Title: Official statistics and claims data records indicate non-response and recall bias within survey-based estimates of health care utilization in the older population

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Author’s response to reviews: see over
We would like to express our gratitude to the two reviewers for their very helpful comments. To address the comments, we made changes to the original manuscript and believe that these changes add strength to the study. On the following pages, we will detail our responses to specific comments and resulting changes to the manuscript.

Response to Reviewer #1 (Guohung Li):

1. How to define “need for care” in table 1 should be described.

**Response:**
We would like to thank the reviewer for this remark. We admit that this was an imprecise wording. In line with the manuscript text, we have changed the wording to “Entitled to long-term care services”.

2. From Page 10, for comparison of baseline characteristics of KORA-Age participants and AOK Middle Franconia insurants, 2015(48.8%) were male in KORA-Age participants interviewed, and 10344(28.1%) were male in AOK insurance sample. This difference seems inconsistent with table1?

**Response:**
The reason why only 28.1% were male in the AOK insurance sample is that the data that we used for our analyses was based on a matched pair design for dementia (cf. Schwarzkopf et al., reference #22). For the purpose of our study, we had “recreated” the original, i.e. “true” dementia prevalence in each 5-year age and sex group by randomly deleting all “supernumerous” dementia patients (cf. subsection “Comparative data” on pages 5-6). However, as dementia is more common in women and older ages, this implied that we had to delete more male and young individuals. This explains why in total, only 28.1% were male in the insurance sample. However, as all our analyses were sex- and age-standardized, this has no influence on our overall estimates. The numbers in Table 1, in contrast, refer to the entire population in the district of Middle Franconia, from which the AOK insurance sample was drawn.
Response to Reviewer #2 (Falk Hoffmann):

Major compulsory revisions:
-On page 6, the third methodological difference is that data sources cover different reference population. The authors emphasize nationality and private insurance. However, as mentioned in the discussion section (page 14), the AOK insures a very “special” population. These persons have a lower socioeconomic status and a higher morbidity (which might lead to higher health services use). This has also been shown in different surveys:


As a consequence, I would suggest to conduct a sensitivity analysis, in which only persons insured within the AOK (KORA-Age) are compared to claims data. Is membership in different statutory health insurance funds assessed in KORA-Age?

Response:
We would like to thank the reviewer for this suggestion and agree that such a sensitivity analyses can help the reader to further understand whether higher health services use may be caused by specific characteristics of the AOK insurants.

Membership in different statutory health insurance funds was not assessed in KORA-Age, but in the baseline surveys. Given that another KORA publication reported that among middle-aged and older individuals, only a small percentage has changed their sickness funds, we believe that this baseline information can well be used to conduct the above sensitivity analysis (cf. [Switching sickness funds and risk compensation mechanisms in the statutory health insurance system in Germany]. Gesundheitswesen 67, (Sonderheft 1). 158-166).

The sensitivity analyses showed that KORA-Age participants insured by AOK had a slightly higher use of health services than participants insured by other SHI funds. However, one also has to keep in mind that only one in four KORA-Age participants was insured by AOK. This can be explained by the industrial history of the study region owing to which many people are enrolled in company health insurance funds.

To integrate these new aspects in our manuscript, we have made the following amendments:

In the methods section on page 7, we have inserted the following paragraph:
“As AOK insures a higher proportion of individuals with lower socioeconomic status compared with other health insurance funds and as this may be associated with higher health service use, we conducted another
sensitivity analysis in which we only considered KORA-Age participants insured by the AOK. As the name of the health insurance fund was not assessed in the KORA-Age study, we used this information from the baseline surveys.”

In the results section on page 12, we have inserted the following paragraph:

“Sensitivity analysis for KORA-Age participants insured by AOK
From the 4,127 KORA-Age participants, 1,105 (26.8%) were insured by AOK at baseline. If utilization rates were calculated for this subgroup only, estimates were slightly higher than those for all SHI insurants (entitlement to LTCI: 6.3%; mean in-hospital days: 3.5; mean physician visits: 10.9; mean number of drugs: 2.6).

Finally, we also address this topic in the discussion section:

“Also, our sensitivity analysis showed that KORA-Age participants insured by AOK had a slightly higher use of health services than participants insured by other SHI funds. However, it must be noted, that due to the industrial history of the KORA study region, many people are enrolled in company health insurance funds. Accordingly, only about one in four KORA-Age participants was insured by AOK. As a consequence, estimates from the sensitivity analysis have more uncertainty, and this holds especially for the entitlement to LTCI, where cell counts for age and sex groups were very small. Also, it must be noted that we used the information on health insurance funds from the baseline surveys, so that some participants might have switched their sickness fund in the meantime. However, there is some evidence from a former KORA study that this does not apply to middle-aged and older age groups to any great extent [42]. Although differences between AOK and other SHI funds with regard to the prevalence of chronic diseases have been reported in the literature [43, 44], published age- and sex-specific health care utilization rates from another large German SHI were very close to those of AOK Middle Franconia [25, 26].”

Minor essential revisions:
Why were claims data of 2006 used (as 2007 would be more close to the study period of KORA-Age)?

Response:
The reason why we used 2006 data rather than the more recent 2007 data is that AOK only provided data for their individuals who were aged 65 years or older in 2006. Using the 2007 data, we would lose information on individuals aged exactly 65 years since all participants then have aged by one year. As a consequence, this would no longer fit to the age range of the KORA-Age study. Furthermore, the exclusion of 65 old individuals would bias the estimates in the youngest age group towards older individuals and thus higher utilization.

