



The prevalence of hearing loss in different age groups, gender and Hearing threshold: A systemic review

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ABSTRACT

Objectives: The current scoping review is an attempt to explore the prevalence of Hearing Loss (HL) in different age groups and prevalence based on gender was our major concern. **Methodology:** In the systemic review, an online search was conducted using Google Scholar, Science Direct, ProQuest, and PubMed. A two-phase mapping approach was used. In the first phase, studies were screened. In the second phase, the data were extracted from selected studies followed by the assessment of data quality. A total of 14 studies were included; 13 were cross-sectional and 1 was qualitative. We compare the studies in tabular form. **Results:** The most common and same character in all studies were the prevalence rate was higher in males than females and the hearing threshold was increasing by increasing age. The hearing loss was more common in rural areas. HL was increasing by the increase in age groups. **Conclusion:** We concluded that by educating and advising people we can decrease hearing abnormalities and co-comorbidities.

Keywords: Prevalence, Children, Adolescents, Systematic review

INTRODUCTION

The human ear is the organ of hearing and equilibrium that identifies and analyzes sound by transduction and keeps up the sensation of equalization. The ear comprises three sections outer ear, center ear, and inner ear. The WHO assessed that in 2012 there was a high extent of people worldwide with impairing hearing loss (360 million individuals or 5.3% of the entire populace), albeit incapacitating hearing loss in East Asia is assessed to be tons higher at 22% [1]. The outer ear collects sound waves and guides them to the tympanic film. The middle ear may be a restricted air-filled cavity within the worldly bone. It is crossed by a sequence of three tiny bones the malleus, incus, and stapes, on the entire called the auditory ossicles. In the hearing cycle, waves of different frequencies came and collapse with the eardrum by which the eardrum vibrates and acts as an amplifier. These sound vibrations clear their path through the ossicles to the cochlea so stable vibrations make the liquid within the cochlea travel like sea waves [2,3]. The development of liquid thus makes the hair cells move. Hair cells toward one side of the cochlea move low-frequency sound data and hair cells at the far edge move high-frequency sound data. The hearable nerve moves signs to the mind where they're then converted into unmistakable and important sounds [4].

Hearing disability features a staggering, and negative effect on the development of babies. Children having two-sided hearing loss or one-sided deafness of fluctuating degrees above 1000 Hz create a noteworthy end of the day impacts on discourse and language sciences [5,6]. Decreased hear-able information additionally antagonistically influences the development of the hear-able sensory system, and may adversely influence the discourse recognition that meddles with the augmentation in social, passionate, conduct, and psychological circles, scholastic accomplishment, professional other options, business, and financial independence [7,8]. Young children sometimes lose their hearing after they get a couple of diseases, including meningitis, encephalitis, measles, chickenpox, and influenza. Head wounds, boisterous clamors, and a couple of drugs can likewise cause deafness. Age-related hearing loss is the loss of hearing that progressively happens during a large portion of folks as we become skilled. It's one of the foremost well-

known conditions influencing more seasoned and older grown-ups. Within the older, incessant hearing misfortune is the third pervasive condition. Roughly half the Chinese population beyond 65 years old have hearing hindrance. It had been assessed that 58.6 million Chinese had a hear-able turmoil within the year 2018 [9-11]. Hearing hindrance is additionally a standard condition in China that increases with age. Experiencing difficulty hearing can make it difficult to grasp and follow a specialist's recommendation, react to admonitions, and listen to telephones, doorbells, and smoke cautions. Hearing misfortune can likewise make it difficult to understand chatting with loved ones, prompting sentiments of disengagement [10]. Conditions that are more normal in individuals, for instance, hypertension or diabetes, can increase hearing misfortune. Prescriptions that are poisonous to the tactile cells in your ears (for instance, some chemotherapy drugs) can likewise cause hearing loss. Fringe hearing loss is generally ordered as conductive (brought about by disability of the external or center ear) or sensorineural (brought about by brokenness within the cochlea or winding ganglion). Hearing loss that has both conductive and sensorineural parts is arranged as blended. Conductive hearing loss results from an obstacle or sickness of the external or center ear that forestalls transmission of sound vitality to the inward ear. The explanations for conductive hearing loss extend from cerumen impaction and otitis to obsession of a minimum of one among the middle ear bones, essentially obsession of the stapes (smallest bone of body found in the ear) due to otosclerosis. Clinical or careful treatment of most kinds of conductive hearing loss regularly brings about full reclamation of hearing. On the other hand sensorineural hearing loss is a type of hearing loss in which the major cause lies in the inner ear or sensory organ or the vestibulocochlear nerve (cranial nerve VIII). Sensorineural hearing loss accounts for about 90% of reported hearing loss [12].

