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REVIEW ARTICLE

A review of the challenges facing people with hearing loss during the COVID-19 outbreak: toward the understanding the helpful solutions

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Abstract

Background and Aim: COVID-19 is a pandemic infectious disease caused by a novel coronavirus has made dramatic changes in people's individual, family, and social lifestyle. Most countries have implemented some regulations including wearing face masks, face shields, and gloves and physical, and social distance in public places to reduce the spread of the virus. However, these global recommendations may be associated with significant social, communication, and behavioral challenges for hearing-impaired people. This review explains the problems that hearing-impaired people may experience in the COVID-19 outbreak and also some helpful solutions that can be implemented by audiologists, healthcare professionals, and other members of the society that somehow interact with these people in such conditions that communication barriers increase.

Recent Findings: Recent findings indicate that wearing face masks, physical, and social distancing, e-learning and virtual communications during COVID-19 pandemic have provided some problems for people with hearing loss. This can, in turn, have negative consequences including increased feelings of loneliness, isolation and also some limitations in access to educational materials and rehabilitation training of lockdowns of schools and rehabilitation centers or some challenges of online learning at home.

Conclusion: People with hearing loss may experience problems during COVID-19 pandemic. There are some strategies that can be implemented to partially solve some communicative and social problems in this group. The use of transparent face masks, compensatory strategies, as well as optimization of virtual, and telehealth, telerehabilitation and tele-education services can be helpful for hearing-impaired people during this pandemic era.

Keywords: COVID-19; face mask; social distancing; hearing-impaired people; communication; compensatory strategies

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Introduction

COVID-19 is a pandemic infectious disease caused by a novel coronavirus that started from in city of Wuhan in China and then quickly spread worldwide and made dramatic changes in people's individual, family, and social lifestyle. These wide-ranged changes made fundamental alternations in the healthcare systems and their

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services. A large number of countries have focused on the reduction of COVID-19-induced deaths, through the implementation of the latest treatment protocol in the world and prevention of its further spread. This condition has given rise to some regulations which have been inevitably established to fight against COVID-19. Some of the new and inevitable regulations during this pandemic include using personal protection types of equipment such as face masks, face shields, and gloves as well as social and physical distancing. In addition, in some countries, wearing face masks in public places have been made mandatory to prevent the spread of the virus. Although wearing the face mask is one of the inevitable ways in the fights against COVID-19 outbreak, it seems to have caused some problems for people with hearing loss in communication and interactions. However, the negative impacts of masks are not limited to hearing-impaired people. Studies on the effect of face masks on the communication interactions of hearing people have shown that they also experience communication difficulties in noisy environments with wearing face masks [1]. Accordingly, Hamton et al. investigated the impact of wearing face masks on speech perception in normal hearing people who work in hospitals and found that when wearing a face mask, speech perception is attenuated by 70 dB compared with no mask condition. In addition, it was shown that although raising the volume of speech improves speech perception, comprehension of what was heard was still lower than no mask condition, indicating the importance of visual cues in communication [1]. They suggested that communication difficulties due to the masks will impact significantly healthcare workers [1]. However, it seems that wearing face masks is more challenging for people with hearing loss who communicate via spoken language. In fact, hearing-impaired people have inherently more severe limitations in communication interactions due to hearing loss and its many problems. However, wearing face masks can apparently exacerbate their communication problems. Verbal communication is one of the problems which has always been challenging for people with hearing loss, especially in noisy environments. Despite all these problems, wearing a face mask has created a new barrier for these people [2]. In particular, receiving medical healthcare can be problematic since it is quite challenging to make verbal communication in noisy environments like clinics and hospitals [2]. Souza et al. suggested that the main obstacle faced by the deaf community in the access to healthcare is related to the linguistic barrier, due to several impediments, such as lack of training of health professionals, financial difficulties to contract interpreters, and absence of adaptations for deaf patients [3]. The consequences of ineffective communication for people with any degree of hearing loss are unpredictable. Hearing loss usually causes psychological, social, educational, and occupational problems [4] and it seems that disabilities from hearing loss often target psychological factors [5]. Several studies have shown that hearing loss is associated with loneliness and social isolation [6-8]. For children and adolescents, communication difficulties due to hearing loss affect social interactions which are associated with many consequences including major problems in education, psychological disorders such as isolation, depression, disappointment, hopelessness, and in more severe cases aggression, and disruption of language and speech acquisition in younger children. Consequences of ineffective communication in hearing-impaired adolescents may happen in other ways because they are changing identities in this age range [8]. It has been shown that communication problems in hearing-impaired children integrated into regular schools might make it difficult for them to function properly in the class, which in turn can lead to feelings of isolation, and lack of belonging [8]. In addition, disruption of proper communication with peers causes the impaired acquisition of social and communication skills, as well as failure in learning social skills. It will lead to consequences such as low self-esteem, social rejection, feelings of inferiority, low, and limited quality of friendship as well as low self-belief and ultimately a negative impact on their mental health [8]. In addition to direct consequences of hearing loss, there are also other factors that affect the communication process such as