In addition, the original matching of demented and non-demented individuals was also based on the 2006 data.
To clarify this decision in the manuscript, we amended the sentence
“*It provided 2005 to 2007 claims data of its insurants aged 65 years and older living in the Bavarian district Middle Franconia*”
to
“*It provided 2005 to 2007 claims data for its insured clients living in the Bavarian district of Middle Franconia who were aged 65 years and older in 2006.***

We also added the following sentence on page 6: “**We analysed the 2006 claims data rather than the more recent 2007 data because the original matching of demented and non-demented individuals was based on the 2006 data and because using the 2007 data would result in losing claims data on individuals aged 65 years.***”

The differences in persons using services of the long-term care is interesting but not unexpected. Could this be due to an exclusion of persons living in nursing homes in the KORA-Age study? Are there any data on non-responders (which were responder in KORA S1 to S4)?

**Response:**
Persons living in nursing homes were excluded in the baseline surveys since these surveys examined the non-institutionalized adult population only. However, we think that this has no influence on the estimates in the KORA-Age study: First, institutionalization is only important in older ages. Due to the design of the baseline surveys, no KORA-Age participant was older than 74 years at baseline and less than 20% were older than 65. Secondly, it is estimated that the mean time spent in nursing homes is about three years (*cf. BMFSFJ 2006: Erster Bericht des Bundesministeriums für Familie, Senioren, Frauen und Jugend über die Situation der Heime und die Betreuung der Bewohnerinnen und Bewohner. Berlin*). Given that there were at least 8 years between baseline survey and KORA-Age study, it is likely that individuals institutionalized at baseline would have died in the meantime.

In the KORA-Age assessment, in contrast, persons living in nursing homes were not excluded. The analysis of the data showed that 27 KORA-Age participants lived in a nursing home and that data from 22 of them came from a proxy interview either with a family member or a professional care giver. In order not to exclude those needing a high level of care, participants were also offered the chance to be interviewed at home in the case that a telephone interview was not possible (this was the case for 60 interviewees).

We clarified this in the text by including the following sentence in the methods section on page 4:
“*If a telephone interview was not possible, individuals were offered the chance to be interviewed at home.***”
Also, we added the following relative clause on page 4 “**(...) of which 60 were performed at the participants’ home.***”
In the discussion section on page 13, we have included the following paragraph:

“The true proportion was underestimated, although we also arranged home visits and proxy interviews in order not to exclude those needing a high level of care, especially those living in nursing homes. In total, 27 individuals among the KORA-Age participants lived in a nursing home, and data from 22 of them came from a proxy interview with either a family member or a professional care giver.”

There was a short non-participant questionnaire, however, it was filled out by only 248 persons. Unfortunately, it contained no question on the type of residence, but it did contain the same two questions on long-term care utilization than in the telephone interview. Of these 248 individuals, 21 reported using services covered by the LTCI. Although this may indicate a slightly higher percentage of LTCI beneficiaries among non-participants, we believe that - owing to the poor response rate for the non-participant questionnaire - these results are not reliable.

Why were drugs used as a proxy for diabetes (page 9) and not diagnoses in claims data and self-reports in the survey?

Response:
We agree that using physician diagnoses in the claims data and self-reports in the survey data would be an alternative to identify individuals with diabetes. We decided to consider drug-treated diabetes only, because we think that this approach leads to a more coherent identification of patients between the two data sources:

On the one hand, the problem with self-report is that some individuals with physician-diagnosed diabetes may not report having the disease (cf. Shah and Manuel: Self-reported diabetes is associated with self-management behaviour: a cohort study. BMC Health Serv Res 2008). On the other hand, physician diagnoses may not always be complete.

We think that these problems are especially important in early disease stages or in the case that individuals had borderline blood sugar levels. In such cases, it is not clear whether or not the physician documents a diabetes diagnosis in the charts and whether or not the patients are really told that they have diabetes.

To justify our decision, we have included the following paragraph in the methods section on page 9:

“The alternative would have been to consider physician diagnoses in the claims data and self-reports in the survey data. However, we considered this approach to be more likely to be subject to bias as some people with physician-diagnosed diabetes may not report having the disease and documentation of diabetes by the physician may not always be complete [34].”
- What was the reason to show confidence intervals for comparisons on diabetes only?

**Response:**

The reason why we have not calculated confidence intervals for the overall estimates in the right columns of tables 2 and 3 is that these are sex- and age-standardized rates. Although Fay and Feuer suggested a method to calculate confidence intervals for standardized rates, their approach can lead to too narrow intervals if there is extra-Poisson variation in the age- and sex-specific count rates (cf. Fay and Feuer: Confidence Intervals for directly standardized rates: A method based on the Gamma distribution. Statistics in Medicine 1997). Furthermore, it has to be noted that comparing confidence intervals from two different standardized rates (like those for AOK and KORA-Age) is not equivalent to testing the difference between the samples (cf. Washington State Department of Health: Guidelines for using confidence intervals for public health assessment, 2004).

Furthermore, we believe that statistical significance of the difference in general is not an important issue when comparing estimated utilization rates from surveys with routine data because underestimation of cost can be a substantial problem even if - owing to large standard errors - the differences are not significant.

In contrast, we have displayed confidence intervals on diabetes because these comparisons were made within the samples and not between them. We have calculated these estimates by fitting linear regression models adjusted by sex and age groups and holding these covariates fixed at the corresponding mean values of the Bavarian population in order to ensure comparability.

To clarify this in the manuscript, we have added the following sentence on page 10:

“The mean utilization rates were estimated using a linear model adjusting for sex and age groups and holding these covariates fixed at the corresponding mean values of the Bavarian population in 2009.”

Discretory revisions:
- No decimal place is given for the Delta in Table 3, but for Delta in Table 2.

**Response:**

Thank you. We have rounded the numbers in Table 2 to the nearest integer. Also, we have corrected some rounding errors in Tables 2 and 3.