Our aim in this study was to learn the prevalence of hearing loss in different groups and major causes or to first areas where hearing loss more common.

METHODOLOGY

In this scoping review study, a step-by-step methodological framework developed by Arksey and O'Malley was used [4]. This methodology was also applied in several other studies [5,6]. The steps involved in the scoping review were determining the study query; identifying relevant research; research selection; charting; collecting; summarizing the data; and reporting the results. Identifying the research question according to the recommendations of the Arksey and O'Malley framework, all aspects of the research area should be considered to develop a question that generates a breadth of coverage. After analyzing the literature, we formed our overriding study question as follows:

Inclusion and Exclusion Criteria

Inclusion criteria were specified as follows: papers written and available in English describing the main research study, using either a quantitative or qualitative study method or a combination of both. The exclusion criteria were developed during the title and abstract examination phase and applied at the full review stage, with one more additional criterion being included. In other words, studies particularly performed on HL among the all aged group population were included in this scoping review study, and the search was also narrowed down to the articles published in the last 18 years. Finally, studies performed in different countries were included in the review. To determine which countries should be included, it's was easy for us because of the low information present regarding our topic, so we included all countries which we found.

Relevant Literature

Identification For the scoping review to be in-depth, Arksey and O'Malley recommended searching several literature resources, which included electronic directories and a reference list of relevant literature [4]. We approached this scoping review study by including several different phases, first focusing on electronic literature databases including Google Scholar, ScienceDirect, ProQuest, and PubMed. The keywords used for the search using Boolean operators were "hearing abnormalities", "Geriatrics hearing loss", "Cross-sectional studies related to hearing loss", "MR effect on hearing", "Child causes of hearing loss", "patterns", "reasons" and predictors. The online search was carried out from June 2020 to August 2020. A final online search was conducted in 2018 to find any potential new studies published.

Screening and Selection of Relevant Literature

The articles were reviewed by reading the titles as well as their abstracts. A specific screening procedure was utilized to evaluate the relevance of the selected literature. Studies were eligible for inclusion in this scoping review if they were conducted according to the scoping review methodology. To identify relevant studies, we examined every single

study acknowledged for the complete review. All studies were examined in batches and upon the conclusion of every fresh batch; all research team members met to examine decisions about the inclusion or exclusion of studies. If there was any disagreement between research team members at the title and abstract assessment phase, it was solved through consensus. Our study’s major purpose was to evaluate the prevalence of hearing loss in different age groups like children, adults, and geriatrics and genders. The results data were collated, summarized quantitatively, and analyzed thematically to identify recurrent patterns in the selected articles. In the first step, relevant data were extracted from sources. To chart this data, a spreadsheet was made and utilized by every member of the research team. Extracted data included the study design, the objectives of studies, conclusions, outcomes, and any information relevant to answering the scoping review questions. Second, data were charted based on the key objectives which we made for our review. In the end, we need to summarize our data and made conclusions from our results.

Charting, Collating and Summarizing the Results

Data were collated, summarized quantitatively, and analyzed thematically to identify recurrent patterns in the selected articles. In the first step, relevant data were extracted from sources. To chart this data, a spreadsheet was made and utilized by every member of the research team. Extracted data included the study design, the objectives of studies, conclusions, outcomes, and any information relevant to answering the scoping review questions. Second, data were charted based on the key themes identified including the prevalence of HL, common causes of HL, common patterns associated with HL, and sociodemographic factors associated with HL.

RESULTS

Originally, 156 content articles were identified and 89 remained after eliminating duplicates. These 89 articles were further reviewed by title which excluded 38, leaving a total of 51 articles for abstract review. The abstract screening method further excluded an additional 26 articles, leading to 25 full-text articles that were assessed for eligibility. Finally, 14 complete articles fulfilled the stipulated requirements for inclusion.

