

Naylor, Burke, Holman

1 **Covid-19 Lockdown Affects Hearing Disability and Handicap in Diverse Ways: A Rapid**

2 **Online Survey Study**

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4 Graham Naylor, Louise Burke, Jack Holman

5 Hearing Sciences (Scottish Section), School of Medicine, University of Nottingham,

6 Glasgow, UK.

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11 **All correspondence should be addressed to:**

12 Graham Naylor, Hearing Sciences, New Lister Building, Glasgow Royal Infirmary, 16

13 Alexandra Parade, Glasgow G31 2ER, UK. E-mail: [graham.naylor@nottingham.ac.uk](mailto:graham.naylor@nottingham.ac.uk)

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~~16 Covid-19 Lockdown Aggravates Hearing Disability and Handicap: A Rapid Online Survey~~

~~17 Study~~

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## ABSTRACT

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**Objectives:** The aim of this study was to explore the perceived effects of Covid-19 social

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distancing restrictions and safety measures on people with hearing loss.

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**Design:** Participants were 129 adults (48.1% female, mean age 64.4 years) with an

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audiometric hearing loss, living in Glasgow, Scotland. A rapidly deployed 24-item online

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questionnaire asked about the effects of certain aspects of lockdown, including face masks,

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social distancing, and video calling, on participants' behaviour, emotions, hearing

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performance, hearing device problems, and tinnitus. Data were analysed descriptively

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across the entire sample, and with Chi-squared tests for differences between subgroups

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self-reporting relatively good and relatively poor unaided hearing, respectively. Additional

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free-text responses provided further perspectives.

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**Results:** Behaviour: Video calls are used more frequently than pre-lockdown. The better

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hearing group use their hearing aids less. Emotions: There is increased anxiety (especially

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among the worse hearing group) concerning verbal communication situations and access to

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audiology services, and greater rumination about one's own hearing loss. Enjoyment of

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group video calls is mixed. The worse hearing group show substantial relief at not being

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obliged to attend challenging social gatherings. Across both groups, a majority would like to

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see all key workers equipped with transparent face masks. Hearing performance: A large

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majority find it hard to converse with people in face masks due to muffled sound and lack of

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speechreading cues, but conversing at a safe distance is not universally problematic. In the

39 worse hearing group, performance in video calls is generally inferior to face-to-face, but  
40 similar to telephone calls. Those who use live subtitling in video calls appreciate their value.  
41 TV and radio updates about Covid-19 are easy to follow for most respondents. There is only  
42 weak evidence of face mask fixtures interfering with hearing aids on the ear, and of tinnitus  
43 having worsened during lockdown.

44 **Conclusions:** With due regard for the limitations of this rapid study, we find that there are  
45 many negative – and a few positive - effects of Covid-19 restrictions and safety measures on  
46 people with hearing loss. From a societal perspective, the widespread adoption of clear face  
47 masks may alleviate some of the difficulties and anxieties this population experience. From  
48 an individual perspective, one may consider using live subtitles on video calls.  
49 Manufacturers of hearing devices should consider developing processing modes and  
50 accessories specifically designed for video calls. Finally, repair and maintenance services  
51 should be resumed as soon as it is safe to do so.

52

## 53 INTRODUCTION

54 Everyday communication and interactions have been fundamentally re-shaped by the social  
55 restrictions and safety measures which have been adopted in response to Covid-19. The  
56 term ‘lockdown’ is used to encapsulate the particularly harsh initial wave of restrictions  
57 which came into force in many countries. Although these measures are hoped to be  
58 temporary, and are subject to change and geographical variation, many elements may  
59 remain in widespread force for a substantial period. As yet, little is known about the  
60 experience of lockdown among people with hearing loss (PHL).

61 The limited literature in this area has focused on face masks as a barrier to communication;  
62 early findings from an Italian hospital suggest that hearing-impaired patients had difficulty  
63 understanding healthcare workers wearing face masks, due to muffled speech and  
64 impossibility of lip-reading (Trecca, Gelardi & Cassano, 2020), while Chodosh, Weinstein and  
65 Blustein (2020) provide an overview of the challenges PHL face from a clinical perspective as  
66 medical staff are required to wear face masks. To date at the time of writing, face masks  
67 have predominantly been worn by key workers such as medical professionals and shop  
68 assistants. However, as lockdown restrictions ease and public life is resumed, the issue is  
69 likely to become more widespread as wearing face masks is encouraged for all members of  
70 the general public (not just key workers), when social distancing is not possible, such as in  
71 shops and on public transport. As a result, everyday interactions are likely to become far  
72 more challenging.

73 Moreover, there is a wider scope of largely unexplored issues beyond face masks which PHL  
74 may face as a result of Covid-19 lockdown. For example, physical distancing measures  
75 dictate that face-to-face interactions are conducted from a greater distance than normal,  
76 possibly hindering speech understanding. Many social, professional, and healthcare  
77 interactions which would previously have occurred face-to-face are now being conducted  
78 over telephone or video calls, which are susceptible to degraded sound quality, and on  
79 video calls, audio/video mismatch and dropouts. Pre-Covid 19 research has found telephone  
80 conversation to be an issue for PHL (Vas, Akeroyd & Hall, 2017; Heffernan et al., 2016),  
81 while there seems to be a dearth of research regarding video calls. Additionally, many  
82 audiology services have been suspended or are being delivered remotely, which may lead to  
83 anxiety and reduced hearing aid use, as repairs cannot be carried out. Finally, as the

84 situation evolves rapidly, accessibility of Covid-19 information updates is very important,  
85 and PHL may struggle to follow televised and radio updates.

86 Conversely, Covid-19 lockdown may have some positive implications for PHL. A ban on large  
87 social gatherings may come as a relief to those who struggle with group conversation and  
88 speech in noise. Similarly, more interactions are currently taking place in the home with  
89 familiar conversation partners and little background noise, and fewer in noisy public places  
90 like restaurants and bars. With more favourable listening conditions and fewer listening  
91 demands becoming the 'new normal', PHL may find their hearing loss to be less bothersome  
92 in everyday life.

93 Most effects, however, are likely to be negative. The potential for aspects of the current  
94 situation to exacerbate communication difficulties, reduce social interaction, and intensify  
95 social isolation and loneliness make it an important research focus. This study used a short  
96 online survey to explore the perceived effects of Covid-19 lockdown on PHL, with a  
97 particular focus on the scope and extent of hearing-related difficulties encountered in  
98 everyday life. A rapid online survey methodology, similar to other Covid-19 research (e.g.  
99 Geldsetzer, 2020; Zhong et al., 2020), was employed to obtain a timely snapshot of a  
100 situation subject to change with little warning. This inevitably means that some aspects of  
101 standard methodology are relaxed in the interest of speed, particularly in relation to  
102 participant recruitment, survey item development and the general level of sophistication in  
103 study design. While the conclusions from such studies are hence open to some question,  
104 they may be the only available source of insight.

105 In this paper, the term 'lockdown' will henceforth be used to encompass the specific range  
106 of social restrictions and safety measures in place at the time and location of data collection  
107 for this study. These are described below under 'Procedure'.

108

## 109 MATERIALS AND METHODS

110 This research has received ethical approval from the West of Scotland Research Ethics  
111 Committee (18/WS/0007) and the NHS Greater Glasgow and Clyde R&D (GN18EN094).

