Author's response to reviews

Title: Main income sources and activities in people with self-reported hearing difficulties; a cross-sectional population-based study in Sweden

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Author's response to reviews: see over
To the Editor of BMC Public Health

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Regarding manuscript # 1417354419736195

Dear Editor,

Thank you for considering publication of our manuscript # 1417354419736195 (“Self-reported hearing difficulties, main income sources, and socio-economic status; a cross-sectional population-based study in Sweden”) in BMC Public Health. We also thank the reviewers for their valuable comments, which all have been considered in the revised manuscript. Below is a point-by-point response to the concerns of the reviewers.

Reviewer 1’s report
This is an interesting paper which adds value to the field. Thank you for the opportunity to review.

Major Compulsory Revisions:
1) The title would be improved by substituting something like "socio-economic status" for "activities". SES is the second major variable in the paper and it would assist researchers performing title searches. The term "activities" also seems to indicate something quite different (e.g., leisure activities, hobbies, lifestyle factors) than what the study variable contains.

   Our answer: We have changed the title accordingly to "Self-reported hearing difficulties, main income sources, and socio-economic status; a cross-sectional population-based study in Sweden". The expression “main income source/activity” has been altered to “main income source” throughout the text of the revised manuscript.

2) Please indicate the minimum amount of work needed for an individual to be assigned to category A (work).

   Our answer: This is not possible since category A (work) is based on income rather than on time worked. The LISA database of Statistics Sweden has no
information on time worked, only on income from that work. We have changed the text slightly in order to clarify this.

3) In the Methods and Materials section, it isn't clear to the reader why Social Insurance and Financial Aid are relevant until after reading the Factors Included in the Analysis section. One sentence, perhaps after the first sentence in the Materials and Methods section, would help the reader make the connection.

**Our answer:** In order to clarify, the following sentence has now been added at the end of the Study Population and Data section: “As further described in *Factors Included in the Analyses*, each included subject was assigned to one of several main income source categories based on his/her main income source in terms of gross income and number of days of gross income during the year of participation in ULF/SILC”.

4) The models are first mentioned in the text in the Results section. Please introduce what these models are in the Materials and Methods section.

**Our answer:** We have clarified the text regarding this in the Statistical Analyses and the Factors Included in the Analyses sections. In the Statistical Analyses section, we now state that “Different types of associations were calculated with either having hearing difficulties or having sickness benefits or disability pension as outcome measure”. We also state that “The associations between independent variables and outcome measure were calculated with binary logistic regression analysis” and “The results are presented as crude and multivariate odds ratios (ORs) with 95% confidence intervals (CIs).” Furthermore, “Most analyses were stratified by gender due to the large gender differences in rates of hearing difficulties (2011; Hogan et al., 2009; Rosenhall et al., 1999), sick leave (Alexanderson and Norlund, 2004; Eriksson et al., 2008; Karlsson et al., 2008; Statistics Sweden, 2010), and unemployment (Statistics Sweden, 2010)”.

5) Please clarify the last sentence in the third paragraph of the Discussion. What are the societal consequences of hearing impairment to which you refer? The term “discredited” has a very different meaning than what I assume the authors intend. Please use “disadvantaged” or something similar.

**Our answer:** The text in this paragraph has been changed to make our message clearer.

*Minor Essential Revisions:*

1) In the Introduction, the acronym ULF/SILC is not fully spelled out for readers.

**Our answer:** The acronym ULF/SILC is now explained in the Study Population and Data section under Materials and Methods.
2) The second sentence in the Study Population and Data section needs to be shortened or broken up into two sentences for clarity (difficult to read). A "were" is also missing before "not on early old-age...."

   **Our answer:** We agree and have changed the text accordingly.

3) An "s" is needed at the end of the first sentence under Statistical analyses.

   **Our answer:** Done!

4) The word "analyses" in the title Statistical Analyses should be capitalized.

   **Our answer:** Done!

5) The "were" in the second sentence under Self-Reported Hearing Difficulties as Outcome should be "was".

   **Our answer:** Done!

6) The last paragraph in the Sickness Benefits/Disability > 6 Months as Outcome section, 1st sentence: Please begin with "Full factorial..." and the "is" should be an "are".

   **Our answer:** Done!

7) Please change instances of "without or with" to "with or without".

   **Our answer:** Done!

8) Please substitute “normal-hearing counterparts” or some other term for “normal-hearing likes” in the first and second paragraphs in the Discussion section and Conclusion.

   **Our answer:** Done!

9) The semi-colon in the last sentence of the Discussion section should be a period.

