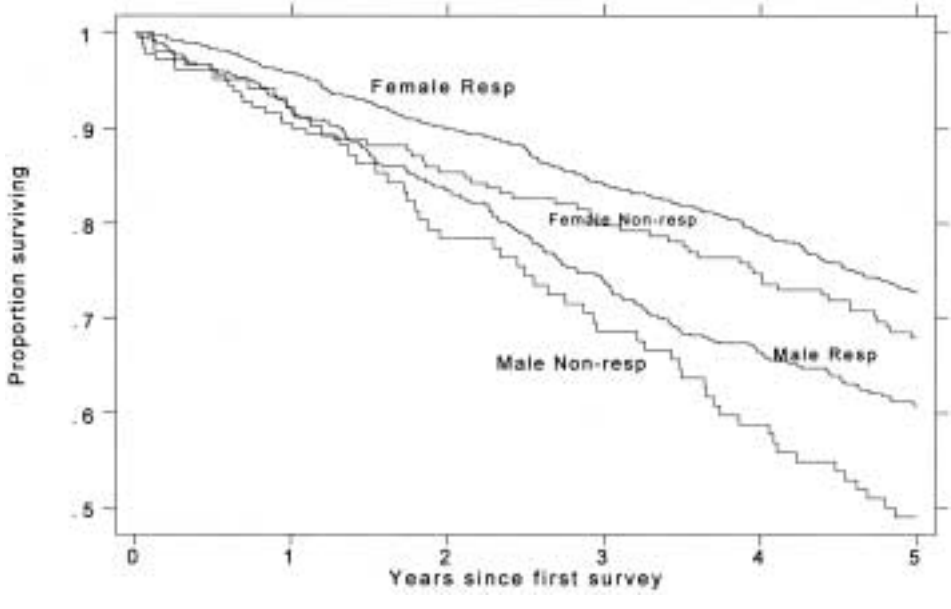

Fig. 1. Survival after first survey, by response status and sex: Age group 75–84

Table 2. Response rates (%) at 1996 follow-up survey, by quartiles of self-reported health on eight Short Form 36 health scales at first (1993) survey

	First quartile	Second quartile	Third quartile	Fourth quartile
Health perception (HP)	84	88	91	89
Physical functioning (PF)	81	87	91	93
Physical role limitation (RP)	85	90	90*	90*
Emotional role limitation (RE)	85	90*	90*	90*
Vitality (VI)	87	87	91	91
Mental health (MH)	84	87	93	90
Social functioning (SF)	83	87	91*	91*
Bodily pain (BP)	86	89	89*	89*

*On several SF 36 scales the distribution of scores was highly discrete, hence the 'quartiles' were not necessarily of exactly equal frequency. For physical role limitation, social functioning and bodily pain the 75th percentile of the distribution was equal to 100; so response rate was pooled over the higher two quartiles for these dimensions. For the emotional role limitation scale the 50th percentile was also 100, so response rates were pooled over the top 3 quartiles.

For the follow-up survey 3,515 questionnaires were mailed at the end of October 1996 and a response rate of 83.9% was achieved. After allowing for people who replied saying they were too ill to complete the questionnaire (2.3%), explicitly refused (1.1%), did not respond but were later discovered to have migrated out of the region or died before the end of 1996 (3.3%), or whose questionnaire failed to be delivered by the post office (1.5%), there were 279 (7.9%) whose failure to respond was for unknown reasons.

The ''unknown'' nonrespondents were slightly older and had a greater proportion of females than the respondents, while nonrespondents who died before the end of 1996 or were said to be too ill to respond were considerably older. Table 2 shows the response rates