### 112 Participants

113 We aimed to recruit at least 100 PHL as participants. 308 members of the participant pool of  
114 Hearing Sciences – Scottish Section of the University of Nottingham were invited, all of  
115 whom were adults who had provided us with an email address and were known to have a  
116 better ear four frequency average threshold (BE4FA) of 25 dB HL or more. There were no  
117 other inclusion or exclusion criteria. In the first wave of recruitment, 199 invites were sent  
118 (with a reminder to non-responders after one week), resulting in 88 participants being  
119 recruited. A second wave of recruitment saw a further 109 invites sent, which recruited a  
120 further 41 participants.

121 Of the total 129 participants, 62 (48.1%) were female, and ages ranged from 27-76 years ( $M$   
122 = 64.4 years). The sample consisted of 32 (24.8%) reporting as non-users of hearing aids  
123 (HA), 25 (19.4%) as unilateral HA users, 71 (55.0%) as bilateral HA users, plus one whose  
124 responses indicate a user of one HA plus one cochlear implant. Of those participants who  
125 used hearing aids, 65% used them for more than eight hours per day. Based on survey  
126 responses, 70 participants experience tinnitus. All participants live in Glasgow, Scotland, and  
127 had previously attended NHS Audiology, from where they were recruited into our

128 participant pool. Participants were not compensated for their participation, as it was  
129 deemed to be undemanding.

130

## 131 **Materials and Measures**

132 We devised a 24-item online survey, aiming to cover a wide range of relevant aspects in a  
133 survey with low participant burden, high face validity, and ease of unsupervised self-  
134 administration. Survey items were based on anecdotal reports on mass and social media  
135 platforms regarding the specific challenges facing PHL as a result of the lockdown,  
136 supplemented by our own theorising. The survey was created and refined by the authors in  
137 an iterative but timely process, including critical review by audiologists and researchers at  
138 Hearing Sciences – Scottish Section.

139 Participants first responded to three questions about their unaided hearing ability, hearing  
140 aid ownership, and frequency of hearing aid use, followed by 21 Covid-related questions.

141 Quantitative responses were on a five-point Likert scale ranging from ‘strongly agree’ to  
142 ‘strongly disagree’, plus ‘not applicable/not sure’. The decision to use a five-point Likert  
143 scale was made under the assumption that participants would find this to be a familiar  
144 format, and to discourage neutral responding, although we intended to collapse the  
145 responses into positive, neutral and negative categories for analyses. Orientation of  
146 questions was randomly varied, so that ‘agreement’ did not always signify ‘worse’ or  
147 ‘better’. One open-ended free text question at the end of the survey asked participants to  
148 describe any other positive or negative effects of lockdown which they had experienced.

149 The survey was administered online using Jisc Online Surveys (JISC, n.d.). Supplementary  
150 data retrieved from the participant database were age, gender and four-frequency average

151 dB HL for each ear, measured at the participants' most recent visit to the department. The  
152 survey questionnaire is reproduced in Supplementary Digital Content file 1.

### 153 Procedure

154 Lockdown was imposed on Scotland on 23<sup>rd</sup> March 2020. At that time, relevant restrictions  
155 in Scotland included the wearing of facemasks during health consultations (and optionally at  
156 any time when out of the home), a two-meter minimum interpersonal distance, and travel  
157 limited to essential local journeys. The public were required to stay at home except for  
158 essential shopping and daily local exercise, and all non-essential businesses were closed,  
159 with employees continuing to work from home where possible. Phase 1 of lockdown easing  
160 ran from 29<sup>th</sup> May – 19<sup>th</sup> June, and data were collected from 29<sup>th</sup> May – 15<sup>th</sup> June. In that  
161 phase, some restaurants and cafes re-opened, but for take-away services only, some  
162 outdoors work and child-minding services were permitted to resume, and up to eight  
163 people from two different households could meet (outdoors only), provided physical  
164 distancing was upheld. The public were still advised to stay at home, and most non-essential  
165 businesses remained closed. Thus participants had over two months' experience of a strong  
166 lockdown prior to data collection, and for most people circumstances changed only slightly  
167 at the start of the data collection period. They remained constant thereafter.

168 Three weeks after data collection began, data from 129 participants were downloaded,  
169 cleaned and analysed.

### 170 Data Analysis

171 The complete dataset is provided in Supplementary Digital Content file 2.



172 Data were analysed across the entire sample and across two subgroups with better and  
173 worse hearing, respectively. Past research has generally indicated that self-reported hearing  
174 ability is a better predictor of self-reported hearing-related outcomes than objective,  
175 audiometric scores (e.g. Alhanbali et al., 2018; Hornsby & Kipp, 2016; Knudsen et al., 2010),  
176 and therefore the subgroups were formed on the basis of self-reported hearing ability  
177 (survey Q2). Of the 129 participants who completed the survey, 18 participants classified  
178 their hearing ability “when not wearing hearing aids” as ‘very poor’, 42 as ‘poor’, 62 as  
179 ‘middling’, five as ‘good’ and two as ‘very good’. One participant (#123) reported her  
180 unaided hearing to be ‘good’, but had a BE4FA of 107.5 dB HL and reported using both a  
181 hearing aid and a cochlear implant. Considering that the next most hearing-impaired  
182 participant to classify their hearing as ‘good’ had a BE4FA 80 dB HL lower than that of  
183 participant #123, this strongly suggested that #123 interpreted the question as asking about  
184 her hearing without her hearing aid, but with her cochlear implant. Her response was  
185 therefore adjusted to align with that of another participant who had the same BE4FA, which  
186 was ‘very poor’. After this adjustment, participants who responded ‘middling’, ‘good’ or  
187 ‘very good’ ( $n = 68$ ) comprised the better-hearing (hereafter BH) group, while the worse  
188 hearing (WH) group consisted of those who responded ‘poor’ or ‘very poor’ ( $n = 61$ ).

189 Group characteristics are presented in Table 1.

190 Prior to analysis, the response categories ‘strongly disagree’ and ‘disagree’ were collapsed  
191 into one ‘disagree’ category, and likewise for the two ‘agree’ categories. Each survey item  
192 was then analysed individually by calculating the frequency of agreement, disagreement  
193 and neutrality. Responses of ‘N/A’ were excluded from all calculations, hence the total N  
194 varies from item to item. Chi-squared tests of the contrast between the BH and WH groups

195 were based on 3x2 cross-tabulations of response (disagree, neutral, agree) x group (BH,  
196 WH). Resulting p-values are reported without correction for multiple comparisons, as all  
197 survey items are to a first approximation regarded as independent research questions.  
198 However, given the number of items collected, we adopt a conservative threshold for  
199 significance at  $p=0.01$ . Data were analysed using *R* version 3.6.2 (R Core Team, 2020).  
200 Free text responses were explored inductively by mapping them onto themes established by  
201 categories of quantitative survey questions and responses (see below).

## 202 RESULTS

### 203 Response rate and sampling bias

204 Some survey items were only relevant to certain participants, such as participants who  
205 owned hearing aids or had tried video subtitle technology. As responses of 'N/A' were  
206 excluded from all calculations, the effective response rate for each survey item varied from  
207 65/129 (Q16) to 126/129 (Q21). The free-text question (Q24) was responded to by 74  
208 participants (57%), although 18 of those were stating that they had nothing more to add.

209 Comparing the 129 participants against the 179 non-respondent invitees, t-tests for age and  
210 BE4FA and Chi-squared test for gender indicated no significant differences on any of these  
211 variables.

