

## PEER REVIEW HISTORY

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### ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	Socioeconomic differences in hearing among middle-aged and older adults: cross-sectional analyses using the Health Survey for England
<b>AUTHORS</b>	Scholes, Shaun; Biddulph, Jane; Davis, Adrian; Mindell, Jennifer

### VERSION 1 – REVIEW

<b>REVIEWER</b>	Pernilla Videhult Pierre Karolinska institutet, Sweden
<b>REVIEW RETURNED</b>	22-Sep-2017

<b>GENERAL COMMENTS</b>	<p>This is a well-written manuscript describing a cross-sectional study on hearing loss and hearing aid use and their respective association with SES. However, there are several major and minor concerns that the authors need to address.</p> <ol style="list-style-type: none"><li>1. The authors write that the hearing method used in their study, screening audiometry, is an objective measure of hearing loss. That is not true, although it is a much less subjective method for hearing assessment than a questionnaire. The authors must therefore change all formulations in their manuscript that state that they use an objective method for hearing assessment:<ul style="list-style-type: none"><li>- page 3, row 9. "objectively measured hearing loss".</li><li>- page 5, row 40. "Objective hearing test".</li><li>- page 13, row 23. "Objectively-measured hearing loss".</li></ul>Perhaps, they could use the word "psychoacoustic" instead?</li><li>2. Page 4, rows 13-16. Reference(s) should be added in support of the statement "...increases with the duration of exposure to work-related noise".</li><li>3. Page 4, rows 16-18. Reference(s) should be added in support of the statement "...higher among persons with cardiovascular disease factors".</li><li>4. Page 4, row 18: "(CVD)" should be added after "cardiovascular disease".</li><li>5. Page 4, rows 22-25. Reference(s) should be added in support of the statement "However, levels of hearing aid use among persons most likely to benefit are low".</li><li>6. Page 4, rows 24-25. Reference(s) should be added in support of the statement "especially among persons in the lowest SES groups."</li></ol>
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7. Page 4, row 29-30: A space is missing in "17-80years".
8. Page 4, row 36: "(HSE)" should be added after "Health Survey for England".
9. Page 5, row 3: "Health Survey for England (HSE)" should be altered to "HSE".
10. Page 5, row 3-8: Are all ages eligible in the HSE? This information should be added in the sentence starting with "The HSE is an annual...".
11. The authors write that hearing loss was defined as a hearing level of  $\geq 35$ dBHL, but in the manuscript, the limit is actually  $>35$ dBHL, since they write on page 6, row 22-31: "Hearing loss was subdivided into two mutually exclusive categories: (1) 'moderate loss' :  $>35$ dBHL to 54dBHL (tone not heard at 35dBHL, but heard at 55dBHL and at 75dBHL), and (2) 'moderately severe or severe loss' :  $>55$ dBHL (tone not heard at 35dBHL and at 55dBHL, but the tone may, or may not, have been heard at 75dBHL)." Therefore, all instances where they state that hearing loss was defined as  $\geq 35$ dBHL should be changed to  $>35$ dBHL. These are:
- page 3, row 18
  - page 6, row 20.
  - page 9, row 26.
  - page 31, row 2.
  - Table 1, footnote.
  - Supplementary Table 2, footnote.
12. Page 7, row 10: "cardiovascular disease" should be changed to "CVD".
13. Page 8, rows 31-33: It should be specified if age was used as a continuous or categorical variable in models A and B. If used as a categorical variable, I would like to know why.
14. Page 9, rows 5-10. The formulation "...were more likely to be in the lowest income tertile ( $P=0.002$ ), had no formal educational qualifications ( $P<0.001$ ), resided in the most deprived IMD quintile ( $P<0.001$ ), and currently smoked cigarettes ( $P=0.011$ )" should be altered to "...were more likely to be in the lowest income tertile ( $P=0.002$ ), to have no formal educational qualifications ( $P<0.001$ ), to reside in the most deprived IMD quintile ( $P<0.001$ ), and to be current smokers ( $P=0.011$ )".
15. Page 9, rows 28-33: p-values should be added to the sentence starting with "The prevalence of 'moderate' loss".
16. Page 9, rows 35-37: p-values should be added to the sentence starting with "Only among men in the oldest age-group...".
17. Page 10, row 31: The authors write "Lower proportions had tried hearing aids in the past, but not currently". Do the authors mean that they were not current users of hearing aids?
18. Page 10, rows 33-38. P-values should be added to the sentence starting with "Current use for persons with...".

