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Original Research Article

Entina HearSmart: a novel mobile based auditory training app for better adaptation of hearing aids

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ABSTRACT

Background: The most common intervention prescribed for hearing impaired individuals is hearing aids. It has been noticed that in spite of using hearing aids, elderly individuals with hearing impairment, still struggle in hearing and understanding. Therefore, additional intervention is required for auditory rehabilitation to ease the adaptation of hearing aids. Evidence from studies published in the recent years suggests that, auditory training is likely a useful tool to improve speech perception and other cognitive skills in patients with hearing loss with and without the use of hearing aids. The aim of the study was to test the usefulness of our mobile app-based auditory training program to increase speech reception and communication and thereby improve hearing aid adaptability in patients with sensorineural hearing loss who have been fitted with a hearing aid.
Methods: 40 patients were selected for the study, they were divided into 2 groups: Group 1 consisted of 20 patients who received auditory training using Entina HearSmart Android App, Group 2 consisted of 20 patients who received no auditory training (Control group).
Results: The results showed that performance on the vowel, consonant and sentence tests in noise was significantly increased in patients who used our app for auditory training compared with that of the Non-Training Group.
Conclusions: Entina HearSmart is a free, standardized and easy way to improve the outcome of hearing aids in adults and must be prescribed when a hearing aid has been fitted. When used sincerely after hearing aids have been fitted, using our app can significantly improve communication and thereby improve hearing aid adaptability.

Keywords: Hearing aids, Hearing, Audiometry, Auditory training

INTRODUCTION

Hearing loss is one of the most common problems faced by individuals and creates problems in daily activities due to impairment of communication. Due to hearing impairment, the acoustic stimuli are perceived to be degraded.[1] This causes great difficulties since speech recognition needs the acoustic signal to be correctly decoded.[2] In daily life, there are a variety of sounds and noises in the background of speech that make communication even more difficult.[3] Research suggests that hearing-impaired individuals have a significantly worse speech perception performance as compared to normal-hearing individuals.[4] This worsening of speech perception causes an increase in the cognitive load imposed by listening.[5] Therefore, hearing-impaired individuals have to put in extra effort to successfully perceive speech.[2,6] This increased cognitive load can cause adverse psychosocial consequences, in the form of mental distress and fatigue, tiredness and sick leave from work owing to stress.[7-12]

The most common intervention prescribed for hearing impaired individuals is hearing aids.[13,14] However, it is estimated that in spite of requiring them, a large population is currently not using hearing aids.[15]

It has been noticed that in spite of using hearing aids, elderly individuals with hearing impairment still struggle in hearing and understanding.[16] The probable cause for the same is a reduction in cognition or memory performance which plays an important role in everyday communication. These changes are known to occur in individuals with hearing loss.[17–19] Therefore, additional intervention is required for auditory rehabilitation to ease the adaptation of hearing aids. Auditory Training is one such intervention to better the auditory skills and improve perceptual distinction of sounds and speech and therefore improve communication skills. This method can help in auditory rehabilitation of patients with hearing loss who require hearing aids.[20,21] A structured auditory training can be used as a self-management tool for auditory rehabilitation.[20–22] The advantage of a well-structured auditory training program which is computer based is that patients can train at home and need to visit their doctor or audiologist only to assess the impact of the training.[14,20,23] The impact of training is best assessed by testing with untrained tasks rather than the tasks the patient has been trained for.[20,24] In addition, it is important to compare the impact of training with that of a control group who has not received training to rule out other confounding factors. Evidence from studies published in the recent years suggests that auditory training is likely a useful tool to improve speech perception and other cognitive skills in patients with hearing loss with and without the use of hearing aids.[20] A recent meta-analysis also suggests that auditory training can also improve working memory and overall cognition in addition to speech perception.[25] Therefore, auditory training coupled with amplification of hearing using hearing aids can together improve cognition and communication skills in patients with hearing loss.[20,25,26]

Objective of this study

To test the usefulness of a mobile app based auditory training program to increase speech reception and communication and thereby improve hearing aid adaptability in patients with sensorineural hearing loss who have been fitted with a hearing aid.