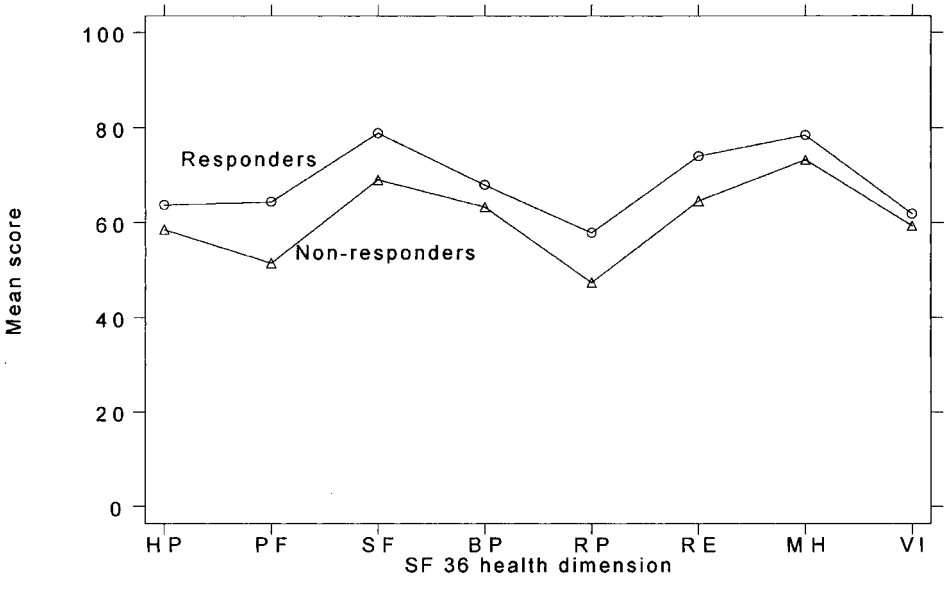

Fig. 2. Self-reported health (mean SF 36 scores) in 1993 by response status in 1996

Table 3. Effects of age, sex, social background and health, as recorded in 1993 Lothian Health Survey, on odds of nonresponse to 1996 follow-up health survey. Values are odds ratios (95% confidence interval) from a logistic regression model

	OR	95% CI
Age: 65–74 vs 55–64	0.62	0.45 to 0.87
75+ vs 55–64	0.81	0.56 to 1.17
Sex: Female vs Male	1.19	0.90 to 1.58
Home tenure: Rented vs Owned	1.37	1.03 to 1.82
Other vs Owned	1.84	1.06 to 3.20
Income support	1.77	1.25 to 2.51
Physical functioning score: lower quartile (45) vs upper quartile (90)	1.29	1.04 to 1.61
Mental health score: lower quartile (65) vs upper quartile (92)	1.17	0.96 to 1.42

in 1996 of those who were in each quartile on each of the SF 36 health dimensions three years earlier. An association between self-reported health and subsequent response is apparent; this is also illustrated in Figure 2, which compares the profiles of mean scores on the SF 36 health dimensions between responders and nonresponders.

To examine the influence of health and social background variables on the likelihood of nonresponse a logistic regression was carried out after exclusion of all except the responding and ''unknown'' nonresponse groups. Since occupational social class is difficult to establish with elderly people the following variables were offered to the model: home tenure; ownership of or access to a car; age at leaving school; income support. Limiting long-term illness was also included in the model, together with age group, sex, and the eight health dimensions treated as linear scores. Using a combination of forward and backward model selection procedures the most parsimonious model was as shown in Table 3, with just two of the social and two health variables retained in addition to age and sex. The age effect indicated that nonresponse was less likely among older people. The sex difference was not significant, but there were associations with home tenure and income support status. People not owning their own home were more likely not to respond, and those on income support were associated with 77% higher odds of nonresponse. Adjusting for these variables there was still a health effect, with those at the lower quartile on the physical functioning scale having estimated odds of nonresponse about 29% higher than those at the upper quartile. There was less variation on the mental health scale and the effect of this health dimension was thus somewhat smaller and only of borderline significance.

Nonresponders to the second survey had higher mortality than responders up to mid-1998, even when self-reported health status at 1993 was controlled. For those who were sent the 1996 follow-up survey we sought the most appropriate logistic regression model relating mortality status at mid-1998 to age, sex, socioeconomic and health variables as measured in 1993 and response status in 1996. Of the available socioeconomic variables measured in 1993 only car access/ownership and home tenure had mildly significant effects on survival between 1996 and 1998, when no health variables were entered into the model. Adding health variables, physical functioning, and limiting long-term illness had independent highly significant effects and the car and home tenure variables became