### 212 Findings

213 Table 2 collates all the quantitative results forming the basis for interpretative and statistical  
214 evaluation.

215 Below, the findings are grouped into themes. These themes (behaviour, emotion, hearing  
216 performance, practical issues, tinnitus) were developed through an iterative process to

217 arrive at a compact structure which best reflected meaningful and distinct aspects of  
 218 hearing disability and handicap. They represent aspects of response to lockdown, rather  
 219 than aspects of lockdown itself (e.g. face masks, video calls), since the former is felt to be  
 220 more illuminating regarding the particular experience of PHL.

221 For each theme, a description of the essence of the quantitative results per survey question  
 222 is followed by a pragmatic summary of the free-text responses relevant to the theme. Free-  
 223 text responses that are relevant for more than one theme are cited more than once.

#### 224 Behaviour ●

225 *Q12. I use video calls (Facebook, FaceTime, Google, Skype, Zoom, etc.) more often now than*  
 226 *I did before lockdown began*

227 There is a widespread increase in the use of video calls, and no significant difference  
 228 between WH and BH groups.

229 *Q19. Since lockdown began, I have been wearing my hearing aids less than usual*

230 After discarding 32 non-users, the majority (61.5%) of the BH group are wearing their HAs  
 231 less than usual, whereas only 26.8% of the WH group are doing so. This difference is  
 232 significant ( $\chi^2(2) = 13.98, p < .001$ ). Figure 1 shows the distributions of responses for both  
 233 groups.

#### 234 *Free-text comments*

235 Behavioural changes were often reflected in free-text responses. Reduced hearing aid usage  
 236 was noted by several participants. According to participant 59: “not going to pub or  
 237 restaurant has meant that I do not use my aids often, but still miss these entertainments”.

238 Participant 73 reported: “not wearing [my hearing aids] as much as not needing to for social

239 interaction as no background noise when making calls at home". Interestingly, one  
240 participant has come to realise her reliance on visual speechreading, and as a result has  
241 endeavoured to learn sign language.

242 Asking others to modify their behaviour was also apparent. Two participants recalled  
243 situations where they asked healthcare staff to repeat themselves and speak more loudly,  
244 respectively. Conversely, two participants explained that video conferences and physical  
245 distancing had made hearing so difficult that they no longer ask others to repeat  
246 themselves, with one reporting that they disengage instead. Finally, one participant's  
247 comment reflected the difficulty in now having to attend healthcare appointments alone:  
248 "Ordinarily, my wife is able to 'Interpret' but [I] now have to attend clinic alone" (participant  
249 79).

#### 250 Emotions ●

251 *Q6. I think key workers should be supplied with clear (transparent) face masks*

252 This opinion is widely shared, with no significant difference between WH and BH groups.

253 *Q8. I am worried about how I will communicate with others if wearing face masks becomes*  
254 *more common*

255 As a whole, respondents expressed a moderate level of worry. The WH group appear to  
256 worry more than the BH group, however this difference is not significant ( $\chi^2(2) = 7.60$ ,  
257  $p=0.022$ ).

258 *Q10. It is a relief not to be obliged to attend social gatherings where I won't hear well*

259 Figure 2 shows the distributions of responses for both groups. Overall there is a moderate  
260 level of relief, being a combination of a broad range of views in the BH group and a strong  
261 indication of relief in the WH group (contrasting BH vs. WH,  $\chi^2(2) = 13.65$ ,  $p=0.001$ ).

262 *Q11. The possibility of having to speak to people wearing face masks or from a distance adds*  
263 *to my anxieties about going to public places (e.g. parks, supermarkets)*

264 Overall results are composed of strong concern in the WH group counterbalanced by lack of  
265 concern in the BH group ( $\chi^2(2) = 15.94$ ,  $p<.001$ ). Figure 3 shows the distributions of  
266 responses for both groups.

267 *Q15. I enjoy group video calls (involving more than two people)*

268 Results indicate a broad range of experience, with roughly as many enjoying as not in the  
269 overall sample. There is a non-significant trend towards less enjoyment in the WH group.  
270 The relatively high number of 'N/A' responses suggests that some have not experienced  
271 group video calls.

272 *Q17. I am more worried than usual about what to do if my hearing aids stop working, or if I*  
273 *can't get batteries*

274 After discarding 32 non-users of HAs, the overall result is a combination of a broad  
275 distribution of feelings in the BH group with a high level of worry in the WH group ( $\chi^2(2) =$   
276  $13.48$ ,  $p=0.001$ ).

277 *Q18. I am less affected by my hearing loss than usual*

278 The BH group shows a tight central tendency (i.e. neither more nor less affected than usual),  
279 while the WH group is considerably more affected than usual ( $\chi^2(2) = 20.70$ ,  $p<.001$ ).

280 *Q20. I think about my hearing loss more often than usual*

281 Figure 4 shows the distributions of responses for both groups. Results showed a strong  
282 difference between groups, with the WH group tending to think about their hearing loss  
283 more than usual, and the BH group not doing so ( $\chi^2(2) = 30.83, p < .001$ ).

284 *Free-text comments*

285 Emotional reactions were evident in free-text responses. Both video calls and conversing  
286 with healthcare professionals wearing masks were described as stressful. One participant  
287 described their recent GP and hospital appointments as “quite stressful situations”  
288 (participant 60) due to the unavailability of transparent face masks. Another said:  
289 “Generally, I just ask people to repeat if [I] haven't heard but zoom conference's for board  
290 more stressful and have asked for support for chairing meeting” (participant 25). “Concern”  
291 about the lack of audiology services for hearing aid maintenance was also documented  
292 (participant 71), as was dissatisfaction with current lifestyle (participant 59: “Not going to  
293 pub or restaurant has meant that I do not use my aids often, but still miss these  
294 entertainments”). However, some positive sentiments were also expressed; participants  
295 reported enjoying the quieter outdoor environment (participants 67 and 125) and easier  
296 outdoor conversation (participant 125), and finding it easier to deal with hearing loss as a  
297 result of less outdoor contact (participant 119).

298 **Hearing performance ●**

299 *Q4. Understanding people wearing face masks is harder because the speech is muffled*

300 Widespread difficulty is evident, with no significant difference between WH and BH groups.

301 *Q5. Understanding people wearing face masks is harder because I can't see their mouth*  
302 *moving*

303 As with Q4, there is widespread difficulty, and no significant difference between WH and BH  
304 groups.

305 *Q9. When people speak to me from a safe distance, I can still hear them well enough*

306 This question elicited a balanced spread of responses, with no significant difference  
307 between WH and BH groups.

308 *Q13. In video calls, I hear worse than if the other person was in the room with me*

309 Overall results show hearing in video calls being slightly worse than being in the room.

310 However this is composed of a balanced spread of opinions in the BH group, and clear  
311 dissatisfaction in the WH group ( $\chi^2(2) = 10.74, p=0.005$ ). Figure 5 shows the distributions of  
312 responses for both groups.

313 *Q14. In video calls, I hear worse than if I was talking to the person on the telephone*

314 There was a broad range of views with no marked consensus, and no significant difference  
315 between WH and BH groups.

316 *Q16. Subtitles on video calls help*

317 A high number of 'N/A' responses (64) suggests that many are unaware of this feature, or at  
318 least do not use it. Amongst those who do use live subtitles, there was clear appreciation of  
319 their value. There is no significant difference between WH and BH groups.