general communication skills, denial, and acceptance of hearing loss, attitudes to the hearing loss, and also attitudes and behaviors of peers and colleagues [9]. Similarly, for the elderly, hearing loss can be associated with disappointment, loneliness and communication difficulties and reduce their quality of life [7]. Therefore, hearing loss impacts personal, and social life and has multidimensional effects on communication, which can cause many problems for people with hearing loss. However, evidence of several studies indicates that the same degree of hearing loss cause a different amount of disability in different people which means that disability and handicap are not precisely predictable from hearing loss severity [9,10]. For example, Chang found that not all elderly persons with hearing impairment perceive hearing handicap and several factors other than auditory factors such as culture also contribute to the self-perceived handicap and disability due to the hearing impairment [10].

Despite all these problems, current state-mandated social and physical distancing has also exacerbated the difficulties for people with hearing loss. Currently, there is not much information available on the effect of face masks and distancing on the severity and the types of problems that hearing-impaired people may experience in this condition. Recently, only a few studies have addressed this important issue. The prevalence of various degrees of hearing loss in Iran is reported to be 14.7% [11]. In our previous study on a nursing home in 2006, 80% of the elderly people suffered from hearing loss [9]. On the other hand, given the population age pyramid, this rate is even likely to be higher in recent years and new studies are needed to examine the adverse effects of changes that may create a barrier to communication in various ways and the quality of life of hearing-impaired people in these conditions. This paper helps to explain various dimensions of the problems that may occur to the hearing-impaired people in the COVID-19 pandemic and to introduce some practical and helpful solutions to possible problems of these people in the new world of wearing face masks and distancing.

Main problems for hearing-impaired people during the COVID-19 outbreak

Face masks: a new barrier to communication for people with hearing loss with decreased acoustic energy of sounds and absence of lipreading and facial expressions

Humans have various communication needs. During the COVID-19 outbreak, some inevitable changes such as wearing the face mask and social and physical distancing are recommended which have affected social interactions for all people. However, these changes have caused several challenges for the hearing-impaired community. They have affected not only daily interactions between hearing-impaired and their partners but also the interaction between them and their therapists which is more important. Communication is the basis of the quality of services provided to the patient which, in this way, they can participate in their healthcare management [12]. This is well achieved through the effective communication between patient and therapist and is the heart of medical care [2]. It has been suggested that the main obstacle faced by the deaf community is receiving health care, the impaired relationship between the healthcare professional and patient [3]. The COVID-19 outbreak is expected to be temporary, but its impacts might last for years. There is little information on the impact of the COVID-19 outbreak on hearing-impaired people [13]. It seems that wearing a face mask is one of the major challenges for either people with hearing loss or their partners. However, there are few studies on face masks as a barrier to communication. A recent study showed that people with hearing loss have many problems in speech perception when talking to the face mask-wearing hospital staff [14] and therefore it has been suggested that the use of face masks has made communication with healthcare professionals harder for many of these patients [15]. Effective communication affects general health, thereby the communication needs of people with hearing loss during this pandemic should be taken into consideration. The prevalence of this problem is even higher in the elderly because about 72.4% of

people over 65 years old suffer from hearing loss and most people who are hospitalized because of COVID-19 infection are old people. Therefore, the COVID-19 outbreak is likely to impact lots of people [14,16]. In addition, a large proportion of older adults comprise audiologists' patient populations and they were asked to stay at home for nonessential services since they are at greater risk of more serious illness with COVID-19, so they were faced many problems in receiving hearing health-care and audiology services [17].

