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Covid-19 Lockdown Affects Hearing Disability and Handicap in Diverse Ways: A Rapid Online Survey Study

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Objectives: The aim of this study was to explore the perceived effects of coronavirus disease 2019 (Covid-19) social distancing restrictions and safety measures on people with hearing loss.

Design: Participants were 129 adults (48.1% female, mean age 64.4 years) with an audiometric hearing loss, living in Glasgow, Scotland. A rapidly deployed 24-item online questionnaire asked about the effects of certain aspects of lockdown, including face masks, social distancing, and video calling, on participants' behavior, emotions, hearing performance, practical issues, and tinnitus. Data were analyzed descriptively across the entire sample, and with Chi-squared tests for differences between subgroups self-reporting relatively good and relatively poor unaided hearing, respectively. Additional free-text responses provided further perspectives.

Results: Behavior: Video calls are used more frequently than prelockdown. The better-hearing group use their hearing aids less. Emotions: There is increased anxiety (especially among the worse hearing group) concerning verbal communication situations and access to audiology services, and greater rumination about one's own hearing loss. Enjoyment of group video calls is mixed. The worse hearing group shows substantial relief at not being obliged to attend challenging social gatherings. Across both groups, a majority would like to see all key workers equipped with transparent face masks. Hearing performance: A large majority finds it hard to converse with people in face masks due to muffled sound and lack of speechreading cues, but conversing at a safe distance is not universally problematic. In the worse hearing group, performance in video calls is generally inferior to face-to-face, but similar to telephone calls. Those who use live subtitling in video calls appreciate their value. TV and radio updates about Covid-19 are easy to follow for most respondents. There is only weak evidence of face mask fixtures interfering with hearing aids on the ear, and of tinnitus having worsened during lockdown.

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

Key words: Covid-19, Hearing disability, Hearing handicap, Social distancing.

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INTRODUCTION

Everyday communication and interactions have been fundamentally reshaped by the social restrictions and safety measures which have been adopted in response to coronavirus disease 2019 (Covid-19). The term "lockdown" is used to encapsulate the particularly harsh initial wave of restrictions which came into force in many countries. Although these measures are hoped to be temporary, and are subject to change and geographical variation, many elements may remain in widespread force for a substantial period. As yet, little is known about the experience of lockdown among people with hearing loss.

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

Moreover, there is a wider scope of largely unexplored issues beyond face masks which people with hearing loss may face as a result of Covid-19 lockdown. For example, physical distancing measures dictate that face-to-face interactions are conducted from a greater distance than normal, possibly hindering speech understanding. Many social, professional, and healthcare interactions which would previously have occurred face-to-face are now being conducted over telephone or video calls, which are susceptible to degraded sound quality, and on video calls, audio/video mismatch, and dropouts. Pre-Covid 19 research has found telephone conversation to be an issue for people with hearing loss (Heffernan et al. 2016; Vas et al. 2017), while there seems to be a dearth of research regarding video calls. Additionally, many audiology services have been suspended or are being delivered remotely, which may lead to anxiety and reduced hearing aid (HA) use, as repairs cannot be carried out. Finally, as the situation evolves rapidly, accessibility of Covid-19 information updates is very important, and people with hearing loss may struggle to follow televised and radio updates.

Conversely, Covid-19 lockdown may have some positive implications for people with hearing loss. A ban on large social gatherings may come as a relief to those who struggle with group conversation and speech in noise. Similarly, more interactions are currently taking place in the home with familiar

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conversation partners and little background noise, and fewer in noisy public places like restaurants and bars. With more favorable listening conditions and fewer listening demands becoming the "new normal," people with hearing loss may find their hearing loss to be less bothersome in everyday life.

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

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

MATERIALS AND METHODS

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

Participants

We aimed to recruit at least 100 people with hearing loss as participants. Three hundred eight members of the participant pool of Hearing Sciences—Scottish Section of the University of Nottingham were invited, all of whom were adults who had provided us with an email address and were known to have a better ear four-frequency average threshold (BE4FA) of 25 dB HL or more. There were no other inclusion or exclusion criteria. In the first wave of recruitment, 199 invites were sent (with a reminder to nonresponders after 1 week), resulting in 88 participants being recruited. A second wave of recruitment saw a further 109 invites sent, which recruited a further 41 participants.