320 *Q21. Televised updates about Covid-19 are easy for me to follow*

321 Most people in the BH group find TV updates easy to follow. The balance is to the same side  
322 in the WH group, but a sizeable minority disagree ( $\chi^2(2) = 13.40, p=0.001$ ).

323 *Q22. Radio updates about Covid-19 are easy for me to follow*

324 This showed a pattern of responses similar to Q21, but with a stronger contrast between  
325 groups ( $\chi^2(2) = 16.84, p<.001$ ). A relatively high number of 'N/A' responses (33) suggests  
326 that many do not listen to the radio for updates about Covid-19.

327 *Free-text comments*

328 Twenty participants left free-text comments describing either enhanced or decreased  
329 hearing performance due to Covid-19 measures. Specific aspects of the current situation  
330 which reportedly make hearing difficult include face masks ("attended a clinic appointment  
331 this week in which I struggled to understand what was said to me by consultant wearing  
332 face mask" – participant 79), physical distancing ("Maintaining 'safe distance' makes it a bit  
333 more difficult to hear others; particularly young grandchildren who would normally come  
334 closer to speak" – participant 48), and video calls ("Group zoom is difficult for me" –  
335 participant 91).

336 However, participants also mentioned more favourable listening environments being  
337 created by social distancing. For example, participant 73: "Not wearing [my hearing aids] as  
338 much as not needing to for social interaction as no background noise when making calls at  
339 home". Similarly, participant 115: "Main contact for 10 weeks is my wife. One to one  
340 conversations are extremely manageable. Occasionally we have to repeat the conversation.  
341 Not a problem." Two participants also reported increased understanding in group video calls  
342 compared to face-to-face group conversation. One, a teacher, stated: "I can actually hear



343 better on Zoom because the students talk louder in their own space, and have to face me,  
344 plus I can crank up the volume on my headphones if I need to” (participant 128).

345 Practical issues ●

346 *Q7. Wearing a face mask interferes with wearing my hearing aid(s)*

347 After discarding 32 non-users of HAs, there are only slight indications of a problem. There is  
348 no significant difference between WH and BH groups, or between wearers of one and two  
349 HAs. Twenty-three HA users responding ‘N/A’ have perhaps not worn face masks with their  
350 HAs.

351 *Free-text comments*

352 Practical issues were reflected across free-text responses from 18 participants. Participants  
353 reported issues relating to closed clinics and cancelled or postponed appointments ( $n = 7$ ),  
354 lack of hearing aid maintenance or repair services ( $n = 8$ ), being unaware of the postal  
355 battery replacement service which is in place ( $n = 1$ ), discomfort when wearing a face mask  
356 and hearing aids at the same time ( $n = 1$ ), and difficulty using hearing aids while on video  
357 calls due to inappropriate behaviour of directional microphones ( $n = 1$ ). Four participants  
358 described using their hearing aids less, or not at all, as a result. For example, participant 100  
359 reported: “Just that one hearing aid wasn't working so didn't see any point in wearing any”.  
360 Similarly, participant 39 commented: “hardly wear my hearing aids, as have got to make  
361 appointment with hospital”.

362 Tinnitus ●

363 *Q23. My tinnitus has been worse since lockdown started*

364 Overall, the distribution is very flat, indicating little if any worsening of tinnitus on average.  
365 There is a non-significant trend towards more worsening of tinnitus in the WH group. The  
366 large number of 'N/A' responses (59) presumably represents people not suffering with  
367 tinnitus.

368 Just one participant left a free-text response in relation to tinnitus: "Being indoors mostly  
369 means less background noise with slight increase in my tinnitus" (participant 11).

370

371  
372

## DISCUSSION

373 In general, it can be concluded that lockdown has had a greater negative impact on people,  
374 the worse their hearing is.

375 Self-reported hearing ability versus audiometric hearing loss ●

376 The BE4FA of participants was quite strongly correlated with the rank (1 'very good' – 5  
377 'very poor') of self-reported hearing ability (Kendall rank correlation,  $\tau_b = 0.521$ ,  $p < .001$ ).

378 Repeating the abovementioned analyses with hearing ability grouped according to  
379 audiometric criteria, i.e. mild (BE4FA 25-40 dB HL) versus moderate to severe (BE4FA >40)  
380 (World Health Organisation, 2020) produced results very similar to those based on self-  
381 reported hearing, although inevitably some group contrasts now achieved significance,  
382 while others lost it.

## 383 Themes

### 384 Behaviour ●

385 Beyond the universal and massive changes in behaviour which the whole community has  
386 experienced, changes specific to PHL are both voluntary (less HA use due to less need) and  
387 involuntary (less HA use due to lack of repair facilities, and health consultations without  
388 partner 'interpreter' support). Increased communication difficulty has led some to change  
389 their conversational tactics.

### 390 Emotions ●

391 The Covid-19 pandemic has induced elevated anxiety in the general population (Wang et al.,  
392 2020). While the relatively strong emotional reactions observed in our PHL may partly  
393 reflect this, it is also clear that they tend to be stronger in the WH group. This suggests that  
394 the interactions of hearing loss and Covid-related restrictions create an additional emotional  
395 burden.

### 396 Hearing performance ●

397 It is clear that face masks are detrimental to hearing performance. However, perhaps  
398 surprisingly, degree of hearing loss seems not to mediate the severity of the challenge. The  
399 seemingly mixed experience of video calls may partly be due to a likely large variety of  
400 technical installations and online behavioural habits. Unfortunately, no survey items probed  
401 these aspects. Video call services with live subtitling provide potential benefits for PHL, but  
402 many appear to be unaware of it. There is an opportunity here for improving the experience  
403 of PHL simply by informing them of such features. Information updates on TV and radio  
404 appear to be accessible for most PHL. It should be noted that in the UK, all TV updates from

405 government are accompanied by live sign-language interpretation. However we do not  
406 know whether any of our respondents are routine sign-language users.

407 Practical issues ●

408 Lack (or perceived lack) of access to audiological services has affected a considerable  
409 number of the respondents. This probably reflects diverse mechanisms, including problems  
410 which were present before lockdown but not dealt with, existing appointments that were  
411 cancelled, and newly arising problems.

412 Some styles of HA will be more susceptible than others to mechanical interference from  
413 face masks strings, and this may be reflected in the inconclusive results on this item.

414 Unfortunately we do not have data on the HA styles of our respondents, but they will be  
415 mixed.

416 An interesting observation from one respondent suggests that there may be scope for HA  
417 manufacturers and hearing-care professionals to consider putting effort into creating HA  
418 signal processing modes or accessories which work well with video-call equipment. This  
419 would be beneficial regardless of whether social restrictions last or return over a long  
420 period.

421 Tinnitus ●

422 The result here was not clear-cut. If anything, the trend was in a plausible direction, as  
423 expressed by one respondent, namely that lower noise levels provoke greater awareness of  
424 tinnitus. However, since there was no control or measurement of tinnitus severity in our  
425 sample, we cannot draw any general conclusions.