   **Our answer:** Done!

10) Table 1 has a typo. Under Men, All, % within variable: variable is misspelled

    **Our answer:** We corrected this mistake.

*Discretionary Revisions*

1) Can Figure 2 be simplified somehow? It is not easily absorbed.
Our answer: Figure 2 has now been simplified so far as to the variable names, which are described under point 2 below. We are aware of that many aspects are included in the figure, however, please consider this figure as one of the major contributions of this manuscript, in that it illustrates many different aspects.

2) The names for each variable are very long, and at times it is distracting from the main points. Please consider identifying what they mean once, and then substituting something shorter (e.g., disability, unemployment, etc.).

Our answer: We agree that some of the variable names were unnecessary long. Therefore, we have shortened several of them, namely “main income sources/activities”, “parental benefits > 6 months”, “unemployment benefits > 6 months”, “sickness benefits > 6 months”, and “disability pension > 6 months” to “main income sources”, “parental benefits”, “unemployment benefits”, “sickness benefits”, and “disability pension”, respectively.

Reviewer 2’s report

General comments
The aim of the present study was to investigate the main income sources/activities in subjects with and without self-reported hearing difficulties, and associations with different socio-demographic factors. In view of the high prevalence of hearing problems, the research question posed is important. Although the number of similar studies on hearing problems may be limited, a few similar studies were mentioned by the authors confirming a relation between work status and hearing problems. So, the study is not entirely original and I think there are several cross-sectional studies linking work status and self-rated health problems in general. The study provides little new knowledge on the reasons for such an association with the limitations of using self-reported measure of hearing loss.

Our answer: Our aim was not to analyze the reasons for associations between self-reported hearing difficulties and different types of sources of income. That would require another study design and other type of data. Rather, we aimed at studying actual sources of income among people with and without self-reported hearing difficulties, using the large population-based Swedish survey of such data and linking to register data from Statistics Sweden, a design that allowed us to conduct more detailed studies of different types of income sources and to adjust for more confounders than in other studies.

The study credits however on studying the effects of socio-economic status (in terms of occupation), type of living area and country of birth and for being based on a large population based sample. The data from the Swedish Social Insurance Agency on sick-leave and disability pension contains information on diagnosis and data on diagnosis was previously published by some of the present authors (Friberg et al. 2012). I therefore wonder why not diagnosis was used in the present study. Controlling for diagnosis could reveal if the associations emanated from hearing loss as a diagnosis or not.
Our answer: Reviewer 2 is right in that there are many different aspects and associations that can be studied regarding people with hearing problems, using different types of data sets. This study is based on two datasets from Statistics Sweden, namely the self-reported survey data from ULF/SILC and the register data from the LISA database, mainly holding socio-economic information, two datasets that we could link at an individual bases for this study. Unfortunately, there is no information about the medical diagnoses legitimating sickness absence or disability pension in the LISA database. The study of Friberg et al that you refer to was using data from the National Social Insurance Agency, not included here. Moreover, in this study the aim was to gain knowledge on the type of income sources people with self-reported hearing difficulties had. The aim was not to study the panorama of specific morbidity they had, or what specific type of morbidity that legitimated their possible sick leave or disability pension. That could be a good suggestion for another study. It is important to remember that data on sick leave or disability pension due to a specific diagnosis is not the same as morbidity data due to that diagnoses. Many people with hearing difficulties or any other disease are not sickness absent or disability pensioned due to that diagnoses.

While reasons for why hearing problems may affect the work status are thoroughly discussed, possible reverse causality should also be considered. Becoming unemployed is associated with psychological stress leading to a decrease in perceived health (Thomas et al. 2005). The same could be said for sick leave and disability pension. It may be that reduced functional ability or poor general health decreases the ability to cope with hearing loss and thus increasing the self-reported prevalence.

Our answer: Such aspects are now mentioned in the discussion section. However, this is a cross-sectional study, i.e. not a study of causality. We have no information about whether the hearing difficulties occurred before or after specific types of sources of income, e.g. unemployment benefit or disability pension.

Also, the possibility of confounding by unknown third factors should be stressed as the sizes of the associations are small (OR of 1.2-1.7).

Our answer: We agree and have, in the Discussion section, included a sentence about this as a limitation of the study.

A main limitation of the study is the lack of an objective measure of the hearing status. Self-rated hearing problems may be related to factors such as general health (Chang et al., 2009), psychosomatic status (Hashimoto et al., 2004) and other factors independent of the actual hearing loss. It may be also that error in self-report is related to labor market status (Baker et al. 2004). That is, individuals may use their health status as justifying for not working.
Our answer: We agree and have even more emphasized these aspects now. A discussion about self-reported and clinically assessed hearing difficulties, their correlations and some pros and cons has now been added in the Introduction section. Since this is a cross-sectional study, we can only speculate about the causalities of the associations found in the study, which we do in the Discussion section, including that some people’s reports may be designed to justify their absence from the labor market.

