Mansoura Nursing Journal (MNJ) Vol. 9. No. 2 – 2022 **Original Article**
Print ISSN: 2735 – 4121 Online ISSN : 2735 – 413X

Relationship between Hearing Impairment and Cognitive Status and Balance Confidence among Geriatric Patients

1Aml Sabry El-Sayed Ibrahim, 2 Neamit Ibrahim Elemam, 3 Heba Noshy Abd El-Aziz Mohamed

1 Demonstrator of Gerontological Nursing, Faculty of Nursing, Mansoura University, Egypt 2,3 Assistant Professor of Gerontological Nursing, Faculty of Nursing, Mansoura University, Egypt

Email: amlsabry1416@yahoo.com

1.ABSTRACT

Background: Hearing impairment is a growing public healthcare issue in the world that increases with age. It has a significant impairment in all aspects of life especially among geriatric patients and its increased severity is directly associated with greater negative consequences. **Aim**: Assess the relationship between hearing impairment and cognitive status and balance confidence among geriatric patients. **Method**: A descriptive research design was utilized with a purposive sample of 112 geriatric patients diagnosed with hearing impairment and met the inclusion criteria. **Setting**: This study was conducted in the outpatient audiology clinic of otolaryngology department at Main Mansoura University Hospital. **Tools**: Data was collected using three tools; Geriatric Patient's Demographic Characteristics and Clinical Data Structured Interview Schedule, Montreal Cognitive Assessment scale and Activities-Specific Balance Confidence scale. **Results**: This study was reported that, 57.1% of the studied subjects had mild grade of hearing impairment, whereas 34.8% of them had a moderate grade of hearing impairment. As for cognitive status, 43.8% of the studied subjects had mild cognitive function impairment, 19.6% of them had a moderate cognitive function impairment. While, 71.4% of the studied subjects had a high level of balance confidence, 28.6% of them had a moderate level of balance confidence. A statistical significant relation found between the severity of hearing impairment and the studied subjects' age, sex, marital status, level of education and work before retirement $p \leq 0.05$ respectively. A highly statistically significant negative relation between the severity of hearing impairment of the studied subjects and their cognitive status and balance confidence $p \leq 0.01$ respectively. **Conclusion**: It can be concluded that, mild grade of hearing impairment is the most prevalent grade among studied subjects followed by moderate grade. Severe grade of hearing impairment was found in older age group than the younger age group, in female than males and in those who are illiterate. More than one third of the studied subjects who have moderate grade of hearing impairment have moderate cognitive function impairment and all the studied subjects who have severe grade of hearing impairment have moderate level of balance confidence. **Recommendations**: Assess the geriatric patients' knowledge and skills they utilize to overcome hearing impairment problems and design an educational program for them about treatment adherence and using hearing aids to improve their cognitive function, psychosocial status and balance confidence.

2.Introduction:

Hearing Impairment (HI) is known as partial or complete loss of the hearing function in one or both ears and could be classified into four grades; mild, moderate, severe and profound[1]. While it affects 466 million persons globally and two-thirds of them are living in the developing countries, it is reported by around one third of the globe's older adults[2]. In Egypt, the last survey estimated HI reported that, around half of the older adults (49.3%) were affected by HI[3]. In Fayoum, HI was one of the top five comorbidities affecting 96.6% of older adults[4]. In Alexandria, HI was reported by 78.6% of the chronically ill hospitalized geriatric patients[5] and 55.5% of institutionalized older adults[6]. Hearing impairment has three main types; conductive, sensorineural and mixed hearing impairment[7] and each type of them has its unique mechanism and causes. Conductive HI results from the interruption of sound waves transmission from the external and middle ear to inner ear and it is mainly caused by tympanic membrane perforation, tympanosclerosis, excessive earwax, ear infections, osteomas, otosclerosis or foreign bodies such as fluids while, sensorineural HI results from the interruption of the sound vibration conversion into electrical signals or/and sending them to the brain through the auditory nerves and it is mainly caused by aging, insults from exposure to noise, ototoxic medications or mechanical trauma[8]. Age-related hearing impairment (ARHI) is categorized as a sensorineural HI and it's the most common sensory disease among older adults[9] and the first cause of HI, globally[10].

Since hearing is a basic human function that is important for communication, socialization and protection from danger, awareness and accurate response to surrounding environment[11], maintaining balance through the contribution of the

vestibular system, its impairment consequently leads to loneliness, social isolation, depression, stigmatization, impaired cognition, poor physical function and postural imbalance[12-20].

Hearing impairment is a serious health condition as it is not merely the distortion of the physical sense of hearing but it also affects the all aspects of life for the geriatric patients[21],[22] so it is vital to the gerontological nurse and all other health care providers to be aware of HI and its negative impact on geriatric patients and participate through the three levels of prevention from rising the public awareness against HI, regular screening, early detection, accurate management and rehabilitation[23].

Significance of the study

Hearing impairment is a very common health condition that is growing in a rapid rate worldwide. It is the first sensory impairment and the fourth cause of disability[24]. While it currently affects 466 million people, this number is expected to be 630 million by 2030 and to be over 900 million by 2050 and also estimated to cost more than 750 billion dollars per year globally. Older adults are the most affected age group due to the combination between inevitable auditory age-related changes besides other risk factors. While HI affects around one third of the globe's older adults, nearly half of the older adults living in Egypt are unfortunately affected by it[2]. Hearing impairment has a devastating negative health impacts especially on geriatric patients and if not detected and well controlled, the negative consequences of HI could go further to cause cognitive function impairment, dementia, impaired balance ability, falls, fractures, increased hospitalization[25] and even death[26].

Therefore, assessing the relationship among hearing impairment and cognitive status and balance confidence among geriatric patients is very important.