## 426 Limitations

427 There are a number of limitations to this study. Firstly, in order to design and conduct this  
428 study in a timely manner, some preliminary steps, such as stringent design and validation of  
429 the survey and deep consideration of inclusion/exclusion criteria, were not taken. This may  
430 compromise the quality of the results. Furthermore, while the restrictions and safety  
431 measures being imposed during the pandemic are similar in many countries, the present  
432 data were drawn from an exclusively Glasgow-based sample and thus may not be  
433 generalisable to other locations. Some between-participant factors which may impact an  
434 individual's perception of lockdown were not measured, notably employment status,  
435 household circumstances and general health. Likewise the potential for multi-morbidity or  
436 dual-sensory loss to exacerbate the negative experience of lockdown beyond hearing loss  
437 alone remains unanswered by these results. Nevertheless, the sample likely varies across  
438 such factors, and therefore the observed associations between hearing loss and aspects of  
439 lockdown are assumed to be real, and not the product of confounding. Note that age was  
440 unrelated to both BE4FA ( $r = 0.019$ ) and self-reported hearing ( $r = -0.054$ ), suggesting that  
441 effects ascribed to hearing ability are not covert age effects. It is conceivable that a person's  
442 length of experience with HAs would affect their responses to our survey. We were able to  
443 dichotomise participants into users vs. non-users of HAs, but not into experienced vs. novice  
444 users. Thus we implicitly assume that length of HA experience for HA users in our sample is  
445 distributed in a roughly representative manner, and is not a significant confounder.

446 The use of email invites and online surveys means that the sample are at least somewhat  
447 technologically competent, therefore no conclusions can be drawn as to the experience of  
448 lockdown amongst PHL who are less computer literate. Finally, the relatively strict lockdown

449 restrictions which were in place during data collection (in particular ‘stay at home’ guidance)  
450 mean that participants may have had limited experience of speaking to people in face  
451 masks, from a safe distance, etc., making it difficult to respond to some questions.

452

## 453 CONCLUSIONS

454 The aim of the study was to ascertain the perceived effects of social restrictions during  
455 Covid-19 lockdown on people with hearing loss. The results indicate that hearing loss  
456 compounds many of the hearing-related challenges (e.g. conversing with face masks) that  
457 everyone faces, and adds additional ones. In general (though not universally), greater  
458 hearing loss is associated with more severe problems.

459 It was found that there are also positive aspects to lockdown for those with hearing loss,  
460 namely that more time is spent in acoustical and social conditions (lower noise, fewer and  
461 more familiar people) which are relatively favourable for spoken communication, and thus  
462 less stressful.

463 Practical implications of the results include that key workers should be provided with  
464 transparent face masks, hearing-aid maintenance services should re-open as soon as it is  
465 safe, patients should be informed about the availability of live subtitling on video-calling  
466 platforms, and device signal processing modes and accessories compatible with video-  
467 calling should be developed and propagated.

468

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470 The authors thank the participants for providing their data for the study, and Andrew Lavens  
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474

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516

517

518 **Figure legends**

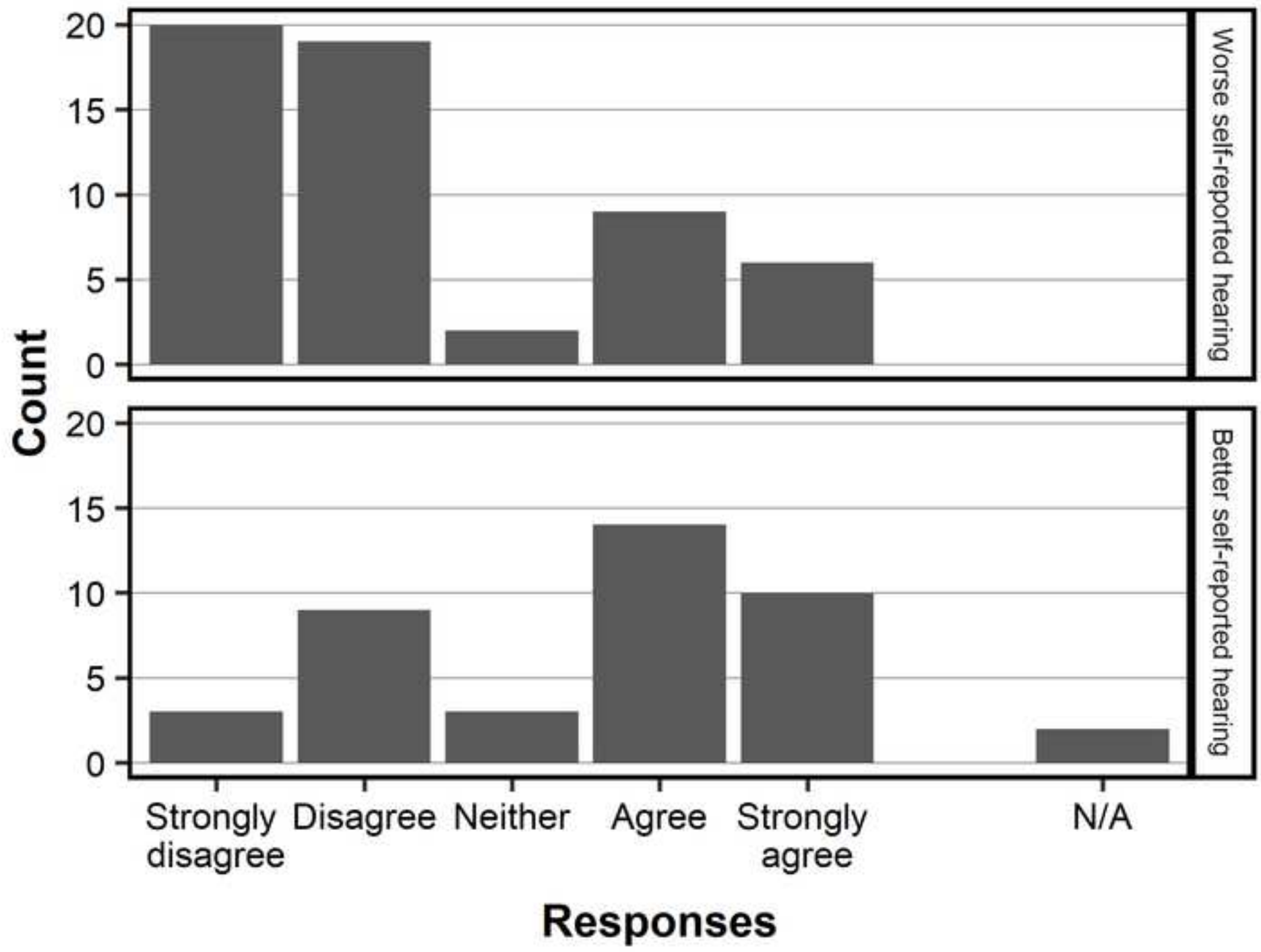
519 Fig. 1. Responses by self-reported hearing ability group to Q19: “Since lockdown began, I  
520 have been wearing my hearing aids less than usual.” The figure includes only responses  
521 from participants who use hearing aids.