Table 4. Effects of age, sex, and self-reported health in 1993 and response status in 1996 on odds of mortality up to mid-1998, for recipients of 1996 follow-up survey. Values are odds ratios (95% confidence interval) from a logistic regression model

	OR	95% CI	*P*-value
Age: 65–74 vs 55–64	2.81	1.57 to 3.07	0.000
75+ vs 55–64	5.03	2.92 to 8.65	0.000
Sex: Female vs Male	0.72	0.54 to 0.95	0.019
Response status: Nonrespondents* vs Respondents	2.20	1.57 to 3.06	0.000
Limiting long-term illness	1.57	1.11 to 2.21	0.01
Physical functioning score: lower quartile (45) vs upper quartile (90)	1.42	1.11 to 1.80	0.005

*Nonrespondents for unknown reasons, refusals and those who replied saying they were too ill to complete the questionnaire. Nonrespondents who were later discovered to have died or migrated out of the region before the end of 1996 were excluded.

non-significant. The only other health variable with a possible significant effect was the bodily pain score. This was not significant when entered as the only health variable or entered after limiting long-term illness, and only marginally significant ($P = 0.03$) when entered after physical functioning, but was highly significant when entered after both physical functioning and limiting long-term illness, with effect in the opposite direction to that expected – more pain associated with lower mortality. No interactions were significant. Exclusion of the pain variable made little difference to the other estimates. Table 4 gives the estimates from the logistic model excluding this possibly spurious effect, and Table 5 shows the variations in mortality by response status in 1996 and 1993 health status as measured by limiting long-term illness and physical functioning score dichotomised at the median.

Among 1993 respondents nonresponse to the 1996 follow-up was associated with approximately twice the risk of mortality in the next 18 months as compared with respondents to the follow-up. Table 5 illustrates that there was little interaction between the effects of limiting long-term illness, low physical functioning score and response status on mortality. We also show mortality for three subcategories of nonresponse; although

Table 5. Mortality rates (%) up to mid 1998 by response status at second survey and limiting long-term illness and physical functioning status at first survey. Values are mortality rates in per cent (sample number)

	Physical functioning score in 1993			
	Below median		Above median	
	Limiting long-term illness	No limiting long-term illness	Limiting long-term illness	No limiting long-term illness
Respondent	10.5 (931)	7.2 (263)	7.0 (344)	3.8 (1,213)
All nonrespondents	23.5 (166)	13.2 (53)	12.9 (31)	7.5 (107)
Nonrespondent for unknown reason	21.1 (109)	11.1 (36)	10.5 (19)	5.7 (87)
Refused	7.7 (13)	0.0 (4)	40.0 (5)	0.0 (9)
Ill nonrespondent	34.1 (44)	23.1 (13)	0.0 (7)	27.3 (11)

numbers were small there is a strong indication of lower mortality among the refusals and, as expected, higher mortality among those who said they were too ill to respond.

4. Discussion

In general it might be expected that frail elderly people, particularly those with severe illnesses, would be less able, and perhaps less willing, to respond to a general health survey. Combined with a greater propensity to respond among the ''worried well'' this would tend to suggest that nonrespondents to such surveys are generally less well than respondents (Criqui et al. 1978, Hoeymans et al. 1998, Paganini-Hill et al. 1993). However, a study of nonresponse to a mail survey of about 15,000 people in Texas showed no difference in reported medical history between respondents and nonrespondents although the respondents had more family history of circulatory diseases and practised healthier lifestyles (Macera et al. 1990). Thus the ''worried well'' could be worried for good reasons while not necessarily reporting worse health. Alternatively, it might be argued that an individual with a degree of ill health that is not too debilitating might be more interested in health matters, and hence more likely to respond, than one who has no health problems and prefers not to think about his or her health. In studies such as the Yorkshire disability survey (Tennant and Badley 1991) response may have been increased among the more disabled because of increased motivation and possible perceived benefits from responding. Our results on mortality suggest that among those aged over 75 the latter source of bias is small whereas the former is relatively large.