Wearing face masks affects daily communications in various ways which are mainly due to decreased acoustic energy of sounds and the absence of lipreading and facial expressions. Numerous studies have shown that wearing face masks decreases the acoustic energy of sounds [1,2,16]. In a recent study, it is shown that face masks act as a low-pass filter. In other words, it allows low frequencies to pass and attenuates high frequencies. This amount of energy attenuation in the N95 face mask is about 12 dB and in the surgical mask is about 3 to 4 dB. In addition, presbycusis primarily attenuates higher frequencies (2−4 kHz) [12,16]. The presence of noise makes communication even more difficult and sometimes impossible [12,16]. But this is not the only problem with wearing a mask. Face masks not only decrease the sound quality of the speaker's voice and make the speech perception difficult, but they also remove visual cues and thereby make lipreading impossible. When wearing a face mask, it is impossible to see people's facial expressions or lips which are essential for daily communication [2]. Various studies have demonstrated the impact of visual features on speech perception [1,2,15]. Some suggest that 60−70% of communication is based on non-verbal cues from lip patterns and facial expressions, which are even more critical for anyone with communication difficulties [15]. This is especially important for people who use sign language for communication. In sign-language communication, most of the information is transferred via facial expressions, so the communication interactions are strongly influenced by wearing face masks. However, sign language is currently less common for communication since many people with any degree of hearing loss use verbal and oral methods of communication. They also benefit from lipreading and facial expressions for a clearer and better speech perception. As face masks cover visual cues, stress, fatigue, and anxiety increase due to ineffective communication [18]. Audio-visual information is vital and helpful in communication especially for patients with severe to profound hearing loss. They usually use a hearing aid or employ verbal and manual methods or body expressions for communication. Therefore, covering lips and body gestures cause major problems for people with hearing loss [18]. The recent study in Itlay during the COVID-19 outbreak showed when people wear masks, 13.6% of subjects did not have difficulties, and 25.4% had mild, 37.3% moderate, and 23.7% severe difficulties. Interestingly, the main concern about face masks was the sound attenuation for 44.1% of subjects and the impossibility of lipreading for 55.9% [19]. In addition, a recent clinical trial shows that wearing face masks has a significant negative impact on the perceived empathy of patients and reduces the positive effects of the patient-therapist relationship [16]. It has been suggested that communication needs to be clear, dynamic, and easy to understand, as it can create a distance between therapist and patients [20].

Physical and social distancing: more multidimensional difficulties for people with hearing loss

The COVID-19 has created various restrictions and barriers for deaf and hearing-impaired people in their everyday communication, which wearing face masks is just one of them. Due to the need to control the outbreak, these restrictions and barriers in many countries are sometimes enforced in the form of relatively strict laws and regulations. Social distancing is another policy in response to the COVID-19 outbreak. Although this could also be a great barrier against the virus spread, it is already a barrier against social life and face-to-face human interactions, especially for hearing-impaired people. Deaf and hearing-impaired people are definitely dependent on everyday communication and need face-to-

face interaction and close eye contact.

Physical and social distancing has negative effects on the quality of life in several ways. Primarily, it makes hearing the sound harder due to an increase in distance. In the case of doubling the distance between people, since the intensity of the sound attenuates logarithmically, it decreases by 6 dB until it reaches the person's ear, and the process of decreased energy increases with distance. The normal conversation usually takes place at a distance between 0.5 and 1 meter. Social distancing recommends a 2-meter distance for safety purposes; so the energy of sound is attenuated by 6 to 12 dB or even more [16]. On the other hand, there is only about a 28 dB difference between the weakest and strongest phonemes in natural conversation, this amount of energy attenuation causes many low-energy phonemes not to be heard, which severely disrupts the communication process [21]. The negative effect of physical distancing is not only due to the reduction of the intensity of sounds, but most of its consequences are also related to the occurrence of social isolation [22]. While social isolation and loneliness are closely related, they do not necessarily mean the same thing. A socially isolated person does not necessarily feel lonely. However, it is shown that hearing loss might lead to both loneliness and social isolation [6-8]. A recent study has shown that lockdown and physical distancing have various negative impacts on all people. However, in this condition, people with hearing loss feel more socially isolated than ever before. In particular, the elderly and children with hearing loss are exposed to higher risks of loneliness and social isolation [22]. In a survey on 150 elderly people, 24 questions was asked about the hearing status, the significance of their hearing health, having problem in communication with masks, use of hearing aids and problem in wearing masks while wearing hearing aids, and use of compensatory strategies and remote services, during the COVID-19 pandemic. Results showed that most the elderly people consider hearing to be an important factor and they were likely to have interaction with their audiologist during the pandemic either directly or virtual. Few elderly people used remote services. Most of them also expressed that they have at least a little problem with their hearing, but interestingly, few used their hearing aids. In addition, most of the elderly persons reported problem in communicating with other people who were wearing a face mask and most of them used some communication strategies such as asking the commuinication partner to repeat the sentence or speak louder. Wearing face masks was more challenging for the elderly people that use hearing aid [17]. In children, interactions are limited to their families due to the school shutdowns. Physical distancing has led to many services being provided online, including remote learning. Many face-to-face interactions have become virtual, which has limited communications to video and phone calls during the outbreak. However, given the technological problems and limitations of such devices, especially telephones, which act as a high-pass filter (where most of the energy of low-frequency speech is filtered in the transmission of some speech features such as the fundamental frequency which is essential to identify people’s voice), it seems that they lack the quality for good communication and it has been shown that people with hearing loss experience many problems in phone calls during the COVID-19 outbreak [12]. In addition, a recent study showed that some hearing-impaired people, especially those with severe hearing loss experience serious problems in speech perception through online systems [2]. A survey on 129 adults with hearing loss showed that people with worse-reported hearing loss have more problems in video calls [13].