METHODS

This study was a prospective study conducted between February 2021 to February 2022 in an ENT OPD setup with attached hearing aid center.

40 patients were selected for the study, they were divided into 2 groups: Group 1 consisted of 20 patients who received auditory training using Entina HearSmart Android App, Group 2 consisted of 20 patients who received no auditory training (Control group).

Inclusion criteria

Adults above the age of 49 years. Bilateral Sensorineural hearing loss. Severity of hearing loss was defined to be moderate to severe in both ears. Patients with hearing impairment without any hearing aid experience in the past.

Exclusion criteria

Patients who did not complete the module in a timely manner. Patients with Neurological deficit.

Audiograms were performed in the same setting for all patients. The Hear in Noise tests were conducted separately in the absence of the audiologist to avoid bias. The same model hearing aid was used and both ears were fitted with hearing aids. Correctness of Hearing Aid programming was tested based on sounds of the speech banana being correctly identified after the hearing aid was given. This was done based on a standardized module in Entina HearSmart Android App.

Auditory training was done using Entina – HearSmart, an app developed by our team on the android platform with modules for intensive auditory training program with two training sessions per day. Auditory Training included training on auditory stimuli with only numbers spoken with background noise comprising of railway station, city traffic, kitchen sounds, nature sounds and crowds. Each background module lasted for 2 minutes, therefore each session lasted for 10 minutes only. The App was designed to have a constant speech to noise ratio and speed of speech. The participants were instructed to identify the numbers in the presence of noise and a score was given based on the correct value entered.

Patients were tested immediately after the hearing aid was fitted as a baseline and again after 15 days in which the training lasted for 10 days.

Objective test was done using a Hear in Noise Test (HINT) once immediately after fitting the hearing aid and once after 10 days to test for improvement. Patients of both groups were instructed to use the hearing aids daily for 10 days when awake. HINT is an adaptive threshold test in which the subject is tasked with identifying and repeating short simple sentences, vowels and consonants. For this test, in addition to speech from the front for the quiet test, noise is added to the front, right, and left side at a 90-degree angle. The speech was tested for vowels, consonants and sentences separately. Speech to Noise ratio was the same throughout and the noise was the same for all patients tested. A total of 100 consonants, 100 vowels and 100 short sentences (in English) were tested and the percentages of correct answers were calculated for each test performed. Patients were given scores accordingly.

Results were analyzed and significance was calculated using Chi Square test.

RESULTS

A set of 100 vowels were played in a pre-recorded voice in the presence of noise, maintaining a constant speech to noise ratio.

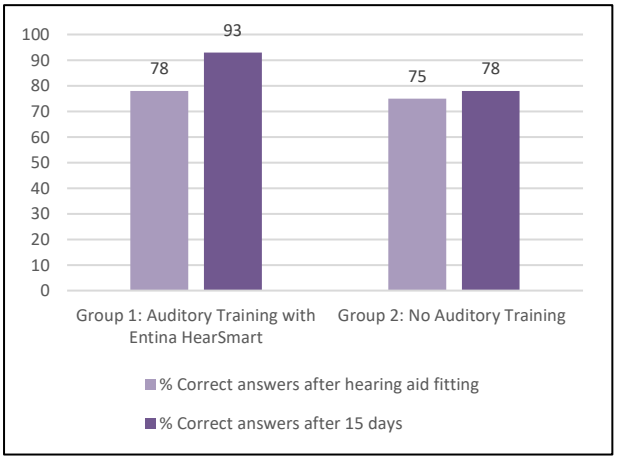

Figure 1: Vowels in noise test - percentage of correct answers.