19. Page 10, rows 45-50. P-values should be added to the sentence starting with "Differences in hearing aid utilisation...".

20. Page 10, row 50. The sentence "Lower use among participants reporting doctor-diagnosed diabetes was also noteworthy." should be removed since the difference was not statistically significant.

21. Page 11, rows 7-8. "yet typically more weakly" should be altered to something like "but did not reach statistical significance".

22. Page 11, rows 24-29. The authors write: "The burden of hearing loss fell highest among persons in the lowest SES groups, especially among men, suggesting hearing loss as a source of socioeconomic inequalities in health." This sentence needs to be revised as the authors show in the results section that SES and hearing loss are not associated among women.

23. Page 12, row 10. Reference #8 is given twice after "for men than women".

24. Page 12, row 26. A space is missing in "69years".

25. Page 12, rows 51-55. The authors write "It remains unclear whether hearing loss is a driver of low SES or whether low SES is a driver of hearing loss" and refers to a study of Emmett SD and Francis HW (Otol Neurotol 2015). There are two main problems with the authors' statement. First, the study by Emmett and Francis is cross-sectional, a study design that is unable to answer the question of direction. Second, I know there are longitudinal studies suggesting that hearing loss is a driver of low SES (e.g., people with hearing loss have been shown to be prone to educational difficulties), as well as longitudinal studies showing that low SES is a driver of hearing loss. The authors should search the literature for these two kinds of longitudinal studies and elaborate their discussion on causes and consequences of hearing loss.

26. Page 12, row 57, and page 13 row 3. The authors write that greater atrophy of the stria vascularis is a potential biologic mechanism for this association, and refer to several papers. I have not read the papers, but based on their titles, I doubt that they are on biologic mechanisms. The authors must refer to papers describing studies on biologic mechanism.

27. Page 13, rows 10-12. The authors write: "Low take-up and use are typically attributed to a perception of hearing loss being an inconsequential part of ageing" and refers to a paper of Chien and Lin (Arch Intern Med 2012). Chien and Lin's study does not deal with attitudes towards use of hearing aids. However, in their comment, Chien and Lin suggest that low use of hearing aids is a consequence of ageing. The authors should remove this reference and instead include studies on attitudes towards hearing aid use.

28. Page 13, rows 28-30. The sentence "Other analyses of HSE 2014 showed that socioeconomic inequalities in hearing were most apparent using objective but not self-report data" should be reformulated so that it fits with the fact that screening audiometry is not an objective method.