Of the total 129 participants, 62 (48.1%) were female, and ages ranged from 27 to 76 years (M = 64.4 years). The sample consisted of 32 (24.8%) reporting as nonusers of HAs, 25 (19.4%) as unilateral HA users, 71 (55.0%) as bilateral HA users, plus one whose responses indicate a user of one HA plus one cochlear implant. Of those participants who used HAs, 65% used them for more than 8 hrs/day. Based on survey responses, 70 participants experience tinnitus. All participants live in Glasgow, Scotland, and had previously attended NHS Audiology, from where they were recruited into our participant pool. Participants were not compensated for their participation, as it was deemed to be undemanding.

Materials and Measures

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

Participants first responded to three questions about their unaided hearing ability, HA ownership, and frequency of HA use, followed by 21 Covid-related questions. Quantitative responses were on a five-point Likert scale ranging from "strongly agree" to "strongly disagree," plus "not applicable/not sure." The decision to use a five-point Likert scale was made under the assumption that participants would find this to be a familiar format, and to discourage neutral responding, although we intended to collapse the responses into positive, neutral, and negative categories for analyses. Orientation of questions was randomly varied, so that "agreement" did not always signify "worse" or "better." One open-ended free-text question at the end of the survey asked participants to describe any other positive or negative effects of lockdown which they had experienced. The survey was administered online using Jisc Online Surveys (JISC 2020). Supplementary data retrieved from the participant database were age, gender, and four-frequency average dB HL for each ear, measured at the participants' most recent visit to the department. The survey questionnaire is reproduced in Supplemental Digital Content 1, http://links.lww.com/EANDH/A701.

Procedure

Lockdown was imposed on Scotland on March 23, 2020. At that time, relevant restrictions in Scotland included the wearing of facemasks during health consultations (and optionally at any time when out of the home), a 2-m minimum interpersonal distance, and travel limited to essential local journeys. The public was required to stay at home except for essential shopping and daily local exercise, and all nonessential businesses were closed, with employees continuing to work from home where possible. Phase 1 of lockdown easing ran from 29 May to 19 June, and data were collected from 29 May to 15 June. In that phase, some restaurants and cafes reopened, but for take-away services only, some outdoors work and child-minding services were permitted to resume, and up to eight people from two different households could meet (outdoors only), provided physical distancing was upheld. The public was still advised to stay at home, and most nonessential businesses remained closed. Thus participants had over 2 months' experience of a strong lockdown prior to data collection, and for most people circumstances changed only slightly at the start of the data collection period. They remained constant thereafter.

Three weeks after data collection began, data from 129 participants were downloaded, cleaned, and analyzed.

Data Analysis

The complete dataset is provided in Supplemental Digital Content 2, http://links.lww.com/EANDH/A702.

Data were analyzed across the entire sample and across two subgroups with better and worse hearing, respectively. Past research has generally indicated that self-reported hearing ability is a better predictor of self-reported hearing-related outcomes

than objective, audiometric scores (e.g., Knudsen et al. 2010; Alhanbali et al. 2018; Hornsby & Kipp 2016), and therefore, the subgroups were formed on the basis of self-reported hearing ability (survey Q2). Of the 129 participants who completed the survey, 18 participants classified their hearing ability "when not wearing HAs" as "very poor," 42 as "poor," 62 as "middling," five as "good" and two as "very good." One participant (#123) reported her hearing "when not wearing HAs" to be "good," but had a BE4FA of 107.5 dB HL and reported using both an HA and a cochlear implant. Considering that all other participants who classified their hearing as "good" had BE4FA at least 80 dB HL lower than that of participant #123, this strongly suggested that #123 interpreted the question as asking about her hearing without her HA, but with her cochlear implant. Her response was therefore adjusted to align with that of another participant who had the same BE4FA, which was "very poor." After this adjustment, participants who responded "middling," "good," or "very good" (n = 68) comprised the better-hearing (hereafter BH) group, while the worse hearing (WH) group consisted of those who responded "poor" or "very poor" (n = 61). Group characteristics are presented in Table 1.

Prior to analysis, the response categories "strongly disagree" and "disagree" were collapsed into one "disagree" category, and likewise for the two "agree" categories. Each survey item was then analyzed individually by calculating the frequency of agreement, disagreement, and neutrality. Responses of "N/A" were excluded from all calculations; hence, the total N varies from item to item. Chi-squared tests of the contrast between the BH and WH groups were based on 3×2 cross-tabulations of response (disagree, neutral, agree) × group (BH, WH). Resulting p values are reported without correction for multiple comparisons, as all survey items are to a first approximation regarded as independent research questions. However, given the number of items collected, we adopt a conservative threshold for significance at $p = 0.01$. Data were analyzed using *R* version 3.6.2 (R Core Team 2020).

Free-text responses were explored inductively by mapping them onto themes established by categories of quantitative survey questions and responses (see below).