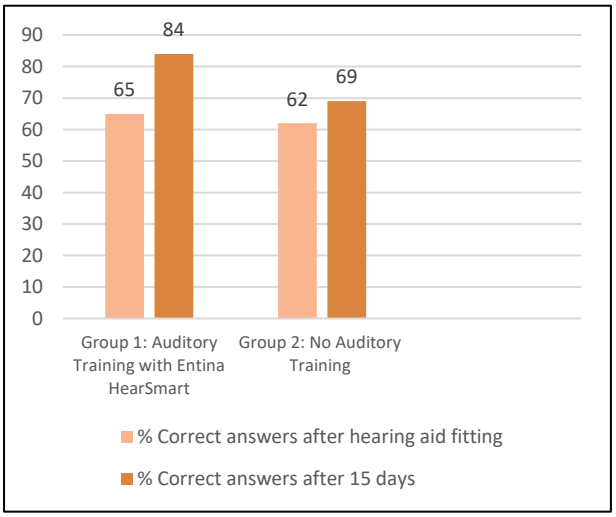

Figure 2: Consonants in noise test - percentage of correct answers.

The group with no auditory training showed an improvement, however there was significantly higher improvement in the group that had received auditory training suing our app.

A set of 100 consonants were played in a pre-recorded voice in the presence of noise, maintaining a constant speech to noise ratio. The group with no auditory training showed an improvement, however there was significantly higher improvement in the group that had received auditory training with our app.

The results showed that performance on the vowels, consonant and sentence tests in noise was significantly increased compared with that of the non-training group.

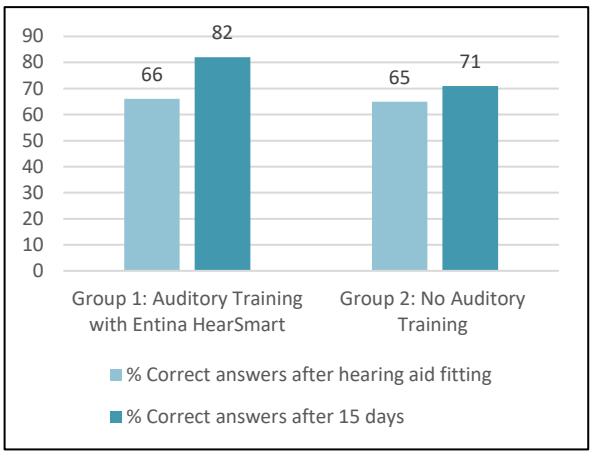

Figure 3: Sentences in noise test - percentage of correct answers.

DISCUSSION

In a similar study conducted by Yu et al, results showed that performance on the consonant and sentence tests in the group receiving auditory training using their mobile app was significantly increased compared with that of the non test group. They also concluded that improved speech perception was retained at 2 weeks after the training was completed. However, vowel scores were not changed after the 4-week training in both groups.[27] In our study however, there was an improvement in the vowels, consonants as well as the sentences tested in noise.

It is known that less than 10% of audiologists offer auditory training to patients with hearing impairment. Patients usually prescribed auditory training often do not complete the training.[28] In such a situation, an android based mobile app which can be used at home along with short training sessions (10 minutes each) can improve compliance and thereby benefit the patients.

Hearing aids are known to reduce problems with communication, but there is no known significant improvement in speech perception, social interaction or cognition. The effect of hearing aids and auditory training significantly improves depressive symptoms with a moderate to large effect size.[29] This is due to an overall improvement in communication and an improvement in speech intelligibility.

There is known to be a short-term improvement of the auditory subfunction shortly after Computer Based Auditory Training. Computer Based Auditory Training programs are an effective option for auditory rehabilitation in Cochlear Implant patients. In a study conducted by Volter et al a Suitable German-language program was conceived as an alternative to face-to-face

training for patients who have undergone cochlear implants.[30] Similarly a mobile based Auditory Training program can be useful for patients who have recently been fitted with hearing aids.