	<p>29. Page 14, rows 7-12. The authors write: "Lastly, since we utilised cross-sectional data, we could not establish the direction of the observed associations, and we cannot establish causality". Do the authors mean different things with direction and causality? If yes, this should be clarified. If no, the sentence should be revised.</p> <p>30. Page 14, rows 19-23. The authors write: "Whilst the burden of hearing loss falls highest among persons in the lowest SES groups, use of hearing aids is demonstrably lower". It should be specified that this association was only found in men.</p> <p>31. Table 1, footnote, Table 2, footnote, Supplementary Table 1, Supplementary Table 2, and Supplementary Table 3. The authors write that p-values are for comparison across groups with respect to hearing loss. Do they mean across all groups, across the different characteristics subgroups or what? This must be specified. It should also be specified, either here or in the statistics section, whether any adjustment for multiple comparison was performed.</p> <p>32. Page 17, row 57. There is a typo after "HearCheck".</p> <p>33. Page 20, row 15 (figure 1). "yrs" should be added after "≥45".</p> <p>34. Page 20, row 15 (figure 1). "N=4759" should be "N=4746" since 8077-3331=4746.</p> <p>35. Page 20, row 15 (figure 1). It is not clear to me what the authors mean when they write "≥45 asked questions on hearing aid use". Does it mean that all of these were asked whether they used a hearing aid?</p> <p>36. Page 20, row 21 (figure 1). "yrs" should be added after "≥45".</p> <p>37. Page 20, row 27 (figure 1). "yrs" should be added after "≥45".</p> <p>38. Page 21, figure 2. The red and blue colours in the figure are not very clear and will be impossible to distinguish if printing in gray scale. Therefore, the authors should use patterns instead of colours.</p> <p>39. Page 21, row 31. "(SES)" should be added after "socioeconomic status".</p> <p>40. Page 22, figure 3. The red and blue colours in the figure are not very clear and will be impossible to distinguish if printing in gray scale. Therefore, the authors should use patterns instead of colours.</p> <p>41. Page 22, row 31. "socioeconomic status" should be altered to "SES".</p> <p>42. Page 28, Supplementary Table 1. Information on missing should be given for each column category.</p>
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<b>REVIEWER</b>	Adele Goman Johns Hopkins University, USA
<b>REVIEW RETURNED</b>	06-Oct-2017

<b>GENERAL COMMENTS</b>	<p>This paper utilized data from the Health Survey for England to examine socioeconomic differences in hearing. The paper is clearly written and addresses an interesting question.</p> <p>The authors acknowledge the limitations of the available hearing data and provide a justification for why they defined hearing loss the way they did. However, the reference cited for this justification highlights a PTA (over 0.5, 1, 2, and 4 kHz) <math>\geq 35</math>dB as the level that is "definitely beneficial". As such I am curious why the authors chose to focus on results for 3kHz and not a combination of 1kHz and 3 kHz (which were the thresholds available). Could the authors elaborate on this choice?</p> <p>Throughout the manuscript there is reference to "broader categories" e.g. Page 6 line 53. It would be helpful to the reader to have these "broader" categories defined.</p> <p>Page 4, Line 25: A reference is needed for hearing aid use being especially low among persons in lowest SES groups.</p> <p>Page 14, line 15: The authors state that "more than one in five women" yet Table 1 indicates 19.6% have hearing loss so the "more than" can be dropped.</p> <p>Reference 18: Please include a URL for this reference</p> <p>Reference 19: Please include a URL for this reference</p>
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### VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

This is a well-written manuscript describing a cross-sectional study on hearing loss and hearing aid use and their respective association with SES. However, there are several major and minor concerns that the authors need to address.

1. The authors write that the hearing method used in their study, screening audiometry, is an objective measure of hearing loss. That is not true, although it is a much less subjective method for hearing assessment than a questionnaire. The authors must therefore change all formulations in their manuscript that state that they use an objective method for hearing assessment:

- page 3, row 9. "objectively measured hearing loss".
  - page 5, row 40. "Objective hearing test".
  - page 13, row 23. "Objectively-measured hearing loss".
- Perhaps, they could use the word "psychoacoustic" instead?

Response: Thank you for raising this point. In the revised manuscript we have removed the word 'objective' in all instances. We now state that hearing test data was obtained from a screening audiometry device.

2. Page 4, rows 13-16. Reference(s) should be added in support of the statement "...increases with the duration of exposure to work-related noise".

Response: We have added the reference for Hoffman et al (2016).

3. Page 4, rows 16-18. Reference(s) should be added in support of the statement "...higher among persons with cardiovascular disease factors".

Response: We have added the following references: Agrawal et al (2008); Agrawal (2009); Hoffman et al (2016); Rigtters et al (2016); Kim et al (2016).

4. Page 4, row 18: "(CVD)" should be added after "cardiovascular disease".

Response: We have done this.

5. Page 4, rows 22-25. Reference(s) should be added in support of the statement "However, levels of hearing aid use among persons most likely to benefit are low".

Response: We have added the following references: Popelka et al (1998); Chien and Lin (2012); Harley et al (2010); and Scholes and Mindell (2015).