RESULTS

Response Rate and Sampling Bias

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

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

Findings

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

Below, the findings are grouped into themes. These themes (behavior, emotion, hearing performance, practical issues, and tinnitus) were developed through an iterative process to arrive at a compact structure which best reflected meaningful and distinct aspects of hearing disability and handicap. They represent aspects of response to lockdown, rather than aspects of lockdown itself (e.g., face masks and video calls) since the former is felt to be more illuminating regarding the particular experience of people with hearing loss.

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

Behavior •

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

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

Q19. Since lockdown began, I have been wearing my HAs less than usual.

After discarding 32 nonusers, the majority (61.5%) of the BH group are wearing their HAs less than usual, whereas only 26.8% of the WH group are doing so. This difference is significant ($\chi^2(2) = 13.98$, $p < 0.001$). Figure 1 shows the distributions of responses for both groups.

Free-Text Comments • Behavioral changes were often reflected in free-text responses. Reduced HA usage was noted by several participants. According to participant 59, "not going to pub or restaurant has meant that I do not use my aids often, but still miss these entertainments." Participant

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 (yrs)	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

The 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)

		Worse hearing group				Better hearing group			
Q	Item statement	n	Disagree (%)	Neutral (%)	Agree (%)	n	Disagree (%)	Neutral (%)	Agree (%)
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.

73 reported: "not wearing [my hearing aids] as much as not needing to for social interaction as no background noise when making calls at home." Interestingly, one participant has come to realize her reliance on visual speechreading, and as a result has endeavored to learn sign language.

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

Emotions •

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

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

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

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

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

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

Q11. 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).

Overall results are composed of strong concern in the WH group counterbalanced by lack of concern in the BH group ($\chi^2(2) = 15.94$, $p < 0.001$). Figure 3 shows the distributions of responses for both groups.

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

Results indicate a broad range of experience, with roughly as many enjoying as not in the overall sample. There is a nonsignificant trend toward less enjoyment in the WH group. The relatively high number of "N/A" responses suggests that some have not experienced group video calls.

Q17. I am more worried than usual about what to do if my HAs stop working, or if I can't get batteries.

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

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

The BH group shows a tight central tendency (i.e., neither more nor less affected than usual), while the WH group is considerably more affected than usual ($\chi^2(2) = 20.70$, $p < 0.001$).

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

Figure 4 shows the distributions of responses for both groups. Results showed a strong difference between groups, with the WH group tending to think about their hearing loss more than usual, and the BH group not doing so ($\chi^2(2) = 30.83$, $p < 0.001$).

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

Hearing performance •

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

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

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

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

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

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

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

Overall results show hearing in video calls being slightly worse than being in the room. However, this is composed of a balanced spread of opinions in the BH group, and clear dissatisfaction in the WH group ($\chi2(2) = 10.74$, $p = 0.005$). Figure 5 shows the distributions of responses for both groups.

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

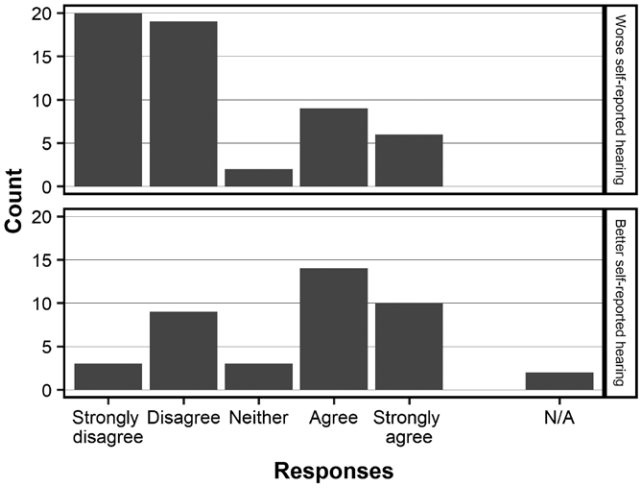

Fig. 1. Responses by self-reported hearing ability group to Q19: "Since lockdown began, I have been wearing my hearing aids less than usual." The figure includes only responses from participants who use hearing aids.