A similar study conducted by Gil et al had fourteen bilateral hearing aid users, who were divided into two groups: seven who received auditory training and seven who did not. Measuring electrophysiological and behavioral auditory processing and administration of the Abbreviated Profile of Hearing Aid Benefit (APHAB) self-report scale were assessed pre and post auditory training. The post-training evaluation of the experimental group demonstrated a statistically significant improvement in performance in some of the behavioral auditory processing tests and higher hearing aid benefit in noisy situations.[31]

A study was conducted by Humes et al in 2019, to evaluate their effects of the at-home auditory training program. The participants were adults, aged 54 to 80 years, with the mild-to-moderate hearing loss. Of the 51 identified eligible participants, 45 enrolled as a volunteer sample and 43 of these completed the study. Frequent-word auditory training regimen completed intervention at home over a period of 5 weeks. The active control group listened to audiobooks (placebo intervention) and the passive control group completed no intervention. The primary outcome measure is a Connected Speech test benefit. The secondary outcome measure is a 66-item self-report profile of hearing aid performance. Participants who received the at-home training intervention demonstrated significant improvements on aided recognition for trained materials, but no generalization of these benefits to nontrained materials was seen. This was despite reasonably good compliance with the at-home training regimen and careful verification of hearing aid function throughout the trial. Based on follow-up post-trial evaluation, the benefits observed for trained materials in the intervention group were sustained for a period of at least 8.5 months.[32]

CONCLUSION

Auditory training has been proved to increase speech understanding in patients with hearing loss. A mobile based standardized app can increase the compliance of auditory training when it can be done from the comfort of the patient's home. When used sincerely after hearing aids have been fitted, such an app can significantly improve communication and thereby improve hearing aid adaptability. Entina HearSmart android app is a free, standardized and easy way to improve the outcome of hearing aids in adults and must be prescribed when a hearing aid has been fitted.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Humes LE, Roberts L. Speech-recognition difficulties of the hearing-impaired elderly: the contributions of audibility. J Speech Hear Res. 1990;33(4):726-35.
2. McCoy SL, Tun PA, Cox LC, Colangelo M, Stewart RA, Wingfield A. Hearing loss and perceptual effort: downstream effects on older adults' memory for speech. Q J Exp Psychol A. 2005;58(1):22-33.
3. Hällgren M, Larsby B, Lyxell B, Arlinger S. Speech understanding in quiet and noise, with and without hearing aids. Int J Audiol. 2005;44(10):574-83.
4. Hagerman B. Clinical measurements of speech reception threshold in noise. Scand Audiol. 1984;13(1):57-63.
5. Shinn-Cunningham BG, Best V. Selective attention in normal and impaired hearing. Trends Amplif. 2008;12(4):283-99.
6. Rönnberg J, Lunner T, Zekveld A, et al. The Ease of Language Understanding (ELU) model: theoretical, empirical, and clinical advances. Front Syst Neurosci. 2013;7(6).
7. Stephens D, Hétu R. Impairment, disability and handicap in audiology: towards a consensus. Audiology. 1991;30(4):185-200.
8. Kramer SE, Kapteyn TS, Festen JM, Kuik DJ. Assessing aspects of auditory handicap by means of pupil dilatation. Audiology. 1997;36(3):155-64.
9. Kramer SE, Kapteyn TS, Houtgast T. Occupational performance: comparing normally-hearing and hearing-impaired employees using the Amsterdam Checklist for Hearing and Work. Int J Audiol. 2006;45(9):503-12.
10. Gatehouse S, Gordon J. Response times to speech stimuli as measures of benefit from amplification. Br J Audiol. 1990;24(1):63-8.
11. Edwards B. The Future of Hearing Aid Technology. Trends Amplif. 2007;11(1):31-45.
12. Hornsby BWY. The effects of hearing aid use on listening effort and mental fatigue associated with sustained speech processing demands. Ear Hear. 2013;34(5):523-34.
13. Chisolm TH, Saunders GH, Frederick MT, McArdle RA, Smith SL, Wilsond RH. Learning to listen again: the role of compliance in auditory training for adults with hearing loss. Am J Audiol. 2013;22(2):339-42.
14. Henshaw H, McCormack A, Ferguson MA. Intrinsic and extrinsic motivation is associated with computer-based auditory training uptake, engagement, and adherence for people with hearing loss. Front Psychol. 2015;6.
15. Davies HR, Cadar D, Herbert A, Orrell M, Steptoe A. Hearing Impairment and Incident Dementia: Findings from the English Longitudinal Study of Ageing. J Am Geriatr Soc. 2017;65(9):2074-81.
16. Kaplan-Neeman R, Muchnik C, Hildesheimer M, Henkin Y. Hearing aid satisfaction and use in the