6. Page 4, rows 24-25. Reference(s) should be added in support of the statement "especially among persons in the lowest SES groups."

Response: We have added the following references: Popelka et al (1998); Nieman et al (2016); Helvik et al (2016); and Mamo et al (2016).

7. Page 4, row 29-30: A space is missing in "17-80years".

Response: We have inserted a space.

8. Page 4, row 36: "(HSE)" should be added after "Health Survey for England".

Response: We have added (HSE).

9. Page 5, row 3: "Health Survey for England (HSE)" should be altered to "HSE".

Response: We have done this.

10. Page 5, row 3-8: Are all ages eligible in the HSE? This information should be added in the sentence starting with "The HSE is an annual...".

Response: The revised manuscript states that "The HSE is an annual, nationally-representative cross-sectional survey of the non-institutionalised general population of all ages. A maximum of two children per household contributed to the 2014 survey. In households with more than two children, two were randomly selected using the Kish grid method."

11. The authors write that hearing loss was defined as a hearing level of  $\geq 35$ dBHL, but in the manuscript, the limit is actually  $>35$ dBHL, since they write on page 6, row 22-31: "Hearing loss was subdivided into two mutually exclusive categories: (1) 'moderate loss' :  $>35$ dBHL to 54dBHL (tone not heard at 35dBHL, but heard at 55dBHL and at 75dBHL), and (2) 'moderately severe or severe loss' :

>55dBHL (tone not heard at 35dBHL and at 55dBHL, but the tone may, or may not, have been heard at 75dBHL)." Therefore, all instances where they state that hearing loss was defined as  $\geq 35$ dBHL should be changed to >35dBHL. These are:

- page 3, row 18
- page 6, row 20.
- page 9, row 26.
- page 31, row 2.
- Table 1, footnote.
- Supplementary Table 2, footnote.

Response: Thank for you raising this important point. Yes, the reviewer is correct. We have changed the text in all instances to >35dBHL.

12. Page 7, row 10: "cardiovascular disease" should be changed to "CVD".

Response: We have changed the text to CVD.

13. Page 8, rows 31-33: It should be specified if age was used as a continuous or categorical variable in models A and B. If used as a categorical variable, I would like to know why.

Response: We have inserted a new sentence which states that to maximise statistical power age was used in the models as a continuous variable.

14. Page 9, rows 5-10. The formulation "...were more likely to be in the lowest income tertile ( $P=0.002$ ), had no formal educational qualifications ( $P<0.001$ ), resided in the most deprived IMD quintile ( $P<0.001$ ), and currently smoked cigarettes ( $P=0.011$ )" should be altered to "...were more likely to be in the lowest income tertile ( $P=0.002$ ), to have no formal educational qualifications ( $P<0.001$ ), to reside in the most deprived IMD quintile ( $P<0.001$ ), and to be current smokers ( $P=0.011$ )".

Response: We have amended the text as suggested.

15. Page 9, rows 28-33: p-values should be added to the sentence starting with "The prevalence of 'moderate' loss".

Response: In the text we state that the prevalence of 'moderate' loss (15% men, 12% women) exceeded that of 'moderately severe or severe' loss (11% and 7%). We did not use a statistical test to test the equality of these two proportions. We have retained the sentence in the manuscript simply as a descriptive statement.

16. Page 9, rows 35-37: p-values should be added to the sentence starting with "Only among men in the oldest age-group...".

Response: Please see our response to Point 15.

17. Page 10, row 31: The authors write "Lower proportions had tried hearing aids in the past, but not currently". Do the authors mean that they were not current users of hearing aids?

Response: Yes this is correct. We defined current hearing aid use as those who answered positively to the question about use of a hearing aid nowadays. Participants classed as not currently using a hearing aid consisted of those: (1) who had tried hearing aids in the past, but did not use a hearing aid nowadays, and (2) those who had never tried a hearing aid.

We have added new text to clarify our definition as follows:

“Current hearing aid use, for the purposes of the present study, consisted of those participants who answered positively to the question about use of a hearing aid nowadays. Participants classed as not currently using a hearing aid consisted of those who had tried hearing aids in the past but did not use a hearing aid nowadays, and those who had never tried a hearing aid.”

