The effect of non-response on estimates of health care utilisation: linking health surveys and registers

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Background: Non-response in health surveys may lead to bias in estimates of health care utilisation. The magnitude, direction and composition of the bias are usually not well known. When data from health surveys are merged with data from registers at the individual level, analyses can reveal non-response bias. Our aim was to estimate the composition, direction and magnitude of non-response bias in the estimation of health care costs in two types of health interview surveys. Methods: The surveys were (1) a national personal interview survey of 22 484 Danes (2) a telephone interview survey of 5000 Danes living in Funen County. Data were linked with register information on health care utilisation in hospitals and primary care. Health care utilisation was estimated for respondents and non-respondents, and the difference was explained by a decomposition method of bias components. Results: The surveys produced the same pattern of non-response, but with slight differences in non-response bias. Response rates for the interview and telephone surveys were 75 and 69%, respectively. Refusal was the most frequent reason for non-response (22 and 20% of those sampled, respectively), whereas illness, non-contact, and other reasons were less frequent. Respondents used 3–6% less health care than non-respondents at the aggregate level, but the opposite was true for some specific types of health care. Non-response due to illness was the main contributor to non-response bias. Conclusions: Different types of non-response have different bias effects. However, the magnitude of the bias encourages the continued use of interview health surveys.

Keywords: non-response, health care, health survey, registers, bias

Health interview surveys contribute important information on health status, health behaviour and health care utilisation in the population. A health survey is often the only source of information when variables of interest are not available from registers. The problem with surveys is, of course, that not all the people who are invited to participate do so. Failure to participate can lead to bias in estimates on the population. If missing data are randomly unavailable for unknown reasons, the non-response might not interfere with the survey’s intention to be representative. However, when non-response is systematically related to health status, non-contact might seriously damage the survey’s ability to provide unbiased estimates. This idea has been widely accepted, and many surveys have been designed to ensure high response rates. Although not unequivocal, there are signs that it is increasingly difficult to obtain high response rates. The climate for taking surveys may deteriorate due to societal changes such as increased urbanisation and changing demographic and family structures, and decreasing norms for civic duty. In addition, over-surveying in some countries and public debates on invasion of privacy and confidentiality may worsen conditions even more.

There is no general agreement about which mode of interview (face-to-face or telephone) results in the highest response rates, and both have been mentioned. The two modes are not usually directly comparable, as different design features are applied, in addition to the mode of interview. Previous studies support the presumption that non-response is a complex phenomenon made up of various effects, especially when the focus is on health care utilisation. Concerning hospital admissions, some studies showed higher utilisation among non-respondents, while other studies showed no differences between respondents and non-respondents. A Danish study showed that the non-respondents in general had the same admission rates as the respondents, but the admission rates were higher among non-respondents around the interview period. The pattern is even more diverse for primary health care. Some studies registered lower health care utilisation for non-respondents, whereas other studies showed higher health care utilisation rates. The present study focuses on the representativeness of estimates of health care utilisation among respondents in sampled surveys by obtaining information on health care utilisation from registers for respondents as well as non-respondents. The aim of the article is 2-fold: (1) to estimate the magnitude, direction and composition of non-response bias in health care utilisation and (2) to compare the non-response bias from two sources of health surveys: a personal interview survey and a telephone interview survey.
Material and methods

Personal interview data

The personal interview data were obtained from The Danish Health Interview Survey 2000 (DHIS).23,24 22,484 Danish citizens aged 16 and above were drawn from the Centralised Civil Register to participate in a national health survey on health care utilisation, health status, morbidity, health behaviour, environmental and occupational health risks and health resources. The sample was stratified to include at least 1000 respondents from each of the 15 Danish counties, and data were weighted by the reciprocals of the sampling probabilities. Data were collected from personal interviews by trained interviewers in three rounds in February, May and September 2000, respectively. 16,688 individuals participated, corresponding to a weighted response rate of 74.5%.

Telephone interview data

The telephone interview data were obtained from The Funen County Health Survey (FCHS). Five thousand people living in Funen County, Denmark aged 16–80 were drawn from the Centralised Civil Register to participate in a health survey on health status, health behaviour and socio-economic background. The sample was stratified with respect to municipalities, and the data were weighted by the reciprocals of the sampling probabilities. Data were gathered through telephone interviews from October 2000 through April 2001.25 A total of 3421 individuals participated, corresponding to a weighted response rate of 69.2%.