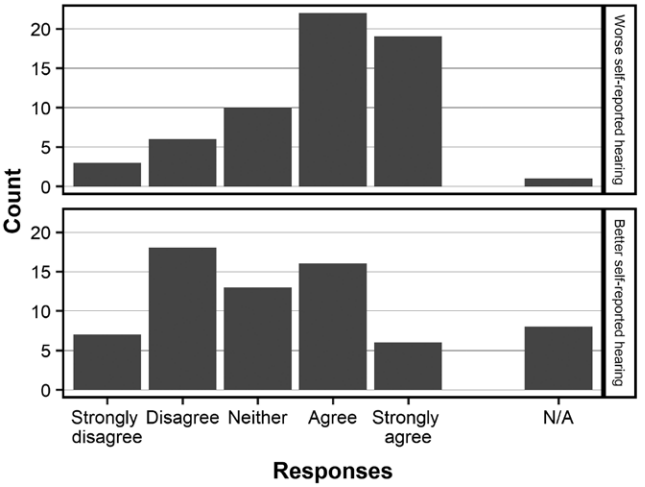

Fig. 2. Responses by self-reported hearing ability group to Q10: "It is a relief not to be obliged to attend social gatherings where I won't hear well."

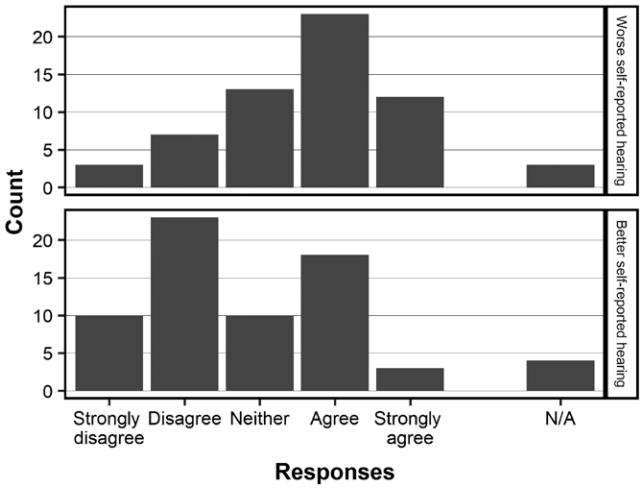

Fig. 3. Responses by self-reported hearing ability group to Q11: "The possibility of having to speak to people wearing face masks or from a distance adds to my anxieties about going to public places (e.g., parks, supermarkets)."

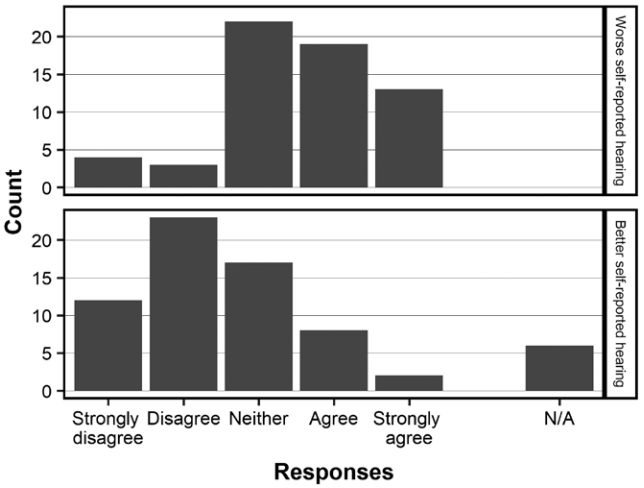

Fig. 4. Responses by self-reported hearing ability group to Q20: "I think about my hearing loss more often than usual."

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

Q16. Subtitles on video calls help.

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

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

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

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

This showed a pattern of responses similar to Q21, but with a stronger contrast between groups ($\chi^2(2) = 16.84$, $p < 0.001$). A relatively high number of "N/A" responses (33) suggest that many do not listen to the radio for updates about Covid-19.

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

However, participants also mentioned more favorable listening environments being created by social distancing. For example, participant 73: "Not wearing [my hearing aids] as much as not needing to for social interaction as no background noise when making calls at home." Similarly, participant 115: "Main contact for 10 weeks is my wife. One to one conversations are extremely manageable. Occasionally we have to repeat the conversation. Not a problem." Two participants also reported increased understanding in group video calls compared to face-to-face group conversation. One, a teacher, stated: "I can actually hear better on Zoom because the students talk louder in their own space, and have to face me, plus I can crank up the volume on my headphones if I need to" (participant 128).

Practical Issues •

Q7. Wearing a face mask interferes with wearing my HA(s).

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

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

Tinnitus •

Q23. My tinnitus has been worse since lockdown started.

Overall, the distribution is very flat, indicating little if any worsening of tinnitus on average. There is a nonsignificant trend toward more worsening of tinnitus in the WH group. The large number of "N/A" responses (59) presumably represents people not suffering with tinnitus.