We have added new text to clarify our results as follows:

“Among participants with hearing loss, 30% of men and 27% of women wore hearing aids nowadays (n=264/769; Table 2). Lower proportions had tried hearing aids in the past, but did not use a hearing aid nowadays (7% men, 10% women); higher proportions had never tried a hearing aid (63% men, 64% women) (data not shown)”.

18. Page 10, rows 33-38. P-values should be added to the sentence starting with “Current use for persons with...”.

Response: We have added the relevant p-values as suggested. The text is as follows:

“Current use of a hearing aid for persons with ‘moderately severe or severe’ loss (53% men, 47% women) exceeded that for persons with ‘moderate’ loss (18% men, 19% women) (p<0.001 men; p=0.004 women).”

19. Page 10, rows 45-50. P-values should be added to the sentence starting with “Differences in hearing aid utilisation...”.

Response: We have revised the text as follows:

“Differences in current hearing aid use by population subgroups were typically minor (p>0.05), with the exception of lower use of a hearing aid nowadays among women classed as physically inactive (p=0.003).”

20. Page 10, row 50. The sentence “Lower use among participants reporting doctor-diagnosed diabetes was also noteworthy.” should be removed since the difference was not statistically significant.

Response: As we mentioned in the Discussion: “the relatively small number of participants with hearing loss may have resulted in our analyses of hearing aid use to be underpowered to detect differences among subgroups”. We have amended the text by describing the findings in terms of marginal statistical significance. The revised text is as follows:

“Lower use among participants reporting doctor-diagnosed diabetes (n=143/768) was marginally statistically significant (p=0.101 men; p=0.077 women).”

21. Page 11, rows 7-8. “yet typically more weakly” should be altered to something like “but did not reach statistical significance”.



Response: We have revised the text as follows: “Among men, area deprivation (as measured by IMD) and highest educational attainment were associated with current hearing aid use in the same direction (i.e. lower levels of use in the lower SES groups) but the odds ratios did not reach statistical significance”.

22. Page 11, rows 24-29. The authors write: “The burden of hearing loss fell highest among persons in the lowest SES groups, especially among men, suggesting hearing loss as a source of socioeconomic inequalities in health.” This sentence needs to be revised as the authors show in the results section that SES and hearing loss are not associated among women.

Response: We have retained this sentence in the manuscript. The estimates in Table 1 do suggest that the burden of hearing loss falls highest among persons in the lowest SES groups. The estimates for women – especially across the IMD quintiles and categories of highest educational attainment – suggest a socially graded relationship. Although the estimates did not reach statistical significance at the 5% level the differences in the prevalence of hearing loss across these groups were marginally significant ( $P=0.077$  and  $P=0.070$ , respectively).

23. Page 12, row 10. Reference #8 is given twice after “for men than women”.

Response: Thank you. We have removed the duplicate reference.

24. Page 12, row 26. A space is missing in “69years”.

Response: We have inserted a space.

25. Page 12, rows 51-55. The authors write “It remains unclear whether hearing loss is a driver of low SES or whether low SES is a driver of hearing loss” and refers to a study of Emmett SD and Francis HW (Otol Neurotol 2015). There are two main problems with the authors’ statement. First, the study by Emmett and Francis is cross-sectional, a study design that is unable to answer the question of direction. Second, I know there are longitudinal studies suggesting that hearing loss is a driver of low SES (e.g., people with hearing loss have been shown to be prone to educational difficulties), as well as longitudinal studies showing that low SES is a driver of hearing loss. The authors should search the literature for these two kinds of longitudinal studies and elaborate their discussion on causes and consequences of hearing loss.

Response: In our original manuscript, we cited the paper by Emmett and Francis (Otol Neurotol 2015) as they discussed the SES – hearing loss association in some detail.