Therefore, another important issue for hearing-impaired people during COVID-19 lockdown is the use and reliance on communication technologies that may be accompanied by many problems [22]. However, despite their limitations, some have reported positive applications of virtual interacations for hearing-impaired people. This is probably because most virtual interactions occur at home which is less noisy compared to the work environment and it is usually with a familiar partner. However, the negative effects and consequences seem to be far greater [13]. Some negative aspects of virtual interactions

include several communication problems, diminished social interactions, and increased isolation [13].

With all these problems, the main problem is when a hearing-impaired person develops COVID-19 disease and is hospitalized. In hospital environments that are full of auditory stressors, psychosocial environmental factors strongly affect speech comprehension. In such environments, hearing-impaired people experience more communication and psychological-social problems [12].

In addition, in cases where hearing-impaired people are hospitalized, medications such as quinine (chloroquine, hydroxychloroquine) are used in some cases. Although the risk of permanent hearing loss is low with these medications, at least a group of patients temporarily experience episodes of hearing loss, tinnitus, and dizziness that can exacerbate their communication problems [23]. There are also some reports on the impact of COVID-19 on the auditory and vestibular system which suggest that the COVID-19 virus causes hearing loss and dizziness [24-27]. However, further studies are needed.

Information and educational limitations: a barrier to learning

Hearing-impaired people may encounter many problems in access to news and information on the COVID-19 outbreak as well as educational materials. As the situation changes rapidly, the accessibility of COVID-19 information updates is very important, and people with hearing loss may struggle to follow updated news on TV and radio [13]. However, educational restrictions for hearing-impaired children and adolescents seem to be a more important problem. This could be discussed for children with hearing loss from two aspects. First, some children who seeking specific habilitation services for the development of speech and language skills, and the second is the problems that hearing-impaired students may experience during the tele-education in online classes.

It seems that the drastic impact of the outbreak is more intensive for the cochlear implantees seeking habilitation services [28]. It has been reported that the cochlear implant (CI) surgery is a key procedure that is impacted by the outbreak [29]. With the prevalence of the COVID-19 outbreak, children with severe hearing loss who need cochlear implants have encountered surgery restrictions or cancellation. For pediatric patients, it is equally heartrending to postpone surgeries that we know to be time-sensitive and for children who are receiving limited benefit from hearing aids, any delay is less than ideal and will likely have irrecoverable consequences [29]. However, for all CI recipients, we must remember that the follow-up is as important as the surgery itself. Activation, subsequent programming, and auditory-based therapy are all key to long-term success [29]. A recent study showed that 96% of the parents reported that they could not follow up their CI mapping dates with their centers and 71% of them expressed that remote learning lessons were difficult for their children [30]. Because of policy for avoiding non-essential services, several services have changed to remote working. Unfortunately, in many countries, remote services at least in some areas of education are not yet operational and thier infrastructure must be provided.