advanced digital era. Laryngoscope. 2012;122(9):2029-36.
17. Lin FR, Metter EJ, O'Brien RJ, Resnick SM, Zonderman AB, Ferrucci L. Hearing loss and incident dementia. Arch Neurol. 2011;68(2):214-20.
18. Lin FR, Ferrucci L, Metter EJ, An Y, Zonderman AB, Resnick SM. Hearing loss and cognition in the Baltimore Longitudinal Study of Aging. Neuropsychology. 2011;25(6):763-70.
19. Fulton SE, Lister JJ, Bush ALH, Edwards JD, Andel R. Mechanisms of the Hearing-Cognition Relationship. Semin Hear. 2015;36(3):140-9.
20. Henshaw H, Ferguson MA. Efficacy of individual computer-based auditory training for people with hearing loss: a systematic review of the evidence. PLoS One. 2013;8(5).
21. Olson AD. Options for Auditory Training for Adults with Hearing Loss. Semin Hear. 2015;36(4):284-95.
22. Dubno JR. Benefits of Auditory Training for Aided Listening by Older Adults. Am J Audiol. 2013;22(2):335.
23. Tye-Murray N, Sommers MS, Mauze E, Schroy C, Barcroft J, Spehar B. Using patient perceptions of relative benefit and enjoyment to assess auditory training. J Am Acad Audiol. 2012;23(8):623-34.
24. Wright BA, Zhang Y. A review of the generalization of auditory learning. Philos Trans R Soc B Biol Sci. 2009;364(1515):301.
25. Lawrence BJ, Jayakody DMP, Henshaw H. Auditory and Cognitive Training for Cognition in Adults With Hearing Loss: A Systematic Review and Meta-Analysis. Trends Hear. 2018;22.
26. Anderson S, Jenkins K. Electrophysiologic Assessment of Auditory Training Benefits in Older Adults. Semin Hear. 2015;36(4):250.
27. Yu J, Jeon H, Song C, Han W. Speech perception enhancement in elderly hearing aid users using an auditory training program for mobile devices. Geriatr Gerontol Int. 2017;17(1):61-8.
28. Sweetow RW, Sabes JH. Auditory training and challenges associated with participation and compliance. J Am Acad Audiol. 2010;21(9):586-93.
29. Nkyekyer J, Meyer D, Pipingas A, Reed NS. The cognitive and psychosocial effects of auditory training and hearing aids in adults with hearing loss. Clin Interv Aging. 2019;14:123-35.
30. Völter C, Schirmer C, Stöckmann C, Dazert S. Computer-based auditory training for hearing rehabilitation of adult cochlear implant users. HNO. 2020;68(11):817-27.
31. Gil D, Iorio MCM. Formal auditory training in adult hearing aid users. Clinics (Sao Paulo). 2010;65(2):165-74.
32. Humes LE, Skinner KG, Kinney DL, Rogers SE, Main AK, Quigley TM. Clinical Effectiveness of an At-Home Auditory Training Program: A Randomized Controlled Trial. Ear Hear. 2019;40(5):1043-60.

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