We have added new text in the revised manuscript which discusses the two different kinds of longitudinal studies as suggested. The revised text is as follows:

“It remains unclear the extent to which hearing loss is a driver of low SES or whether low SES is a driver of hearing loss. First, analysis in Finland (Jarvelin et al 1997) showed that hearing loss early in life – with its detrimental impact on educational attainment in adolescence – can be a driver of low SES in young adulthood through fewer opportunities for entering into higher education and through more frequent spells of unemployment. Secondly, longitudinal studies have suggested low SES to be a key driver of hearing loss in middle-to-older age through factors such as working in jobs with a greater potential for exposure to damaging levels of noise. For example, analysis of the Beaver Dam Eye Study showed that the development of incident hearing loss was more likely among participants with lower levels of educational attainment and among those who worked in industrial occupations versus management and professional positions (Cruickshanks et al 2003; Cruickshanks et al 2010).”

26. Page 12, row 57, and page 13 row 3. The authors write that greater atrophy of the stria vascularis is a potential biologic mechanism for this association, and refer to several papers. I have not read the papers, but based on their titles, I doubt that they are on biologic mechanisms. The authors must refer to papers describing studies on biologic mechanism.

Response: Thank you for raising this point. The term “biologic mechanism” was used in the study by Kim et al (2017, p.722): who state that “several biologic mechanisms may explain the association between diabetes mellitus and hearing loss”. Using similar wording to Kim et al (2017) we have revised the text as follows:

“Explanations for the association between diabetes and hearing loss include the microvascular and neuropathic complications that affect diabetics in multiple organ systems which may also affect the inner ear”.

We have replaced the references in the original manuscript with the following two supportive references:

Friedman SA, Schulman RH and Weiss S. Hearing and diabetic neuropathy. Arch Intern Med 1975;135:573–6.

Fukushima H, Cureoglu S, Schachern PA et al. Effects of type 2 diabetes mellitus on cochlear structure in humans. Arch Otolaryngol Head Neck Surg 2006 1975;132:934–8.

27. Page 13, rows 10-12. The authors write: “Low take-up and use are typically attributed to a perception of hearing loss being an inconsequential part of ageing” and refers to a paper of Chien and Lin (Arch Intern Med 2012). Chien and Lin’s study does not deal with attitudes towards use of hearing aids. However, in their comment, Chien and Lin suggest that low use of hearing aids is a consequence of ageing. The authors should remove this reference and instead include studies on attitudes towards hearing aid use.

Response: Thank you for pointing out this typo. We have amended this sentence and have added text which briefly summarises a recent on attitudes towards hearing aid use. The revised text is as follows, based on the study by Meyer et al (2014):

“Low take-up and use are typically attributed to a perception of hearing loss being an expected consequence of ageing. Non-audiological drivers for older adults with hearing impairment consulting a health professional and/or to use hearing aids included a positive attitude to hearing aids (their own and from significant others) and self-efficacy about hearing aids (e.g. placement and battery removal)”.

28. Page 13, rows 28-30. The sentence “Other analyses of HSE 2014 showed that socioeconomic inequalities in hearing were most apparent using objective but not self-report data” should be reformulated so that it fits with the fact that screening audiometry is not an objective method.

Response: We have amended the text as follows: “Other analyses of HSE 2014 data showed that socioeconomic inequalities in hearing were most apparent using the data from the audiometric screening device but not self-report data”.

29. Page 14, rows 7-12. The authors write: "Lastly, since we utilised cross-sectional data, we could not establish the direction of the observed associations, and we cannot establish causality". Do the authors mean different things with direction and causality? If yes, this should be clarified. If no, the sentence should be revised.

Response: Thank you, we agree that this sentence was not clear. We have improved the wording of this sentence: the revised text is as follows:

"Lastly, since we utilised cross-sectional data, we were unable to assess the temporal relationship between SES and hearing, and so could not establish causality".

30. Page 14, rows 19-23. The authors write: "Whilst the burden of hearing loss falls highest among persons in the lowest SES groups, use of hearing aids is demonstrably lower". It should be specified that this association was only found in men.

Response: We have revised the text as follows: "Whilst the burden of hearing loss falls highest among persons, but especially men, in the lowest SES groups, use of hearing aids is demonstrably lower".