In the conclusion it is stated that the associations with unemployment, long-term sickness absence, and disability pension were stronger among women than men. It should however be noted that the confidence intervals were overlapping and thus this difference was not statistically significant.

Our answer: Some of the confidence intervals in question are indeed overlapping. Therefore, we have altered one sentence in Conclusions. The formulation in the revised manuscript is: “Hearing difficulties were more prevalent among men, but a significant association with unemployment was found only among women, and the associations with long-term sickness absence and disability pension tended to be stronger in women.” (The previous formulation was: "Hearing difficulties were more prevalent among men, but the associations with unemployment, long-term sickness absence, and disability pension were stronger among women with hearing difficulties.”) The text in the Abstract section has also been changed accordingly.

The sex difference was explained by that “the hearing disability affects skills traditionally associated with women”, and that “the societal consequences of hearing impairment are more pronounced in women since they are already discredited because of some other characteristics, such as lower social status and self-image”. An additional possibility is that some of the difference may be due to measurement error in self-reported hearing: It is plausible that the probability of false reporting decreases with the intensity of the condition and the amount of false reporting would thus be lower among men in which the prevalence and amount of hearing loss is largest.

Our answer: We agree that there are many possible explanations for the findings and have now elaborated more on this in the Introduction and Discussion sections. As pointed out in the Introduction section, a person that has self-reported hearing difficulties may have significant threshold elevations as measured with pure tone audiometry (PTA). However, it is also common to have self-reported hearing difficulties with normal PTA results (e.g. (Hashimoto et al., 2004)) and according to us this does not mean that the self-report is false. Hearing is complex and so is the interpretation of self-reported health measures, but PTA is a rather crude measure that can hardly cover all aspects of hearing. We find that discussing gender differences in measurement error in self-reported health is mostly beyond the scope of this paper, but we have now commented on this in the Discussion section.
The data and the analysis seem solid. The paper is well written with data appropriately presented in tables. The methods seem appropriate and well described.

**Our answer:** We thank Reviewer 2 for these nice comments!

I found the analyses with sickness benefits/disability pension (tables 5 and 6) and with attachment to the labour marked (tables 7 and 8) as dependant variables superfluous. This is a cross-sectional study and I cannot see that the interpretation is gained by swapping hearing loss from being a dependant to an independent variable.

**Our answer:** We have followed your suggestion regarding Tables 7 and 8, and removed them. However, we do find it important to include results stratified for women and men, due to the often found gender differences regarding the studied aspects, and therefore want to keep Tables 5 and 6. For example, Tables 5 and 6 indicate that the associations of having sickness benefits/disability pension with age differ between men and in women, which motivates gender stratification, as discussed in the Statistical Analyses section. Also, Reviewer 1 has not made any comments about finding them superfluous.

The limitations of self-reported measure of hearing should be stressed. The reliability of the single item measure used should be referenced, and if possible also its validity (or lack of) related to clinically assessed hearing loss or audiometry. Maybe it is possible to control for other possible spurious factors such as general health as mentioned earlier. Controlling for diagnosis as mentioned earlier would also strengthen the study.

**Our answer:** A discussion about self-reported and clinically assessed hearing difficulties, their correlations and some pros and cons has now been included in the Introduction section and in the methodological considerations of the Discussion section. As mentioned above, there were no data on diagnoses in the databases used for this study. Moreover, how to control for e.g. sick-leave diagnoses, considering the aim of this study, could be discussed.

I recommend revisions according to the following suggestions:

*Major Compulsory Revisions:*

**Introduction:**
1) Please give references to previous works studying the association between SES or occupation and hearing loss.

**Our answer:** Accordingly, references have been added in the Introduction section. Moreover, most of the information regarding this which was in the Discussion section can now be found in the Introduction section.

2) First paragraph: The increase in prevalence of self-reported hearing loss found in the ULF/SILC is in conflict with studies from USA (Hoffman et al. 2010) and Australia (Zhan et al. 2010) indicating improved hearing, measured by audiometry,
in the present adult generation compared to the past. Please, expand the reflections on possible changes.

**Our answer:** Improved hearing in the adult population has indeed been found in some studies (Hoffman et al., 2010; Zhan et al., 2010; Zheng et al., 2011), whereas other studies contradict these results (2011; US Department of Health and Human Services, 1994). A discussion about these results and possible causes has now been included in the Introduction section.

Method:
3) The reliability of the single item measure used should be referenced, and if possible also its validity (or lack of) related to clinically assessed hearing loss or audiometry.

**Our answer:** A discussion about self-reported and clinically assessed hearing difficulties, their correlations and some pros and cons has now been included in the Introduction section and in the methodological considerations of the Discussion section.