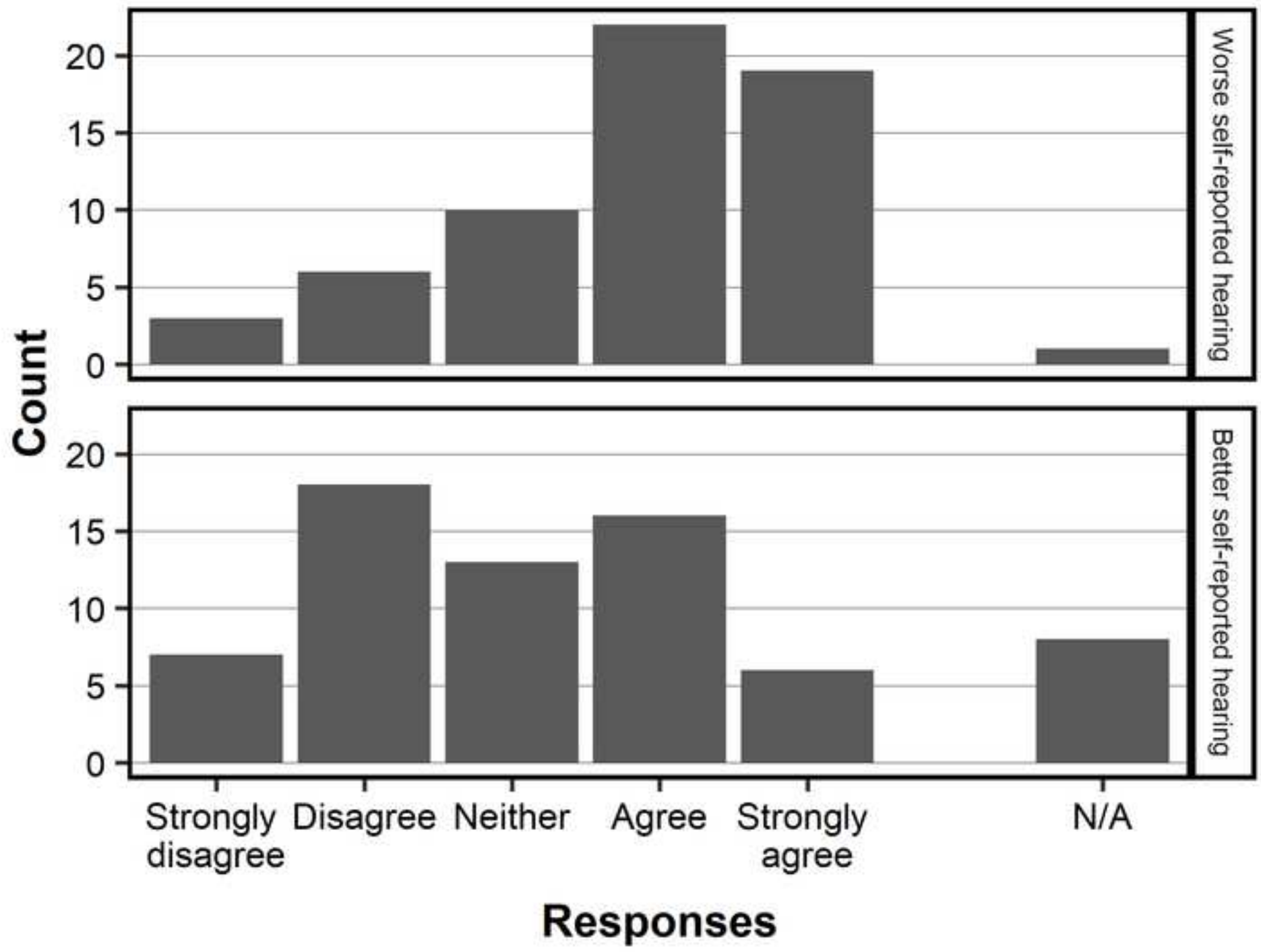
522 Fig. 2. Responses by self-reported hearing ability group to Q10: “It is a relief not to be  
523 obliged to attend social gatherings where I won’t hear well.”

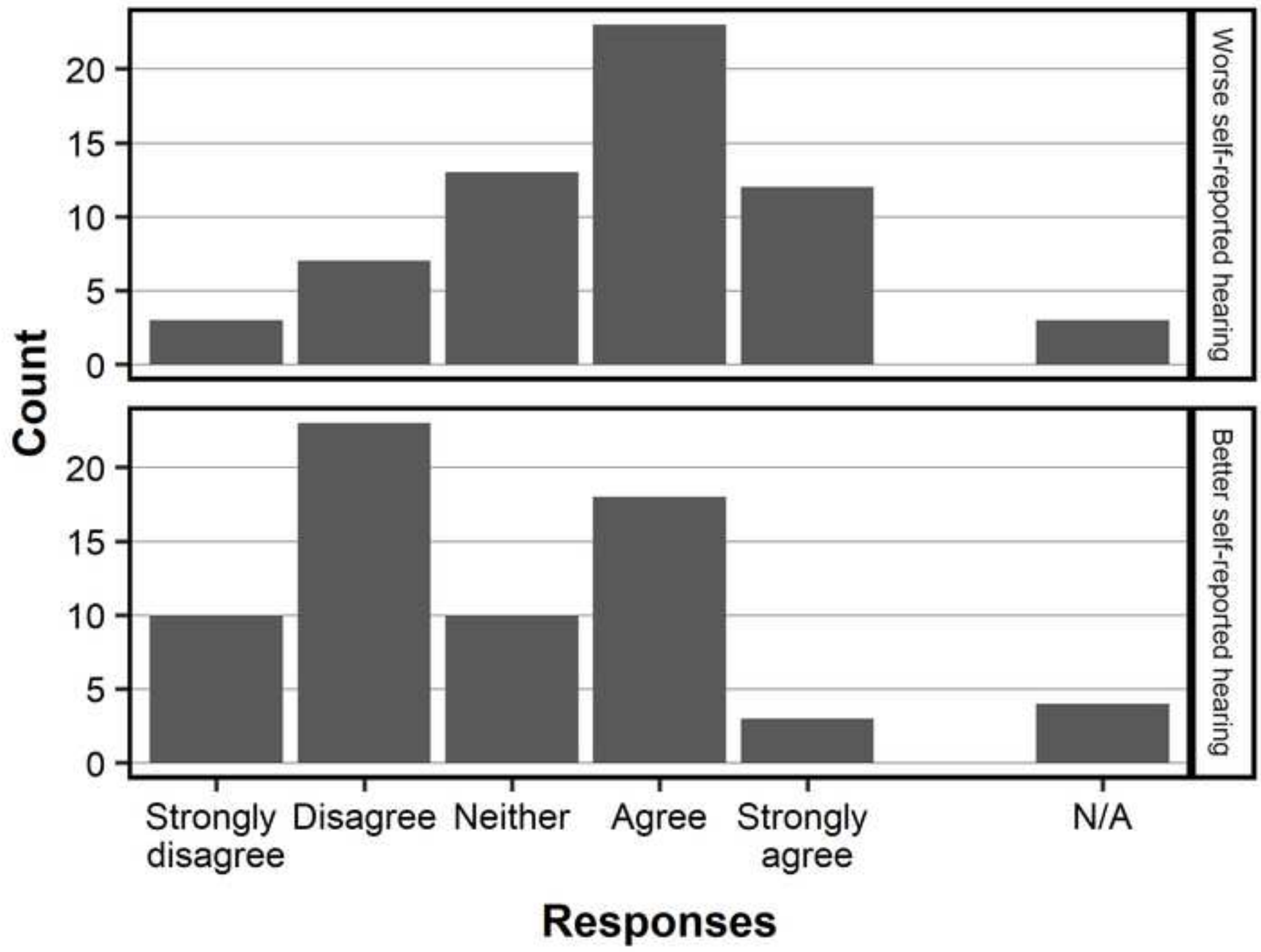
524 Fig. 3. Responses by self-reported hearing ability group to Q11: “The possibility of having to  
525 speak to people wearing face masks or from a distance adds to my anxieties about going to  
526 public places (e.g. parks, supermarkets).”