31. Table 1, footnote, Table 2, footnote, Supplementary Table 1, Supplementary Table 2, and Supplementary Table 3. The authors write that p-values are for comparison across groups with respect to hearing loss. Do they mean across all groups, across the different characteristics subgroups or what? This must be specified. It should also be specified, either here or in the statistics section, whether any adjustment for multiple comparison was performed.

Response: we have clarified what we mean by revising all footnotes. For example, the revised footnote in Table 1 is as follows:

"Prevalence of hearing loss (>35dBHL at 3.0 kHz in the better hearing ear) across the categories of each variable (age-group; duration of work-related noise exposure; income tertiles; Index of Multiple Deprivation quintiles; and highest educational attainment) were compared using the Chi-square ( $\chi^2$ ) tests".

In each footnote we state that no adjustment to the p-values for multiple comparisons was made.

32. Page 17, row 57. There is a typo after "HearCheck".

Response: We have deleted this.

33. Page 20, row 15 (figure 1). "yrs" should be added after " $\geq 45$ ".

Response: We have added this.

34. Page 20, row 15 (figure 1). "N=4759" should be "N=4746" since  $8077-3331=4746$ .

Response: Thank for you spotting this error. The number of HSE participants aged 16-44 was 3318 (not 3331 as originally stated): therefore the N=4759 was correct. Figure 1 has been revised to take account of all suggestions.

35. Page 20, row 15 (figure 1). It is not clear to me what the authors mean when they write " $\geq 45$  asked questions on hearing aid use". Does it mean that all of these were asked whether they used a hearing aid?

Response: Thank for you raising this point. Yes, the reviewer is correct. All participants in the main interview part of the survey were asked whether they wore a hearing aid nowadays. We have added the text below in the Methods section:

“Overall, 8077 participants aged 16+ years were interviewed, including questions on the use of hearing aids”.

36. Page 20, row 21 (figure 1). "yrs" should be added after "≥45".

Response: We have added this.

37. Page 20, row 27 (figure 1). "yrs" should be added after "≥45".

Response: We have added this.

38. Page 21, figure 2. The red and blue colours in the figure are not very clear and will be impossible to distinguish if printing in gray scale. Therefore, the authors should use patterns instead of colours.

Response: We have retained the colour scheme but now use different marker symbols (triangles for age-adjusted; circles for fully-adjusted) that would better distinguish the two sets of estimates if printing in grey scale.

39. Page 21, row 31. "(SES)" should be added after "socioeconomic status".

Response: We have revised as requested.

40. Page 22, figure 3. The red and blue colours in the figure are not very clear and will be impossible to distinguish if printing in gray scale. Therefore, the authors should use patterns instead of colours.

Response: Please see response to page 38.

41. Page 22, row 31. "socioeconomic status" should be altered to "SES".

Response: We have revised as requested.

42. Page 28, Supplementary Table 1. Information on missing should be given for each column category.

Response: We have revised Supplementary Table 1 to include the participants with missing data for each column category. The p-values are unchanged as the comparisons excluded participants with missing data.

Reviewer: 2

This paper utilized data from the Health Survey for England to examine socioeconomic differences in hearing. The paper is clearly written and addresses an interesting question.

Response: Thank you

The authors acknowledge the limitations of the available hearing data and provide a justification for why they defined hearing loss the way they did. However, the reference cited for this justification highlights a PTA (over 0.5, 1, 2, and 4 kHz)  $\geq 35$ dB as the level that is “definitely beneficial”.

As such I am curious why the authors chose to focus on results for 3kHz and not a combination of 1kHz and 3 kHz (which were the thresholds available). Could the authors elaborate on this choice?

Response: Thank you for raising this point. In the revised manuscript we have elaborated on the choice of 3 kHz. The added text is as follows:

“Hearing loss was defined as >35dBHL at 3.0 kHz in the better-hearing ear, the level at which intervention has been shown to be definitely beneficial. More specifically, a comparison of different screen programmes conducted as part of the NHS Health Technology Assessment Programme (Davis et al, 2007) showed that hearing loss of >35dBHL at 3.0 kHz was the best predictor (in terms of the d-prime statistic: a combination of good sensitivity and a low false alarm rate) for the ability of persons to gain the greatest benefit from hearing aids. The use of hearing loss of 35dBHL at 3.0 kHz had 88% sensitivity and 10% false alarm rate (Davis et al, 2007).”