In particular, failure of early hearing loss diagnosis and intervention leads to delayed speech and language development especially for children that have recently diagnosed with hearing loss. Given the vital contribution of hearing in language and speech development, early interventions minimize the negative impacts of hearing loss [4]. In addition, in cases when a hearing aid or cochlear implant was broken, they postponed referring to fix that due to financial problems, fear, or anxiety [13]. The financial burden resulted from cochlear implants imposes a lot of costs to families in the current socio-economic conditions. In a recent study, 79% of parents reported cochlear implant processor malfunction affected their auditory mode of communication with the child. Both parents and children are affected mentally and experience anxiety by cochlear implant malfunction. In young children, malfunction or temporary use of cochlear implants is directly related to the effectiveness of treatment. Such behavioral and psychological changes in

parents will also have major negative impacts on home-based activities [30].

However, a recent study in Turkey on demands for hearing aids during the COVID-19 outbreak showed an explosion [31]. Although hearing aids can improve quality of life, but only about one in five persons who could benefit from hearing aids actually wears one [21].

Although virtual communications and remote learning can be helpful in this era, there are some problems regarding these services. One of the main problems of tele-education for students is that not all students have access to online learning and teaching technologies such as the internet, computer, or smartphones especially in rural areas, therefore, some students will have educational problems [32,33]. It is also difficult to adjust particularly for students living in rural areas and those from low-income families [33]. A comprehensive literature review of e-learning in the COVID-19 pandemic era have been conductd and have shown that there are numerous challenges for students and academics which generally include difficulties to adjust by lecturers and students, connectivity issues, mental health-related issues such as stress, depression and anxiety, lack of basic needs, lack of teaching, and learning resources, unconducive physical environment [33].

Even if there is access to the required technology, hearing-impaired students still have specific demands. Many deaf and hearing-impaired people use verbal and oral methods for communication. Therefore it is vital for them to see their teacher's face and hear him/her in order to understand concepts and materials. To compensate for the problem, hearing-impaired students have to rely on their knowledge of the language which requires more effort and leads to fatigue. In fact, communication limitations are their main problem in online classes. The next problem is that available technologies are not optimal for hearing-impaired people. Slow Internet connection during online class may cause them they fail to see their teachers or hear him/her which exacerbates their problem. In recent years, a high number of deaf and hearing-impaired children study are integrated into regular schools and the current online classes fail to provide them with optimal learning outcomes. It has been suggested that the lack of social interactions, poor communication, and poor students' outcomes were associated with the perceived ineffectiveness of e-learning [32]. In addition, in a recent study in Ghana, more than half of the participants interviewed believed that the traditional approach in learning is more suitable than online learning [32]

The other problem in some low-income countries is the lack of history and adequate infrastructure for online education. In addition, in some countries, telemedicine and telerehabilitation have been used for a long time and both families and physicians have experienced using them. A recent survey on 120 audiologists in UK has shown that 30% of audiologists had used tele-audiology prior to COVID-19 restrictions; and 98% had done at the time COVID-19 outbreak. The experience of audiologists with tele-audiology has generally been positive and it has been suggested that tele-audiology can improve travel, convenience, flexibility, and scheduling, that it can have little or no impact on satisfaction and quality of care, but that it can negatively impact personal interactions. There is also another concern about tele-audiology that we can not conduct some clinical procedures remotely [34]. Similar to tele-education, some concerns about telemedicine are technological limitations such as access to and use of technology, and poor internet connection [34]. Thus improvements to infrastructure and training are necessary and also there is a need hybrid method providing both remote and face-to-face services [34]. For example, there is a challenge for parents whose child has been recently diagnosed with hearing loss. They need specific counseling services and mental support to accept their child's hearing problem. Services that psychologically provide the therapist's empathy for parents of hearing-impaired children that are less feasible in online counseling. In addition, due to the absence of face-to-face communication required to manage the complex mental conditions that they may experience in this situation, they also may reject the full cooperation in telerehabilitation

programs.

The other possible problem mentioned by families of children with hearing loss in the online classes is the psychological problem for all family members, especially parents. For example, parents reported that performing therapeutic exercises at home is difficult and exhausting. This is because families and children have stayed at home for a long time. In such a situation, children will not cooperate in performing the requested tasks [30]. In addition, they have more difficulty in adapting to online learning environments because this is new for them. A recent study showed that with respect to the home training programs and remote learning aspects, 96% of the parents agreed that the home training methods were challenging and 71% of the parents expressed that remote learning lessons were difficult for their children [30].

Regardless of the type and amount of services available to different patients, as well as the various problems, there are some strategies to help hearing-impaired people to improve the communication and interactions in difficult situations, some of which are mentioned below.