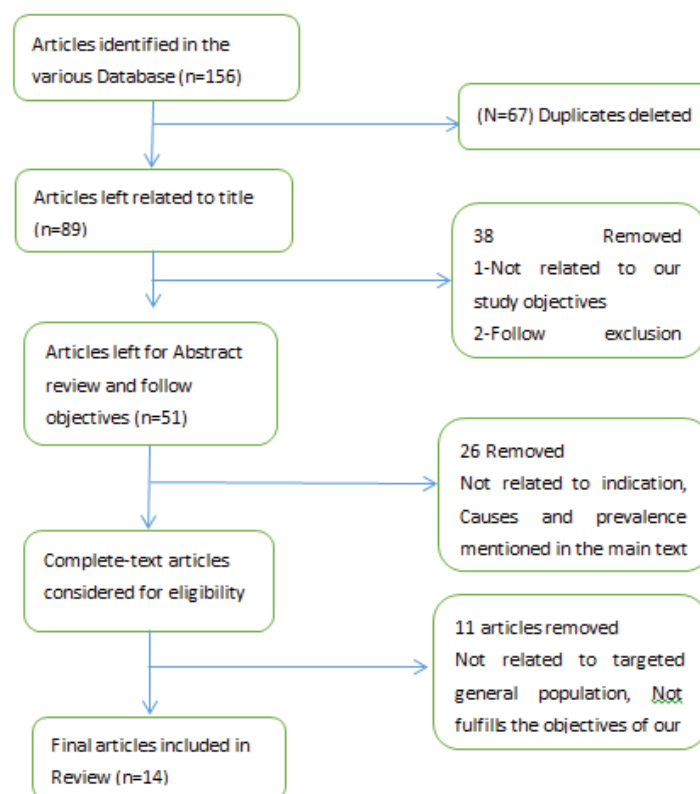


Figure 1 Flow diagram of study selection

Characteristics of Included Studies

A total of 14 studies were identified and included in this scoping review study; the characteristics of the included studies are presented in Figure 1. These studies were executed using different methodologies such as cross-sectional, quantitative, and population based-methods or observational designs [5-9,12-19]. The number of participants in these studies ranged from 21 to 15718 and publication dates ranged from 2001 to 2018. Data on the prevalence of hearing loss in different age groups was collected through a questionnaire or telephonic interview, face-to-face interviews, and observer-rated compliance with recommendations [1-3,7-17]. Three of the studies were undertaken in China, two in South Korea and India two studies in the United States, and one each from Iran, Swedish, Netherland, Norway [7-10,12,14-20]. All studies were conducted on hospitalized patients and lay public through questionnaires from different countries and focused on the prevalence of hearing abnormalities (Table 1).