Register-based data

Data from each survey were merged with data from individual-level computerised registers including: all somatic hospital visits, services in the primary health care sector such as GP visits, physiotherapy, specialist treatment, dentistry, and dispensed prescription medicine in 2000 and 2001. The use of registers to extract information on health care utilisation makes it possible to obtain exact information on health care services over a long period of time. The registers also make it possible to distinguish between different types of health care, and the different types of services can be added by measuring health care utilisation in monetary terms. Health care services were measured as the long-run costs of the services and approximated by prices, charges or fees.

Hospital visits were extracted from the National Patient Register and the Funen County Patient Administrative System (FPAS) and linked to DHIS and FCHS, respectively. These registers include records on somatic inpatient stays, ambulatory and emergency room visits. Each hospital admission was described by an estimated charge based on the 2002 Danish case-mix system of Diagnosis Related Groups (DRGs). The case-mix system covers inpatient hospital stays, whereas ambulatory and emergency room visits are described by a similar but simpler system. Capital costs are not included in the case-mix system. All charges were adjusted to 2003 price level for hospital treatments.

The services in the primary health care sector were extracted from the Registry of Public Health Insurance and linked to DHIS and FCHS. This registry includes all partly or fully reimbursed health services in primary health care, i.e. from general practitioners, physiotherapists, dentists and specialists. Each service is described with a reimbursement fee. As considerable co-payment exists for dental health care and physiotherapy, these fees were adjusted to reflect the full amount (reimbursement + co-payment). Expert judgments were used to adjust the dental care fees to the approximate average level of dental care fees, whereas the relevant fees for physiotherapy were adjusted by dividing the reimbursement fees by the proportion of reimbursement. General practitioners are partly financed through capitation (about one-third of GP revenue), and the GP reimbursement fees were scaled up by this amount. All reimbursement fees were adjusted for inflation up to 2003 by the price index for physicians and physiotherapists.

Medicine data were extracted from the Register of Medicinal Product Statistics (RMPS) and Odense University Pharmacoepidemiologic Database (OPED) and linked to DHIS and FCHS, respectively. These databases consist of all prescription refunds from Denmark and Funen County, respectively. The dispensed medicine is described by the total purchase price in the RMPS, whereas pharmacy retail prices including Value added tax (VAT) are used for the OPED. A further difference is that OPED includes prescription medicine entitled to reimbursement, whereas RMPS includes all prescribed medicines. Neither of the databases contains information on over-the-counter-medicine. Medicines dispensed in hospitals are included in the hospital charges. The medicine prices were adjusted for inflation to the 2003 level by the index for pharmaceutical products and equipment.

The Danish Data Protection Agency has approved the linking of the registers and the survey data and all local confidentiality and privacy requirements have been met.

Statistical analysis

As non-response can have many causes, non-respondents were classified into different types of non-response along the lines of Kjoller and Thoning.9 The following categories were used: Interviewed, Refusals, Illness, Non-contacts, and a residual category of Other (table 1). The category of interviewed consisted of partially or completely interviewed respondents. That is, the item non-response is included in the category of interviewed, as can be seen in the table. People living outside Funen County or registered as dead were regarded as not belonging to the parent population under investigation and were excluded from the full sample.

Differences in health care utilisation between respondents and non-respondents were analysed with ANOVA. The effect of different types of non-response bias on the estimates of health care utilisation has been analysed in a decomposition framework. Groves and Couper suggest a decomposition of the survey estimate into components of bias from the different types of non-response:7

$$
\mu_{\text{interviewed}} = \mu + (m_{\text{refusals}}/n) + (m_{\text{illness}}/n)(\pi_{\text{interviewed}} - \pi_{\text{illness}}) + (m_{\text{non-contacts}}/n)(\pi_{\text{interviewed}} - \pi_{\text{non-contacts}}) + (m_{\text{other}}/n)(\pi_{\text{interviewed}} - \pi_{\text{other}}),
$$

where $\mu$ is the mean health care utilisation for the different categories of non-response, $n_j$ is the weighted number of people in the $j$th non-response category, and $n$ is the weighted sample size. This formula makes it possible to quantify the effect on bias from the proportion of (the specific type of) non-respondents and the difference between the respondents and (the specific type of) the non-respondents. Each of the differences in means was tested by a t-test for comparing two means.

Results

Table 1 displays the categorisation of respondents and non-respondents for the two sources. The response rate was higher for the personal interview survey (74.5%) than the telephone survey (69.2%). The most frequent reason for non-response was refusal (22.1 and 20.3%, respectively). The non-contacts constituted the second largest category, which was larger in the telephone survey than in the interview survey (8% vs. 2%). Illness and hospital visits played a relatively minor role in the...
magnitude of non-response, although some refusals may have been due to health-related disabilities.