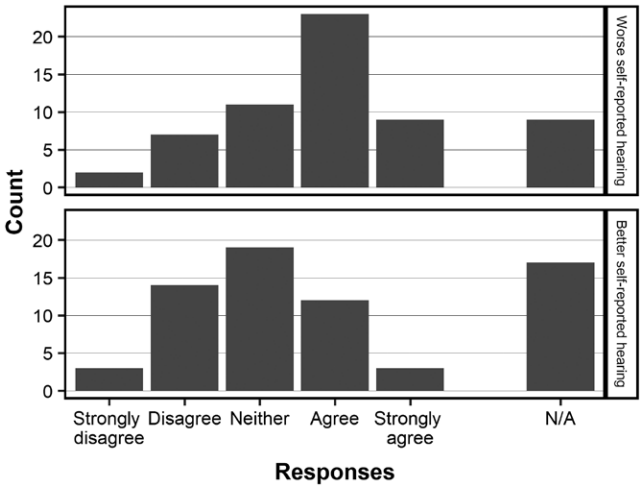

Fig. 5. Responses by self-reported hearing ability group to Q13: "In video calls, I hear worse than if the other person was in the room with me."

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

DISCUSSION

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

Self-Reported Hearing Ability Versus Audiometric Hearing Loss

The BE4FA of participants was quite strongly correlated with the rank (1, "very good"–5, "very poor") of self-reported hearing ability (Kendall rank correlation, $\tau b = 0.521$, $p < 0.001$). Repeating the abovementioned analyses with hearing ability grouped according to audiometric criteria, that is, mild (BE4FA 25–40 dB HL) versus moderate to severe (BE4FA > 40) (World Health Organisation 2020) produced results very similar to those based on self-reported hearing, although inevitably some group contrasts now achieved significance, while others lost it.

Themes

Behavior • Beyond the universal and massive changes in behavior which the whole community has experienced, changes specific to people with hearing loss are both voluntary (less HA use due to less need) and involuntary (less HA use due to lack of repair facilities, and health consultations without partner "interpreter" support). Increased communication difficulty has led some to change their conversational tactics.

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

Hearing Performance • It is clear that face masks are detrimental to hearing performance. However, perhaps surprisingly, degree of hearing loss seems not to mediate the severity of the challenge. The seemingly mixed experience of video calls may partly be due to a likely large variety of technical installations and online behavioral habits. Unfortunately, no survey items probed these aspects. Video call services with live subtitling provide potential benefits for people with hearing loss, but many appear to be unaware of it. There is an opportunity here for improving the experience of people with hearing loss simply by informing them of such features. Information updates on TV and radio appear to be accessible for most people with hearing loss. It should be noted that in the United Kingdom, all TV updates from government are accompanied by live sign-language interpretation. However, we do not know whether any of our respondents are routine sign-language users.

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

Some styles of HA will be more susceptible than others to mechanical interference from face masks strings, and this may be reflected in the inconclusive results on this item. Unfortunately, we do not have data on the HA styles of our respondents, but they will be mixed.

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

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

Limitations

There are a number of limitations to this study. First, to design and conduct this study in a timely manner, some preliminary steps, such as stringent design and validation of the survey and deep consideration of inclusion/exclusion criteria, were not taken. This may compromise the quality of the results. Furthermore, while the restrictions and safety measures being imposed during the pandemic are similar in many countries, the present data were drawn from an exclusively Glasgow-based sample and thus may not be generalizable to other locations. Some between-participant factors which may impact an individual's perception of lockdown were not measured, notably employment status, household circumstances, and general health. Likewise, the potential for multi-morbidity or dual-sensory loss to exacerbate the negative experience of lockdown beyond hearing loss alone remains unanswered by these results. Nevertheless, the sample likely varies across such factors, and therefore, the observed associations between hearing loss and aspects of lockdown are assumed to be real, and not the product of confounding. Note that age was unrelated to both BE4FA ($r = 0.019$) and self-reported hearing ($r = -0.054$), suggesting that effects ascribed to hearing ability are not covert age effects. It is conceivable that a person's length of experience with HAs would affect their responses to our survey. We were able to dichotomize participants into users

vs. nonusers of HAs, but not into experienced vs. novice users. Thus, we implicitly assume that length of HA experience for HA users in our sample is distributed in a roughly representative manner, and is not a significant confounder.

The use of email invites and online surveys means that the samples are at least somewhat technologically competent; therefore, no conclusions can be drawn as to the experience of lockdown among people with hearing loss who are less computer literate. Finally, the relatively strict lockdown restrictions which were in place during data collection (in particular "stay at home" guidance) mean that participants may have had limited experience of speaking to people in face masks, from a safe distance, etc., making it difficult to respond to some questions.

CONCLUSIONS

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

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

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

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