Table 1 Characteristics of included studies

References	Aim of study	Study design, Sample size	Conclusion of study	Results
[17]	To examine the prevalence of Hearing Loss (HL) among age groups, genders in Zhijiang province of china	Population based Cross-sectional study (n=3754) between 18-97 years age	The prevalence of hearing loss was higher in males and the hearing threshold was increasing with age.	The prevalence of hearing loss in males and females was 31.6% and 24.1% respectively. The hearing threshold was increasing by increasing age.
[18]	This study aims to investigate the prevalence of hearing loss, and to analyze the major demographics and risk factors in older adults of China.	Cross-sectional investigation (n=6984) in older adults greater than 60 years age	Hearing loss is prevalent in nearly two-thirds of adults aged 60 years and older in China population.	The prevalence of hearing loss was increasing by age from (60-80) years, (57-81.36)% respectively. The prevalence of HL was more in males than females 60.87,56.99% respectively
[12]	This study aimed at the associations between Pure Tone Audiometrically assessed (PTA) hearing loss in young to middle-aged adults.	Cross-sectional Study design Participants N=15322 (Male=48%, women=62%)	This study suggested that there is cause for concern about the future development of hearing problems in this population since hearing problems generally worsen with age.	The prevalence of hearing loss was more common in Young, urban and well-educated participants. The prevalence of HL was more in males than females.
Sangeet et al. (2014) India	The prospective analytical study was designed for the Radiological assessment of HRCT and MRI diagnostic tools.	Patients (n=280) Male (n=158) Females (n=122)	In the present study, we found lower incidences of congenital anomalies comparative to existing literature.	This study showed that HRCT scan and MRI scan revealed similar morphology findings of malformed inner ears, except for vestibulocochlear nerves which were more appreciated on MRI scan
[3]	The purpose of this work was to study the diagnostic value of CT and MRI in children with sensorineural hearing loss	Children's (n=21) Male (n=12) Female (n=9)	CT and MRI are important modalities to analyze the inner ear in children, but MRI provides vast information on vestibulocochlear nerves.	CT and MRI allowed accurate identification of malformations of the inner ear in children with congenital deafness. CT provides the information related to temporal bone and MRI provides additional information.
[16]	The purpose of this study to find the prevalence of HL in different ages related to diabetes mellitus.	Cross-sectional study participants (n=37773) Male (n=28672) Females (n=9101)	The prevalence of hearing loss increases with age and the presence of Diabetes Mellitus.	The prevalence of hearing loss increased with age, being 1.6%, 1.8%, 4.6%, 14.0%, 30.8%, and 49.2% in subjects in their twenties, thirties, forties, fifties, sixties, and seventies, respectively.
[14]	This research aims to study the prevalence of hearing disorders and their relationship to age and gender among primary school students of Zahedan, Iran.	Cross-sectional study Patients (n=1500)	According to the obtained results, the authors emphasize annual hearing screening programs for school-age children to promote health care and to prevent social and educational problems in this region	The prevalence of hearing loss was most common in boys with 8.7% than girls which was 7.7% according to the study.
[13]	The objective of this study is to estimate the prevalence of HL and to identify its different types.	Cross-sectional study design Participants (n=2574)	Evidence-based guidelines to identify monitor and manage otitis media, make strategies to prevent hearing loss.	In this study prevalence rate was only 1.75% and which majority of cases were females (71.1%). More than half of the cases had bilateral deafness (56.7%)

[11]	The aim of this study to estimate the prevalence of profound-hearing loss in children	Retrospective review Children (n=All children reported under 10 year age between 2006-2015)	The prevalence of severe hearing loss was decreased gradually in all age groups annually.	The prevalence of severe-profound hearing loss was higher in males than females and decreased gradually from the year 2010 to 2015. The hearing loss was also more common in rural than urban areas
[10]	This study aimed to investigate the hearing threshold among different age groups, genders, and geographic areas in China	Cross-sectional Random Study design Participant (n=562)	People living in the rural area of Qinling in China had higher hearing threshold levels, particularly males, and hearing thresholds increased with age.	The hearing threshold was increasing by increasing age from young, middle age, and elderly people.
[3]	The authors investigate the impact of hearing loss on quality of life in a large population of older adults.	Population-based Longitudinal-study Participants (n=2688) from which 42% were male.	The severity of the hearing loss is associated with reduced quality of life in older adults.	Out of the total participants, 28% had a mild hearing loss and 24% had moderate to severe hearing loss. Hearing loss was increased by increasing age.
[8]	Prevalence of hearing loss a comparison study.	National cross-sectional survey Participants (n=5742)	Hearing loss is more prevalent among US adults than previously reported.	Hearing loss was 5.5-fold higher in men vs women and 70% lower in black subjects vs white subjects.
[16]	The study aimed at Prevalence of hearing loss in school children's	Pro forma Questionnaire study Children's (n=15718)	Regular screening of children during this stage would ensure that their school lives were not affected by hearing impairments	Prevalence of hearing loss was 7.9% in school children's from which 4.79% suffered from chronic otitis media and 3.06% from otitis media.
[19]	The objective of this study is To study work participation of persons with hearing loss, and associations with hearing disabilities, self-reported workability, fatigue, and work accommodation.	Cross-sectional internet-based study Workers (n=3330)	The hearing loss seemed to influence work participation factors negatively and the degree of unemployment was increased	The degree of hearing loss was associated with work-ability. Due to HL workers were on sick leave etc so, increasing unfavorable conditions degree of employment decreases.

Prevalence based on Age Groups and Gender

In our scoping review, we collect data from different articles and analyze them. We found that hearing loss was an increase by increasing age. The prevalence of hearing loss increased with age, being 1.6%, 1.8%, 4.6%, 14.0%, 30.8%, and 49.2% in subjects in their twenties, thirties, forties, fifties, sixties, and seventies, respectively (Figure 2).