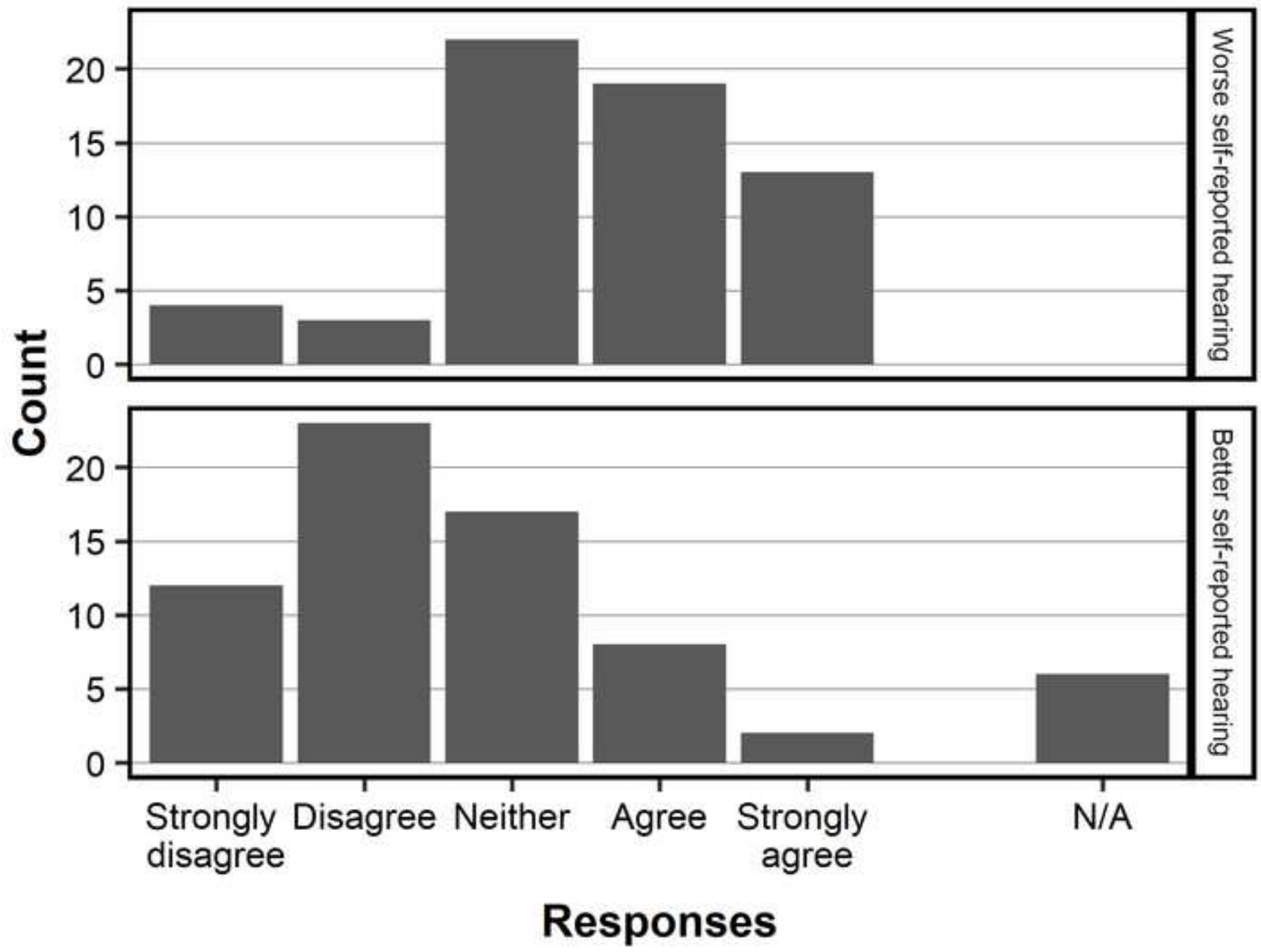
527 Fig. 4. Responses by self-reported hearing ability group to Q20: “I think about my hearing  
528 loss more often than usual.”

529 Fig. 5. Responses by self-reported hearing ability group to Q13: “In video calls, I hear worse  
530 than if the other person was in the room with me.”









