Author's response to reviews

Title: Associations between number of sick-leave days and future all-cause and cause-specific mortality. A population-based cohort study

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Author's response to reviews: see over
Dear Mr. Vargas,

Thank you for the comprehensive comments and suggestions from the reviewers. We are pleased that the review was favorable and that you are willing to consider a revised version of the manuscript for publication in BMC Public Health. We have revised the manuscript thoroughly, based on these comments. Point by point answers to each comment and how they have been addressed are listed below in this response letter with denoted pages and lines for the revisions in the manuscript.

Yours sincerely

Emma Björkenstam, corresponding author

**Reviewer #1:**

**Major Compulsory Revisions:**

1. p.5 line 101: Should be explained here why you have a category 1-15 days, when they are not registered for employed people.

   **Reply:** Thank you for this comment, making it obvious to us that we had not been clear enough in explaining that the category of “1-15 sick-leave days” reimbursed by the Social Insurance Agency, mainly concerns sick-leave spells lasting for 15-30 days, that is, for up to a month. This is now explained more thoroughly in the methods sections and also through footnotes in each of the tables. The absolute majority of sickness absentees are employed and usually day 2-14 (after a qualifying day without benefits) of their sick-leave spells are reimbursed through so called sick pay by the employer. However, for those unemployed with unemployment allowances, sick-leave spells are reimbursed by the Social Insurance Agency already from the second day of a sick-leave spell. From the dataset used it was not possible to detect of the reimbursed sick-leave days were generated during a period of unemployment or from a period of paid work. For most employed, a sick leave spell is reimbursed form the Social Insurance Agency from the 15th day of a sick-leave spell.

   **Changes in manuscript:** Page 5, lines 105-107 and 109-113; page 18, line 424; page 19, line 428; page 20, line 438, page 21, line 449; page 22, line 459;

2. Results: The group 1-15 days of sick leave does not include employees with 1-14 days of sick leave. Therefore this group is not comparable with any of the other groups and it seems irrelevant to compare their IRR with that of the others. One cannot conclude (in Conclusions) that even relatively few sick leave days means an increased risk of mortality, without specifying that this was only documented for at least 16 days of sickness absence. For instance, in the group 1-15 days, there must be many unemployed people, which we know have an increased risk of mortality. A way to deal with this would be to include them in the reference group, as employees with 1-14 days of sick leave must be in the reference group. This would also mean that the reference group has relatively less unemployed people and students that any of the other groups? This needs to be handled.

   **Reply:** Please see our response to the above, first comment. In the revised manuscript we have made it clearer what the category 1-15 reimbursed sick-leave days include. Regarding your comment here, about that in this category unemployed people are
overrepresented, we agree, and have now extended the text about this in the limitation section of the Discussion. However, in the reference group, other groups of unemployed are overrepresented, possibly groups with higher risks for premature deaths than those unemployed who qualify for unemployment benefits (to qualify for that you need to have had employment for at least 12 months, and there is also a time limit for how long you can get unemployment benefits). In the reference group, all unemployed without unemployment benefits are included, including immigrants – to large degree refugees with different types of morbidity. This is one reason for why we find it very important to adjust for birth country.

**Changes in manuscript:** We have now included more text on this in the discussion section, regarding limitations, lines 279-287.

3. p. 10: The discussion about whether only a few causes of sick leave are due to diseases that may be mortal is relevant. It is not entirely clear whether the authors expected to find no association between sick leave and mortality, but such an explanation would in my opinion be wrong. The question is whether there is a higher risk than one could expect from sick leave due to mortal diseases, even after a two-year wash-out period. This is not possible to determine from these analyses, which should be clearly stated. Of course, it still may be argued that the relative risks indicate a higher mortality than expected.

**Reply:** Based on the few previous studies on this topic, we expected to find an association between sick leave and mortality. We agree that it is hard to determine whether there is a higher risk than one could expect from sick leave due to mortal diseases as we only have inpatient data as a morbidity measure and therefore only could adjust for those. We describe this as a limitation in the manuscript. Nevertheless, we find it important to conduct a more comprehensive study to find out if the results from the few previous studies, based on smaller and highly selected groups and often shorter follow ups, would occur also in a larger and nationwide cohort. Our findings, that they do, mean that more detailed studies about this are warranted.

**Changes in manuscript:** The importance if this is now pointed out more in the discussion section, lines 270-

**Minor essential revisions:**

4. p. 5 line 110: Median number of inpatient care must be for those who were hospitalized, not for the entire cohort?

**Reply:** Thank you for pointing this out. Inpatient care medians were only calculated for those with inpatient care. This has been included in the revised manuscript.

**Changes in manuscript:** Page 6, lines 116-117.

5. A two-year wash-out period is somewhat arbitrary. It may take longer to die from any of the 3 specific causes used here. This should be discussed.

**Reply:** We introduced the wash-out period in order to exclude deaths occurring during the sickness absence in 1995. That is, some sickness absence is due to a disease or injury that very soon might lead death, e.g., some MIs, strokes, cancers or severe suicide attempts. From that point of view, a one-year wash out period might have been the best. In prospective studies of sickness absence, using either disability pension or mortality as outcome, different wash-out periods have been used, not seldom two years. However, there is no consensus on this, and, based on the current level of research here, cannot be. Future studies might investigate the differences in outcome,
using different washout periods for the same dataset.

Changes in manuscript: We changed the writing about this in the background, line 74-75, and included a sentence about this in the discussion section, line 292-295.

Discretionary revisions:

6. p. 13: It is stated that "Hence, part of the increased risks may have been attributed to other types of impaired health among sick-listed people, and not only to the sick leave itself." It is difficult to imagine how sick leave itself should increase the risk without suggesting any mechanism. In my view sick leave can only be a marker of other causes of mortality, but these may well be attributed to factors that are not impaired health per se, which seems to be an important point.

Reply: We agree, and have omitted this writing. The literature about possible negative and positive consequences of being sickness absent includes several such types of consequences – however, this was already pointed out in the background section, and there is no need to repeat that here.

Changes in manuscript: Page 13, line 274-275.