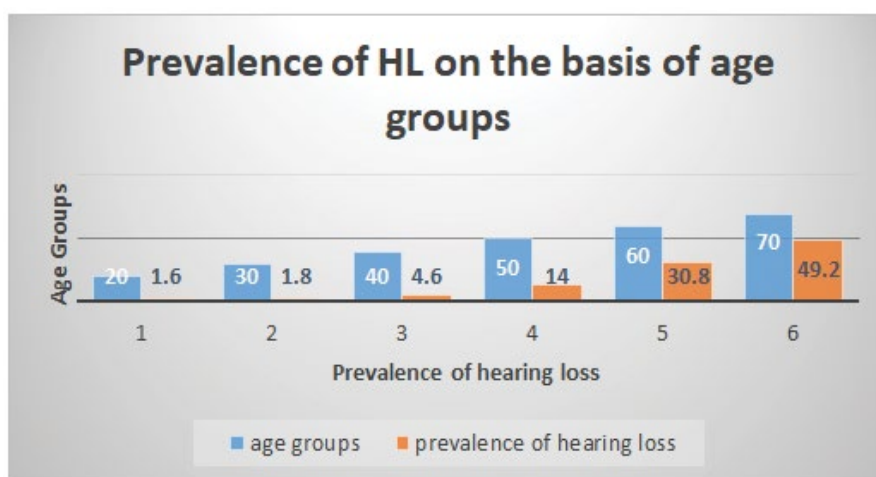


Figure 2 Prevalence of hearing loss based on age groups

On the other hand, if we talk about prevalence concerning gender then we concluded that hearing abnormalities were more common in females than males. The average prevalence of hearing loss in females and males was 42.3% and 36.8% respectively as shown in Figure 3.

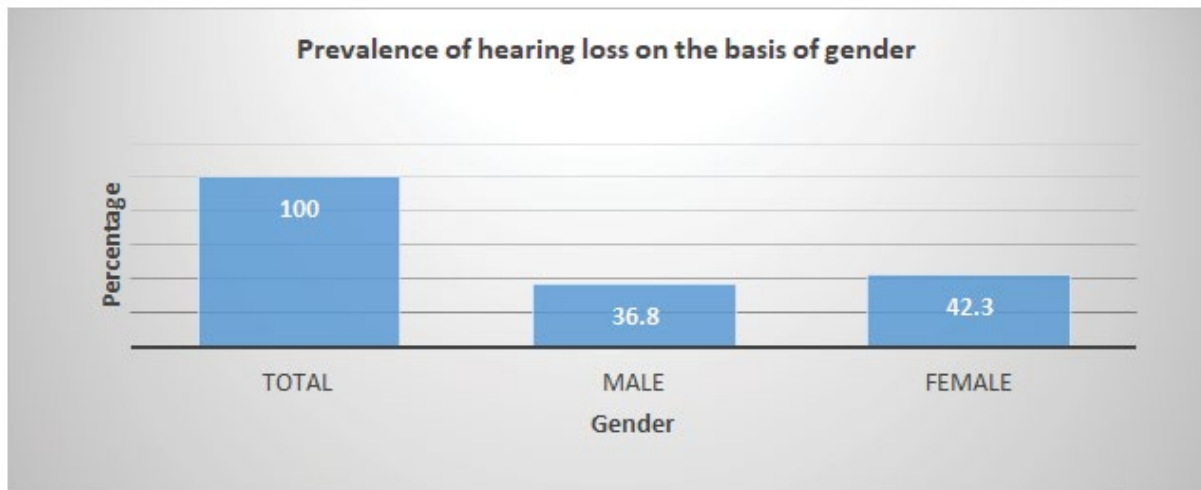


Figure 3 Prevalence of hearing loss on the basis of gender

DISCUSSION

Fourteen papers were selected for systematic review, but there was significant variation in the identification method for hearing impairment, normality criteria, and investigated age groups, which consequently led to variability in the prevalence and its associated factors [3,4-6,13].