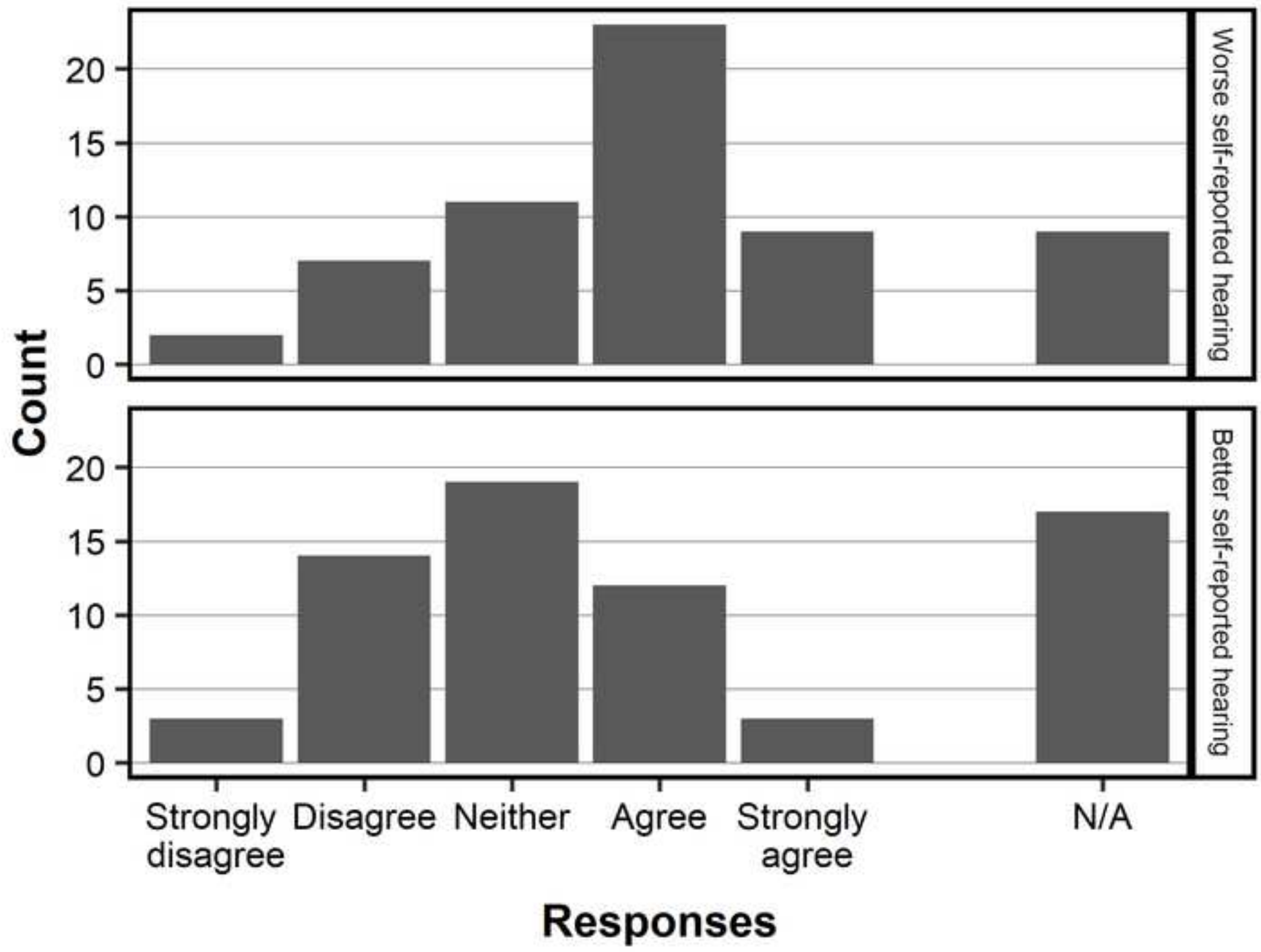


Table 1. Sample and hearing group characteristics

Characteristic	Total sample	Self-reported unaided hearing ability		Hearing loss severity	
		Better (BH group)	Worse (WH group)	Mild (BE4FA 25-40)	Moderate – profound (BE4FA >40)
N	129	68 (53%)	61 (47%)	76 (59%)	53 (41%)
Age (years)	64.4 (9.4)	63.9 (9.9)	64.9 (8.9)	63.3 (9.9)	65.9 (8.6)
Age range	27-76	36-76	27-76	36-76	27-76
Female	62 (48%)	68 (53%)	61 (42%)	66 (51%)	63 (43%)
BE4FA (dB HL)	41.8 (17.1)	32.6 (7.0)	52 (19.1)	31.2 (4.3)	56.9 (17.1)
BE4FA range	25-107.5	25-53.75	26.5-107.5	25-38.75	40-107.5

*Self-reported hearing group is determined by responses to survey question 1. BE4FA, better ear four-frequency average threshold. Categorical variables are presented as n (%); continuous variables are presented as mean (SD).*



Table 2. Numerical results (basis for statistical tests)

Q	Item statement	Worse Hearing group				Better Hearing group			
		n	%	%	%	n	%	%	%
4	Understanding people wearing face masks is harder because the speech is muffled	56	3.6	3.6	92.9	62	1.6	12.9	85.5
5	Understanding people wearing face masks is harder because I can't see their mouth moving	57	5.3	14.0	80.7	59	8.5	23.7	67.8
6	I think key workers should be supplied with clear (transparent) face masks	58	1.7	25.9	72.4	64	3.1	43.8	53.1
7	Wearing a face mask interferes with wearing my hearing aid(s)	44	22.7	27.3	50.0	30	36.7	33.3	30.0
8	I am worried about how I will communicate with others if wearing face masks becomes more common	59	6.8	27.1	66.1	60	16.7	41.7	41.7
9	When people speak to me from a safe distance, I can still hear them well enough	61	45.9	18.0	36.1	65	32.3	26.2	41.5
10	It is a relief not to be obliged to attend social gatherings where I won't hear well	60	15.0	16.7	68.3	60	41.7	21.7	36.7
11	The possibility of having to speak to people wearing face masks or from a distance adds to my anxieties about going to public places (e.g. parks, supermarkets)	58	17.2	22.4	60.3	64	51.6	15.6	32.8
12	I use video calls (Facebook, FaceTime, Google, Skype, Zoom, etc.) more often now than I did before lockdown began	53	15.1	7.5	77.4	55	18.2	7.3	74.5
13	In video calls, I hear worse than if the other person was in the room with me	52	17.3	21.2	61.5	51	33.3	37.3	29.4
14	In video calls, I hear worse than if I was talking to the person on the telephone	52	38.5	15.4	46.2	51	47.1	27.5	25.5
15	I enjoy group video calls (involving more than two people)	49	42.9	20.4	36.7	47	21.3	29.8	48.9
16	Subtitles on video calls help	39	5.1	23.1	71.8	26	7.7	34.6	57.7
17	I am more worried than usual about what to do if my hearing aids stop working, or if I can't get batteries	56	10.7	14.3	75.0	37	35.1	27.0	37.8
18	I am less affected by my hearing loss than usual	60	60.0	18.3	21.7	62	21.0	48.4	30.6
19	Since lockdown began, I have been wearing my hearing aids less than usual	56	69.6	3.6	26.8	39	30.8	7.7	61.5
20	I think about my hearing loss more often than usual	61	11.5	36.1	52.5	62	56.5	27.4	16.1
21	Televised updates about covid-19 are easy for me to follow	61	24.6	23.0	52.5	65	3.1	21.5	75.4
22	Radio updates about covid-19 are easy for me to follow	43	37.2	27.9	34.9	53	5.7	26.4	67.9
23	My tinnitus has been worse since lockdown started	38	26.3	31.6	42.1	32	43.8	37.5	18.8

Counts (n) are excluding 'N/A' responses. 'Disagree' is the sum of 'disagree' and 'strongly disagree' responses, 'Agree' is the sum of 'agree' and 'strongly agree' responses. Hearing group is determined by responses to survey question 1.

Study Questionnaire

1. How many hearing aids do you wear?	<i>I don't own HAs</i>		<i>1 hearing aid</i>		<i>2 hearing aids</i>	
2. How is your hearing (when you are not wearing hearing aids)?	<i>Very good</i>	<i>Good</i>	<i>Middling</i>	<i>Poor</i>	<i>Very poor</i>	
3. On an average day at the moment, how many hours do you use your hearing aid(s)?	<i>None</i>	<i>Less than 1 hour per day</i>	<i>1-4 hours per day</i>	<i>4-8 hours a day</i>	<i>More than 8 hours a day</i>	
	<i>Strongly agree</i>	<i>Agree</i>	<i>Neither agree nor disagree</i>	<i>Disagree</i>	<i>Strongly disagree</i>	<i>Don't know/not applicable</i>
4. Understanding people wearing face masks is harder because the speech is muffled	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Understanding people wearing face masks is harder because I can't see their mouth moving	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I think key workers should be supplied with clear (transparent) face masks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Wearing a face mask interferes with wearing my hearing aid(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I am worried about how I will communicate with others if wearing face masks becomes more common	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. When people speak to me from a safe distance, I can still hear them well enough	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	<i>Strongly agree</i>	<i>Agree</i>	<i>Neither agree nor disagree</i>	<i>Disagree</i>	<i>Strongly disagree</i>	<i>Don't know/not applicable</i>
10. It is a relief not to be obliged to attend social gatherings where I won't hear well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. The possibility of having to speak to people wearing face masks or from a distance adds to my anxieties about going to public places (e.g. parks, supermarkets)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I use video calls (Facebook, FaceTime, Google, Skype, Zoom, etc.) more often now than I did before lockdown began	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. In video calls, I hear worse than if the other person was in the room with me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. In video calls, I hear worse than if I was talking to the person on the telephone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. I enjoy group video calls (involving more than two people)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. Subtitles on video calls help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. I am more worried than usual about what to do if my hearing aids stop working, or if I can't get batteries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. I am less affected by my hearing loss than usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	<i>Strongly agree</i>	<i>Agree</i>	<i>Neither agree nor disagree</i>	<i>Disagree</i>	<i>Strongly disagree</i>	<i>Don't know/not applicable</i>
19. Since lockdown began, I have been wearing my hearing aids less than usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I think about my hearing loss more often than usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. Televised updates about covid-19 are easy for me to follow	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. Radio updates about covid-19 are easy for me to follow	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. My tinnitus has been worse since lockdown started	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. Is there anything that you have encountered during lockdown that is related to your hearing loss and has not been mentioned (good or bad)?	<i>Free-text box</i>					