4) Please make additional analysis controlling for diagnosis (if available).

**Our answer:** As pointed out in our previous answers, data on this was not included in the LISA database.

Discussion:
5) Page 15. As mentioned in the general comment section I miss a discussion on possible reverse causality.

**Our answer:** As previously mentioned, this has now been included in the Discussion section of the revised manuscript.

6) Page 16. The sex difference was explained by that “the hearing disability affects skills traditionally associated with women”, and that the that “the societal consequences of hearing impairment are more pronounced in women since they are already discredited because of some other characteristics, such as lower social status and self-image”. An additional possibility is that some of the difference may be due to measurement error in self-reported hearing: It is plausible that the probability of false reporting decreases with the intensity of the condition and the amount of false reporting would thus be lower among men in which the prevalence and amount of hearing loss is largest.

**Our answer:** We agree that there are many possible explanations for the findings and have now elaborated more on this in the Introduction and Discussion sections. As pointed out in the Introduction section, a person that has self-reported hearing difficulties may have significant threshold elevations as measured with pure tone audiometry (PTA). However, it is also common to have self-reported hearing difficulties with normal PTA results (e.g. (Hashimoto et al.,
2004)) and according to us this does not mean that the self-report is false. Hearing is complex and so is the interpretation of self-reported health measures, but PTA is a rather crude measure that can hardly cover all aspects of hearing. We find that discussing gender differences in measurement error in self-reported health is mostly beyond the scope of this paper, but we have now commented on this in the Discussion section.

Strengths and Limitations:
7) As mentioned in the general comment section I miss a discussion on possible confounding by unknown third factors and the possibility that measurement error in self-report is related to labor market status.

**Our answer:** This has now been included in the Discussion section.

8) The limitations of self-reported measure of hearing should be stressed.

**Our answer:** This has now been included in the Discussion section.

Conclusion:
9) In the conclusion it is stated that the associations with unemployment, long-term sickness absence, and disability pension were stronger among women than men. It should however be noted that the confidence intervals were overlapping and thus this difference was not statistically significant.

**Our answer:** Some of the confidence intervals in question are indeed overlapping. Therefore, we have altered one sentence in Conclusions. The formulation in the revised manuscript is: “Hearing difficulties were more prevalent among men, but a significant association with unemployment was found only among women, and the associations with long-term sickness absence and disability pension tended to be stronger in women.” (The previous formulation was: ”Hearing difficulties were more prevalent among men, but the associations with unemployment, long-term sickness absence, and disability pension were stronger among women with hearing difficulties.”) The text in the Abstract section has also been changed accordingly.

**Minor Essential Revisions**
10) Page 16, first paragraph last sentence: Is it really possible to suggest that hearing difficulties are on rise, the age distribution of these two data sets seems different. It seems that Rosenhall et al. 1999 incorporates 16-20 years olds.

**Our answer:** Rosenhall and co-workers also present their data stratified by age and gender (figure 2 (Rosenhall et al., 1999)). When comparing their figure 2 with our table 1 it can be concluded that the prevalence of self-reported hearing difficulties has increased in men and women in all comparable age groups (25-34, 35-44, 45-54, and 55-64 years). To clarify this, the sentence in question has now been altered to: “In a previous Swedish study of men and women, the age-specific
prevalence of self-reported hearing difficulties was lower than in the present investigation (Rosenhall et al., 1999), thus in agreement with the notion that hearing difficulties are on the rise.” (The formulation in the original manuscript was: “In an earlier study from Sweden, the prevalence of self-reported hearing difficulties was lower than in the present investigation (Rosenhall et al., 1999), in agreement with the notion that hearing difficulties are on the rise.”)

**Discretionary Revisions**

11) I found the analyses with sickness benefits/disability pension (tables 5 and 6) and with attachment to the labour marked (tables 7 and 8) as dependant variables superfluous. This is a cross-sectional study and I cannot see that the interpretation is gained by swapping hearing loss from being a dependant to an independent variable. I therefore suggest deleting all these four tables.

**Our answer:** We have followed your suggestion regarding Tables 7 and 8, and removed them. However, we do find it important to include results stratified for women and men, due to the often found gender differences regarding the studied aspects, and therefore want to keep Tables 5 and 6. For example, Tables 5 and 6 indicate that the associations of having sickness benefits/disability pension with age differ between men and in women, which motivates gender stratification, as discussed under Statistical Analyses. Also, Reviewer 1 has not made any comments about finding them superfluous.

Yours sincerely,

Pernilla Videhult Pierre, PhD

**References:**


Hoffman, H.J., Dobie, R.A., Ko, C.W., Themann, C.L. and Murphy, W.J. (2010) Americans hear as well or better today compared with 40 years ago: hearing