The prevalence's found in the studies varied according to the method, age group, and normality criterion established by the authors and population under study; there was also variability in the study of risk factors associated with HL. In studies which we add in our review elaborated that hearing loss is an alarming situation world wide. Everyone needs to give special concern to this because overall around 466 million people have disabling hearing loss from which 34 million are children [14]. Hearing loss may result from genetic causes, complications at birth, certain infectious diseases, chronic ear infections, the use of particular drugs, exposure to excessive noise, and aging. It's a rumor that hearing aids, helping machines can help patients in hearing but WHO proves that 83% of patients used hearing aids but only 17% who get benefit from its use [15]. Studies have proved that hearing loss increases by increasing age, from infants to geriatrics. Due to the latest technologies and knowledge people aware now and take preventive measures due to which patients reporting decreases overall from 2010-2016 [12-16].

According to our review, a recently published study in 2018 conducted in the Chinese public concluded that the prevalence of hearing loss was more common in males with 31.6% and females with 24.6% [17]. The prevalence of HL is directly related to other diseases as the author indicated that high-frequency hearing loss is related to hyperlipidemia. Several lifestyles and environmental factors, which can be influenced by awareness and education, were significantly associated with hearing loss. Another study which was also conducted in China in 2018, proved that hearing loss was increased by increasing age [18]. If we compare both studies' statistics we find that the prevalence of hearing loss is 31.4% at up to 40 years of age and 54.3% at greater than 60 years of age. So, we should need to take care of our lifestyle modification. We can reduce this ratio by taking special and modified preventive measures [15-17].

We also add two interesting studies in our review whose objectives were to elaborate diagnostic tools used to study ear structure and collect information related to ear pre and post-operative. Studies prove that CT and MRI both have similar outcomes but MRI provides brief information about the cochlear part and CT is good for temporal bone study [9,10]. The HRCT scan reveals many types of bony inner ear malformations and the MRI scan provides better visualization of the membranous labyrinth and the status of vestibulocochlear nerves.

According to studies added in our scoping review, the prevalence of HL was more common in rural areas may be due to some reasons behind this like rural people are UN-educated and do not follow special guidelines. They are not following any protocol regarding prevention from hearing loss [16]. The noise was also a major cause of deafness

in different age groups. One study proved that the prevalence of HL was increased by increasing age from twenties, thirties, forties, fifties, sixties, and seventies [16]. The prevalence of HL was increasing with age and directly proportional to comorbidities like diabetes mellitus [16-18].

We also need to educate people regarding hearing loss and deafness and its consequences. Nowadays different regions take control of Hearing loss but not all, so, we should take care of this and need to educate. In this scoping review study, we also identified that information regarding hearing loss is obtained from a variety of different sources, such as drug stores, recent ENT surgeon prescriptions, earlier reports, relatives, or friends. Lastly, face to face interview could be an important method through which individuals could obtain information, but their poor legibility makes this challenging. Additionally, the high rate of illiteracy may cause hearing loss. Providing information in the native (indigenous) languages of the population and using accessible language without complicated medical terminology could enhance the listener's ability of understanding [15-19].

CONCLUSION

Evidence obtained from included studies concluded that there is a lot of causes of hearing loss. Hearing loss was more common in males than females due to extra responsibilities. Hearing loss was increasing by increasing age. There are different diagnostic tools to diagnose hearing loss but more precisely are HRCT and MRI. We recommend an MRI test for hearing loss before operate and to learn about ear structure. Educating and advising individuals to maintain good general health and fitness would have benefits for hearing preservation. Furthermore, we found evidence that among several common chronic diseases, hypertension is the most closely related to hearing loss, which requires special attention to the hearing of patients with hypertension. Hearing loss is a multifactorial condition that is a result of multiple intrinsic and extrinsic factors acting on the ears, and further prospective studies, with a multicentre approach and wider ranges of exposure, are required to confirm the related risk factors. We hope that our data can provide information on hearing loss for the event of national public health policies, and may help to spot some related factors for early intervention. As a developing country, society is more concerned about various fatal diseases, economy, and ecology, so that our country attaches lesser importance to deafness than other developed countries, and that we simultaneously hope to arouse the government's attention to the present condition.