The mean health care costs for respondents and non-respondents are shown in table 2. The first column shows the mean health care costs for the overall representative samples for all sampled individuals. The figures are remarkably similar for both the interview and the telephone surveys. The resulting non-response bias could be derived by comparing the first and the second columns. Health care costs were a bit smaller for respondents at the overall level [DHIS: Denmark Kroner (DKK) 19 966; FCHS: DKK 19 073] than for the whole sampled population (DHIS: DKK 20 510; FCHS: DKK 20 254) (1 USD = 8.33 DKK, 2005 PPP),29 An F-test for the differences between the respondents and non-respondents was only significant at a 10% level in the FCHS (F-statistics unavailable in the DHIS at the aggregate level).

The interviewed had a significantly lower level of hospital utilisation and medicines, and a higher level of dentistry in DHIS at a 5% level of significance. In the telephone survey, which is a smaller sample, the interviewed had a lower level of hospital utilisation and medicine use at a 5% level of significance, and a higher level of specialist care and dentistry at a 10% level of significance.

The magnitude and composition of the non-response bias in health care utilisation is illustrated in table 3 by applying Groves and Couper’s decomposition.7 The size of non-response bias for each type of health care consists of the proportion of the specific type of non-respondents (which is constant with respect to health care) and the difference between the interviewed and the specific type of non-respondents. The biggest contributor to non-response bias was illness. Although the ill or disabled constituted only about 1%, the large differential in health care utilisation between the interviewed and the ill or disabled contributed to a considerable non-response bias component for the aggregate level (DHIS: DKK 615; FCHS: DKK 608). Refusal was the dominating reason for non-response, but the effect on non-response bias was not large, as the differential between the interviewed and those who refused was small.

At the aggregate level, all bias components were negative for the telephone survey, indicating that all types of non-response led to an underestimation of the magnitude of health costs.
Data weighted by the reciprocals of the sampling probability

\[ d = \frac{\text{Data}}{\text{weight}} \]

T-tests for H0:

\[ c = \text{T-tests for } H_0 : \]

Component

m

pronounced for types of health care such as hospitalisation, they need health care. Therefore, this pattern is most non-response. This group of people may not be able to health care utilisation is directly influenced by this reason for non-response bias was small and insignificant in most cases. For some specific types of health care, this should be expected, as health care utilisation is directly influenced by this reason for non-response. This group of people may not be able to participate because they are too ill, i.e. the same reason that they need health care. Therefore, this pattern is most pronounced for types of health care such as hospitalisation, GP visits and prescription medicine. The two modes of interview produced almost the same pattern of non-response, although the proportion of respondents was higher in the interview survey. However, some bias components had opposite effects in the two modes of interview.

Although the present study is not directly comparable with most of the studies in the literature, the results are in accordance with the main tendencies from previous findings: that hospital utilisation is higher among non-respondents or that there are no differences between respondents and non-respondents. As for the primary care utilisation, the less clear pattern is also in accordance with the literature, with some studies showing lower and some studies higher health care utilisation for non-respondents.

Specific strengths of this study were that it used representative data from the general population and not only from a patient group or an insurance group, and investigated two modes of interview data. Linkage to registers made it possible to extract exact information on several types of health care in primary and secondary health care sectors for a long period of time. It also made it possible to measure health care utilisation in monetary terms by applying fees and charges as proxies for the costs of the services. The advantage of using a common unit of measurement is that different types of health care services can be aggregated. Furthermore, the cost of the service

<table>
<thead>
<tr>
<th>Interviewed</th>
<th>All</th>
<th>Refusals</th>
<th>Illness</th>
<th>Non contacts</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \mu_{int} )</td>
<td>( \mu_n )</td>
<td>( (\mu_{int}/\mu_n) )</td>
<td>( (\mu_{int} - \mu_n) )</td>
<td>( (\mu_{int}/\mu_n) )</td>
<td>( (\mu_{int} - \mu_n) )</td>
</tr>
</tbody>
</table>
| Interview survey \( (n=22\,484) \)