Helpful strategies

Compensatory strategies

Due to the problems that occur to hearing-impaired people, it will be very good that all persons who somehow have interaction with hearing-impaired people to be aware of the negative impacts of physical distancing while communicating with them. Physical distancing is harmful to hearing-impaired people who communicate via spoken language and exacerbate pre-existing social isolation and withdrawal social and emotional loneliness [14]. If these people do not find ways to solve their problem during the critical conditions that there are lots of communication barriers like the COVID-19 era, they will feel more isolated and lonely [22].

Given the importance of the COVID-19 outbreak, the World Federation of the Deaf has issued a statement that all governments should provide the access to information and health services in national sign languages, as well as access to all forms of daily life activities such as education and other public services which may be presented in different formats during this outbreak [35**]** So that no deaf or hearing-impaired person becomes ill due to lack of access or ignorance of critical information about COVID-19 preventive strategies or performing high-risk health behaviors.

There are also some recommendations for persons for audiologists, healthcare professionals/ workers, families with hearing-impaired persons, and also all members of the community that has interaction with these people on how to facilitate communication with hearing-impaired people. These strategies can be also implemented by the hearing-impaired people themselves. In this regard, effective communication and empathy with hearing-impaired people should be ensured and healthcare professionals should be encouraged to become familiar with these issues and apply them especially in interactions with the elderly [14,21,36].

- Attract people's attention and have eye contact with hearing-impaired people.
- If they do not understand you, repeat your sentence with more emphasis on keywords. Hearing-impaired people can also ask the partner for repeating with a slower rate and more emphasis.
- Ask hearing-impaired people about the best way to communicate with them and if required, write it down.
- If a person suffers hearing loss and avoids using a hearing aid, encourage them to use it, and ensure that the hearing aid or cochlear implant functions well. Studies suggest that the use of a hearing aid reduces the psychosocial consequences of hearing loss [7].
- Avoid several people talking to one patient at the same time (reduce the number of people who want to communicate with the patient).
- Provide clear communication for all patients which includes talking to the patient face-to-face, reducing the background noise, speaking slowly, not speaking while walking, etc.
- Use transparent or clear face masks as shown in Fig. 1. As shown, these masks make the use of lipreading and visual cues possible.

Fig. 1. Transparent face mask.

- Use technologies to improve communication, such as phone call-to text apps or speech-to-text apps.

Essential information should be provided to healthcare workers and the deaf and hearing-impaired people on what to do in these conditions so that they do not get confused and face problems in medical centers. Healthcare workers could use to be encouraged to use these strategies to help hearing-impaired people visiting hospitals. The Massachusetts Commission for the Deaf and Hard of Hearing has designed a COVID-19 visual tool to assist healthcare professionals and Deaf and hearing-impaired people to communicate better during medical appointments [14]. These visual cards include figures about prevention and treatment of illness, get medical help, quick communication, patient's symptoms and duration of that, and some tips for health providers [14]. In this way, healthcare workers can easily ask hearing-impaired people about their symptoms and give them the necessary advice on COVID-19 prevention [14]. People with hearing loss should also be prepared before entering medical centers. They can use pre-prepared notes and show their notes to the healthcare workers that they cannot hear them or they cannot understand them when wearing a face mask. In addition, they could be taught to employ compensatory strategies such as asking to repeat the sentence or speaking slowly to better communicate with therapists.

Optimization of telehealth, telerehabilitation and tele-education

How could the loneliness of hearing-impaired people be managed during the COVID-19 outbreak? As mentioned currently many face-to-face interactions have become virtual, which has limited communications to video and phone calls. Although remote strategies can never replace face-to-face services, telehealth can be used to securely communicate with the hearing impaired. The simplest way is to use phone calls. We can call them and ask if they need any specific help. Such human behaviors to some extent can help to alleviate their feelings of loneliness and isolation. Taking these strategies, hearing-impaired people will realize that they are important and this is a sign of social responsibility which will be associated with many positive effects [22]. It seems that all people have a social responsibility toward them. It is not only the audiologists' social and ethical responsibility but also other healthcare professionals and those who are in contact with these people. In addition, many services can be provided remotely without the physical presence of people to prevent the spread of the virus. Due to the prolongation of lockdown, with schools temporarily closed, there are no more options for rehabilitation centers and schools but to provide services online, however, a series of essential changes should be made and platforms have to be provided. Rehabilitation centers should be prepared to continue rehabilitation programs for hearing-impaired children online. Meanwhile, it is necessary to motivate parents to be serious about the continuous use of hearing aids and following up on online rehabilitation classes for their hearing-impaired children. In fact, rehabilitation methods should be more family-based and motivate them to perform active rehabilitation activities at home and limit face-to-face visits except in urgent cases. Although a recent study has shown that the home training programs provided by their clinicians were followed accurately by 50% of the parents and a significant number of parents reported that

they did not follow the methods at home [30].