RECOMMENDATIONS

According to our scoping review, we recommend give special attention to hearing loss related to other diseases, as most diseases can be a cause of hearing loss. We should educate and advise individuals about their health and fitness. We also recommend and invite researchers to pay full attention to this topic and provide the latest information to the public

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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REFERENCES

- [1] Westerhof, Johannes P., et al. "Congenital malformations of the inner ear and the vestibulocochlear nerve in children with sensorineural hearing loss: evaluation with CT and MRI." *Journal of Computer Assisted Tomography*, Vol. 25, No. 5, 2001, pp. 719-26.
- [2] Dalton, Dayna S., et al. "The impact of hearing loss on quality of life in older adults." *The Gerontologist*, Vol. 43, No. 5, 2003, pp. 661-8.
- [3] Arksey, Hilary, and Lisa O'Malley. "Scoping studies: towards a methodological framework." *International Journal of Social Research Methodology*, Vol. 8, No. 1, 2005, pp. 19-32.
- [4] Agrawal, Yuri, Elizabeth A. Platz, and John K. Niparko. "Prevalence of hearing loss and differences by

- demographic characteristics among US adults: data from the National Health and Nutrition Examination Survey, 1999-2004." *Archives of Internal Medicine*, Vol. 168, No. 14, 2008, pp. 1522-30.
- [5] Brien, Susan E., et al. "Overview of a formal scoping review on health system report cards." *Implementation Science*, Vol. 5, No. 1, 2010, pp.
- [6] Islam, Md Azharul, et al. "Prevalence and pattern of hearing loss." *Medicine Today*, Vol. 23, No. 1, 2011, pp. 18-21.
- [7] Al-Rowaily, Mohammed A., et al. "Hearing impairments among Saudi preschool children." *International Journal of Pediatric Otorhinolaryngology*, Vol. 76, No. 11, 2012, pp. 1674-7.
- [8] Absalan, Aqeel, et al. "A prevalence study of hearing loss among primary school children in the south east of Iran." *International Journal of Otolaryngology*, Vol. 2013, 2013, pp. 1-4.
- [9] Sekhar, Deepa L., Thomas R. Zalewski, and Ian M. Paul. "Variability of state school-based hearing screening protocols in the United States." *Journal of Community Health*, Vol. 38, No. 3, 2013, pp. 569-74.
- [10] Pham, Mai T., et al. "A scoping review of scoping reviews: advancing the approach and enhancing the consistency." *Research Synthesis Methods*, Vol. 5, No. 4, 2014, pp. 371-85.
- [11] Oh, In-Hwan, et al. "Hearing loss as a function of aging and diabetes mellitus: a cross sectional study." *PLoS One*, Vol. 9, No. 12, 2014, pp. e116161.
- [12] Agarwal, Sangeet Kumar, et al. "Radiological assessment of the Indian children with congenital sensorineural hearing loss." *International Journal of Otolaryngology*, Vol. 2014, 2014.
- [13] Pierre, Pernilla Videhult, Ann-Christin Johnson, and Anders Fridberger. "Subjective and clinically assessed hearing loss; a cross-sectional register-based study on a swedish population aged 18 through 50 years." *PloS One*, Vol. 10, No. 4, 2015, pp. e0123290.
- [14] Cunningham, Lisa L., and Debara L. Tucci. "Hearing loss in adults." *New England Journal of Medicine*, Vol. 377, No. 25, 2017, pp. 2465-73
- [15] Gong, Rui, et al. "Hearing loss prevalence and risk factors among older adults in China." *International Journal of Audiology*, Vol. 57, No. 5, 2018, pp. 354-9.
- [16] Im, Gi Jung, et al. "Prevalence of severe-profound hearing loss in South Korea: a nationwide population-based study to analyse a 10-year trend (2006–2015)." *Scientific Reports*, Vol. 8, No. 1, 2018, pp. 1-9.
- [17] Wang, Junguo, et al. "A cross-sectional study on the hearing threshold levels among people in qinling, qinghai, and Nanjing, China." *American Journal of Audiology*, Vol. 27, No. 1, 2018, pp. 147-55.
- [18] World Health Organization. Deafness prevention. Estimates (2018). <https://www.who.int/deafness/estimates/en/>
- [19] Heine, Chyrisse, Colette J. Browning, and Cathy Honge Gong. "Sensory loss in China: prevalence, use of aids, and impacts on social participation." *Frontiers in Public Health*, Vol. 7, 2019, pp. 1-5.
- [20] Wang, Dahui, et al. "Hearing threshold levels and hearing loss among people in Zhejiang, China: a population-based cross-sectional study." *BMJ Open*, Vol. 9, No. 4, 2019, pp. e027152.