However nonrespondents are not a homogeneous group and the extent and direction of bias may depend on the relative numbers of refusals and non-contacts. There is conflicting evidence in the literature: Goddard (1998), using personal interviews, found that refusal at follow-up was associated with less reported ill-health in the first survey; but the results of Etter and Perninger (1997) indicated larger health expenditures by those refusing to respond to a postal survey. In our study those refusing at the follow-up had reported worse health in the initial survey than those who co-operated with the follow-up, but the number of explicit refusals was too small to permit firm conclusions.

The analysis of our follow-up survey was constrained by the fact that nonrespondents to the second survey, whether refusals, too ill, or for unknown reasons, had at least responded once three years earlier, and therefore probably constituted a healthier category than the nonrespondents to the first survey. Nevertheless there was clear evidence of an association between self-reported physical health and subsequent willingness to respond, even after omission of those who returned information to the effect that they were too ill to complete the questionnaire, and controlling for socioeconomic effects, which could confound the relationship.

The socioeconomic variables included in our model for nonresponse, home tenure and dependence on income support, have been found in other studies of nonresponse in a variety of populations. In a seven-year follow-up of the Health and Lifestyle Survey, whose target population was all adults aged 18 and over in Great Britain, similar, but weaker, associations were found between nonresponse and indicators of physical and psychological ill-health, after controlling for socioeconomic effects (Gray et al. 1996). The stronger health effects in our study may be due to the high average age of our sample.

Strong association between self-reported health and subsequent mortality has been found in many studies (Jagger and Clarke 1988; Mossey and Shapiro 1982; Sundquist and Johansson 1997), so our finding that self-reported health measures taken three years before the follow-up were significant predictors of mortality after the follow-up was not unexpected. On the other hand the well documented association between socioeconomic deprivation and mortality (Carstairs and Morris 1990) was 'ignorable' after adjustment for self-reported health. After adjustment for health variables there were still significant differences in mortality between respondents to the follow-up and nonrespondents, leaving potential for biased health estimates in the follow-up. Among those who responded to both surveys there were substantial numbers of transitions from poor self-reported health to better health as well as the more numerous deteriorating transitions, which might be expected, in an elderly population (Cohen and Forbes 1999). So perhaps it is not surprising that adjustment for the SF 36 measures recorded in 1993 failed to reduce the 1996 nonresponse mechanism to one equivalent to missing at random.

Although we have shown some quite large differences between respondents and nonrespondents the degree of bias depends crucially on the extent of nonresponse. Since our response rates were high the overall bias was quite low. On the self-reported health measures the respondents' mean values differed by at most about two per cent from the means for the whole sample (excluding the dead, migrated, and undelivered). For 5-year mortality respondents' rates were generally less than ten per cent lower than the rates for the whole sample.

The response rate of 82% in the first survey was remarkable, especially in view of the 15-page length of the questionnaire (although item nonresponse did increase with age). To an extent this is accounted for by the exclusion from the response rate denominator of questionnaires that were returned undelivered by the Post Office, persons abroad at the time of the survey and those who had died. But it also reflects the fact that the sample was targeted disproportionately towards the elderly. Not only are people over 55 more likely to be aware of and interested in health problems, they also probably have more time on their hands, are less mobile, and perhaps have generational attitudes inclining them to be more compliant with quasi-official bodies.

Although attempts were made in the first survey to locate hard-to-find sample members through telephone enquiries this was largely unsuccessful. A few responses were also offered voluntarily by telephone, but this was in no sense a formally mixed mode survey. There is evidence, however, that following a postal survey by use of telephone interviews for late and reluctant respondents can reduce nonresponse bias on health questions (Brambilla and McKinlay 1987).

It is possible that some apparent nonrespondents to the first survey were people who had recently moved out of Lothian Region, without this information having yet been recorded on the sampling frame (and without the Post Office having been informed, so the questionnaires were not classified as undelivered). In this case some of the ill-health effects associated with nonrespondents would also have been associated with out-migration, the two sources of bias being confounded. Without detailed information on the inflow to and outflow from the Lothian Region it is not possible to separate these different sources of bias.

In summary we conclude that prevalence of common sources of ill-health in the over

75's is likely to be underestimated, even by a carefully conducted health survey, but among the 'young elderly' such prevalence estimates are unlikely to be severely biased if a reasonably high response rate is achieved.

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