Currently, telemedicine is going to continue to be the first choice in order to maintain social distancing [28]. Regardless of problems in telehealth, tele-audiology, and tele-education, Some data on hearing-impaired people using online services reported positive results [34]. For example, it has been found that some hearing-impaired people are more comfortable with online communication [34].

It has been suggested that tele-audiology has met physical distancing requirements by providing convenience and satisfaction for patients. Vast technological advances in artificial intelligence and virtual reality can help to remove place, time, and even language barriers and allow an audiologist in one country to counsel a patient in another country to troubleshoot a malfunctioning hearing aid or help a patient to seek tinnitus relief [37]. A recent study has also shown the effectiveness of pilot tele-audiology for demands of patients in a primary care service with the same quality [20]. They suggested that it can be an appropriate way to provide the necessary assistance to patients in social distance conditions [20]. Some digital platforms like websites and applications have been introduced for tele-audiology and telerehabilitation services. For example, tele-therapeutic multimodal systems like train2hear have been found to be effective for adult CI users that provides a cost-effective and structured rehabilitation platform to these users [28]. Many tools have been designed in this regard, but the effectiveness of these methods must be monitored over time. However, this is not generalizable to all countries. As mentioned low-income countries may encounter more problems in remote services and there is a need to provide and improve adequate infrastructures.

School teachers that are chosen for remote learning should be aware of the special needs of children with hearing loss and provide the necessary facilities for the proper understanding of the educational materials for these students. This is of significant importance for those hearing-impaired children integrated into regular schools. It is important to know the demands of hearing-impaired children and how they can be met. On the other hand, the full participation of parents in the education of their deaf and hearing-impaired children in the critical COVID-19 outbreak seems more important than ever. It is recommended to support teachers of deaf and hearing-impaired children and reduce the number of their students in the class. How is it possible to establish these behavioral changes and provide such services to parents that are in remote areas and lack the necessary literacy skills to help them for accessing online facilities? This is a question that service-providing managers should answer and find the necessary solutions. As mentioned, some countries have had a history of tele-education for a long time, but some lack such a history and has just started these service, thereby its infrastructure must be provided. For example, relatively acceptable strategies have been taken for hearing-impaired people in some countries such as Iran. Based on Irna news the State Welfare Organization Of Iran Education Organization has provided special educational content for hearing-impaired students during the COVID-19 outbreak era in different provinces and cities of Iran so that students can fully benefit from online education. In addition, a variety of educational materials also be provided to students living in areas with no internet access in the form of CDs. Education in the Iran national media is also broadcast at all levels with a sign language interpreter, which may be useful to some hearing-impaired people because they might not be familiar with sign language and at the present, the first choice for hearing–impaired children to communicate is an auditory-verbal training method. Regarding the feasibility of telerehabilitation in Iran, a recent study has shown that there is an appropriate acceptance and administrative culture to implement this technology among rehabilitation experts, and will be a promising method in rehabilitation academic centers [38].

The COVID-19 has provided an opportunity to investigate the use of such technologies for this group of people to improve the services in such critical conditions. According to the topics mentioned above, we can help hearing-impaired people to overcome their problems in critical situations with optimization of tele-audiology,

telehealth, and tele-education services.

Conclusion

COVID-19 outbreak has caused a lot of problems for hearing-impaired people. Wearing masks and social distancing disrupts the communication that has already been impaired in these patients and increases its consequences such as depression and loneliness. There are some compensatory strategies that may be useful for hearing-impaired people and they need to be trained for those helpful strategies, which are primarily the responsibility of audiologists or other healthcare professionals who somehow have interactions with these people to help them to overcome their problems in the critical situations. Optimization of tele-audiology, telehealth, and tele-education services is also needed which it should be addressed by improving the adequate infrastructures.

Conflict of interest

The authors state that there was no conflict of interest.

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