Throughout the manuscript there is reference to “broader categories” e.g. Page 6 line 53. It would be helpful to the reader to have these “broader” categories defined.

Response: We have defined the broader categories in the revised manuscript. The revised text is as follows:

“The IMD 2010 quintiles were recoded into three categories: Q1 and Q2 (least deprived); Q3; and Q4 and Q5 (most deprived). Educational status was recoded into two categories: O level or equivalent and above, and no qualifications.”

“Age-at-interview was recoded into three categories: 45-64; 65-74; and 75+ years. Duration of exposure to work-related noise was dichotomised into none and at least some exposure to loud noise.”

Page 4, Line 25: A reference is needed for hearing aid use being especially low among persons in lowest SES groups.

Response: We have added the following references: Popelka et al (1998); Nieman et al (2016); Helvik et al (2016); and Mamo et al (2016).

Page 14, line 15: The authors state that “more than one in five women” yet Table 1 indicates 19.6% have hearing loss so the “more than” can be dropped.

Response: We have amended the text as requested.

Reference 18: Please include a URL for this reference

Response: We have added the URL for this reference.

<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/2015-06-25>

Reference 19: Please include a URL for this reference

Response: We have added the URL for this reference.

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/6871/1871208.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6871/1871208.pdf)

## VERSION 2 – REVIEW

<b>REVIEWER</b>	Pernilla Videhult Pierre Karolinska Institutet, Sweden
<b>REVIEW RETURNED</b>	30-Oct-2017

<b>GENERAL COMMENTS</b>	My opinion is that the authors have satisfactorily addressed all issues.
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<b>REVIEWER</b>	Adele Goman Johns Hopkins University, USA
<b>REVIEW RETURNED</b>	10-Nov-2017

<b>GENERAL COMMENTS</b>	<p>This version of the manuscript has addressed the concerns raised by the reviewers. My additional comments are:</p> <p>Page 6: The manuscript states: "...Assessment Programme showed that the combination of &gt;35dBHL at 3.0 kHz..". "the combination" should be changed to "hearing loss" as the authors indicated in their response to reviewers.</p> <p>Reference to marginal significance should be removed (Pages 10, 11, 12). "Did not reach statistical significance" would be more appropriate.</p>
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## VERSION 2 – AUTHOR RESPONSE

Reviewer: 1

My opinion is that the authors have satisfactorily addressed all issues.

Response: Thank you for taking the time to review our manuscript.

Reviewer: 2

This version of the manuscript has addressed the concerns raised by the reviewers. My additional comments are:

Page 6: The manuscript states: "...Assessment Programme showed that the combination of >35dBHL at 3.0 kHz..". "the combination" should be changed to "hearing loss" as the authors indicated in their response to reviewers.

Reference to marginal significance should be removed (Pages 10, 11, 12). "Did not reach statistical significance" would be more appropriate.

Response: Thank you for taking the time to review our manuscript.

Point 1: We have amended the sentence as suggested: in line with the wording used in the response to reviewers. Our wording is as follows:

“More specifically, a comparison of different screen programmes conducted as part of the NHS Health Technology Assessment Programme (Davis et al, 2007) showed that hearing loss of >35dBHL at 3.0 kHz was the best predictor (in terms of the d-prime statistic: a combination of good sensitivity and a low false alarm rate) for the ability of persons to gain the greatest benefit from hearing aids.”

Point 2: As suggested by the reviewer we have removed the reference to marginal significance and now explain that the findings did not reach statistical significance. For example, we now state that “the association between SES and hearing loss did not reach statistical significance”. (Page 11)

I have uploaded both a clean and a marked copy of the revised manuscript. In addition I have accepted the marked changes to the Supplementary Data File and have uploaded this as a clean copy.