All components

| Hospital | 11,844 | 12,285 | 0.22 | 110 | 0.01 | -35093** | 0.02 | -31 | 0.00 | 274 |
| GP | 18,48 | 18,64 | 0.22 | 18 | 0.01 | -1605** | 0.02 | 164 | 0.00 | -373 |
| Physiotherapy | 435 | 436 | 0.22 | 53 | 0.01 | -1194** | 0.02 | 227 | 0.00 | -126 |
| Specialist | 684 | 692 | 0.22 | -62 | 0.01 | 189 | 0.02 | 110 | 0.00 | 183 |
| Dentist | 1727 | 1652 | 0.22 | 229 | 0.01 | 1865** | 0.02 | 606 | 0.00 | 695** |
| Medicine | 3428 | 3581 | 0.22 | -191 | 0.01 | -9390** | 0.02 | 743 | 0.00 | 282 |
| Total | 19,966 | 20,510 | 0.22 | 157 | 0.01 | -46228 | 0.02 | 1813 | 0.00 | 935 |
| **Size of bias** Hospital | 11,844 | 12,285 | 24 | 467 | 0.01 | -1 | 1 |
| GP | 18,48 | 18,64 | 4 | -21 | 3 | 1 |
| Physiotherapy | 435 | 436 | 12 | -16 | 4 | 1 |
| Specialist | 684 | 692 | -14 | 3 | 2 | 1 |
| Dentist | 1727 | 1652 | 51 | 12 | 10 | 3 |
| Medicine | 3428 | 3581 | -42 | -125 | 1 | 1 |
| Total | 19,966 | 20,510 | 35 | -615 | 31 | 4 |
| Telephone survey \( (n=4985) \)

All components

| Hospital | 12,203 | 13,304 | 0.20 | -974 | 0.01 | -41902** | 0.08 | -3480 | 0.01 | -10,504 |
| GP | 17,11 | 17,47 | 0.20 | 56 | 0.01 | -1967** | 0.08 | -210 | 0.01 | -549 |
| Physiotherapy | 391 | 367 | 0.20 | 130 | 0.01 | -1543 | 0.08 | 130 | 0.01 | 281** |
| Specialist | 606 | 573 | 0.20 | 92 | 0.01 | 192 | 0.08 | 93 | 0.01 | 323** |
| Dentist | 1654 | 1575 | 0.20 | 137 | 0.01 | 883 | 0.08 | 440 | 0.01 | 385** |
| Medicine | 2509 | 2688 | 0.20 | -300 | 0.01 | -9685** | 0.08 | -85 | 0.01 | -170 |
| Total | 19,073 | 20,254 | 0.20 | -858 | 0.01 | -54023** | 0.08 | -3111 | 0.01 | -10235 |
| **Size of bias** Hospital | 12,203 | 13,304 | 197 | -471 | 0.01 | -279 | 154 |
| GP | 17,11 | 17,47 | 11 | -22 | 17 | -8 |
| Physiotherapy | 391 | 367 | 26 | -17 | 10 | 4 |
| Specialist | 606 | 573 | 19 | 2 | 7 | 5 |
| Dentist | 1654 | 1575 | 28 | 10 | 35 | 6 |
| Medicine | 2509 | 2688 | 60 | -109 | 7 | -2 |
| Total | 19,073 | 20,254 | 173 | -608 | 250 | -150 |

a: Both years included, Danish Kroner, 2003 price level (1 USD = 8.33 DKK, 2005 PPP)

b: The proportion of non-response for type \( j (m_n/m) \) remains constant for all types of health care
c: T-tests for H0: \( (\mu_{int} - \mu_n) = 0 \), based on stratification adjusted standard errors, \( *P < 0.05 \), **P < 0.01
d: Data weighted by the reciprocals of the sampling probability
e: T-tests for aggregate health care costs not available as specific costs have been obtained from different servers
The effect of non-response bias

Conclusions

The two modes of interview (personal and telephone) produce the same pattern of non-response, but do not produce the same non-response bias with respect to health care utilisation. Refusal is the most frequent reason for non-response, whereas illness is the most important contributor to non-response bias.

There seems to be a trend towards decreasing participation rates in health interview surveys. However, the general validity of the results may not be threatened by the bias produced by non-response, although the underreporting caused by non-participating ill people is an important component that should be taken into consideration in surveys based on general populations.

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Conflicts of interest: None declared.

Key points

- Non-response in health surveys may lead to bias in estimates of health care utilisation and this bias is complex and poorly understood.
- The paper decomposes non-response bias into four types of non-response for six types of health care utilisation and compares two modes of interview surveys for the general population linked to registers.
- Refusal is the most frequent reason for non-response, whereas illness is the most important contributor to the size of non-response bias.
- Underreporting caused by non-participation of ill people is a potential threat to validity and must always be considered in health surveys.

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