Study Aim

The current study aimed to assess the relationship between hearing impairment and cognitive and balance confidence among geriatric patients.

Research questions

1. What is the severity of hearing impairment among geriatric patients?
2. What is the degree of cognitive status and level of balance confidence among geriatric patients?
3. What is the relationship between hearing impairment and cognitive status and balance confidence among geriatric patients?

3. Subjects and Method

Study Design

A descriptive research design was utilized to accomplish the study's aim.

Study Setting

This study was conducted in the outpatient audiology clinic of otolaryngology department at Main Mansoura University Hospital.

Subjects:

The study included 112 geriatric patients attending the previous mentioned setting and was selected according to the following criteria:

Inclusion criteria:

1. Aged 60 years and more.
2. Diagnosed with hearing impairment.
3. Participating in the study voluntarily.
4. Able to communicate.
5. Available at the time of data collection.

Exclusion criteria:

1. Patients who have a history of neurological or/and mental disorders such as (i.e. dementia, schizophrenia, stroke, Parkinson's disorder, epilepsy, brain tumor and related medications.
2. Patients who have sudden or asymmetrical hearing impairment or using hearing aids.
3. Patients who have bilateral severe or profound hearing impairment.

Sample size calculation:

A purposive sample size was calculated using DSS research software (https://DSS research.com/). A previous study found the prevalence of hearing impairment was 18.5 ±6.2 (among elderly with hearing loss and 16.3 ± 2.5 (among adults with hearing loss)[27], with alpha error of 3% and study power of 90%. Then the calculated sample size was 106. We can add (5%) for precision, then the sample size was 112.

Tools of data collection:

In order to collect the necessary data three tools were used:

ToolI:Geriatric Patient's Demographic Characteristics and Clinical Data Structured Interview Schedule:

It was developed by the researcher after review of relevant literature and divided into three parts: **Part I**: Demographic characteristics of the

geriatric patients such as age, gender, marital status, level of education, occupation before retirement, income and living condition such as noisy living environment, etc. **Part II:** Medical history of geriatric patients such as types, severity, duration of HI and other medical diseases. **Part III:** Social activities such as social participation, visits and phone calls to relatives or friends.

Tool II: Montreal Cognitive Assessment Scale (MOCA)

This tool was developed by **(Bédirian et al., 2005)**[28]**.** It was translated into Arabic language and validated by **(El Gaafary & Rahman, 2009)**[29]**.** It was designed for assessing the elder's cognition and especially to detect mild cognitive impairment in elders scoring in the normal range on the Mini Mental State Exam (MMSE). It consists of 30 items that investigate the short-term memory, visuospatial abilities , executive functioning, phonemic fluency, verbal abstraction, attention, concentration, working memory via target detection, serial subtraction, digits forward, digits backward, language, repetition and orientation to time and place. The score is 30 points and classified as; a score of 26-30 is assigned for those who have normal cognitive function, a score of 18-25 is assigned for those who have mild cognitive impairment, a score of 10-17 is assigned for those who have moderate cognitive impairment and a score of less than 10 is assigned for those who have severe cognitive impairment.

Tool III: Activities-Specific Balance Confidence (ABC) scale:

This tool was developed by **(Myers & Powell, 1995)**[30] to assess an individual's balance confidence in performing various ambulatory activities without falling. It consists of Sixteen items self-report measure, patients rate their confidence in performing tasks on a scale, the total score for each item is running from 0% to 100% , total the ratings (possible range = 0 - 1600), divided by 16 to get each subject's ABC score and classified as; a score of < 50% is assigned for those who have low confidence a score of 50% to 80% is assigned for those who have moderate confidence and a score of > 80% is assigned for those who have high confidence. The tool was modified by the researcher to meet the research environment.

1. An official written letter was obtained from the dean of the faculty of nursing and directed to the head of the department of otolaryngology in the outpatient audiology clinic at Main Mansoura University Hospital to obtain his approval and was informed about the purpose of the study and the time of data collection.
2. Every geriatric patient was interviewed individually by the researcher to collect the necessary information via all study tools in the waiting area of audiology outpatient clinic of otolaryngology department.
3. According to the schedule of audiology outpatient clinic of otolaryngology department, the researcher visited the clinic 4 days per week from 8 A.M. to 2 P.M.
4. The research managed to interview from 2 to 4 geriatric patients daily, time of each interview ranged from 40-50 minutes to complete the study tools according to the level of understanding of the geriatric patient.
5. The data collection covered a period of four months started from the beginning of March 2021 till the end of June 2021.

Validity of the tools

Tool III (Activities-Specific Balance Confidence scale) was translated into Arabic language by the researcher and Validity of the translation was checked by an expert of English language from the Faculty of Education. To ensure the validity of the translation, back up translation technique was used in this study. Before using the tools of the study, five experts in the field of gerontological nursing checked its validity and feasibility. Accordingly, the necessary modifications were done.

Reliability

The reliability of tool III (Activities-Specific Balance Confidence scale) was tested and found to be high with a Cronbach's alpha value of 0.95.

Pilot Study

A pilot study was carried out on 10% (12) of the study subjects before starting data collection to ascertain the clarity and applicability of study tools and they were excluded from the study.

Ethical Considerations

Ethical approval was taken from the Research Ethics Committee of the Faculty of Nursing – Mansoura University. Geriatric patient's verbal consent to participate in the study was obtained after an explanation of the aim of the study and its nature, benefits and risks. Privacy of the study subjects and confidentiality of the collected data was assured and were only used for the study. Each geriatric patient was assured that the participation was voluntary, and they were

informed that they have the right to withdraw from the study at any time without any consequences or penalty.

Data analysis:

The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 26, SPSS Inc. Chicago, IL, USA). Descriptive appropriate statistical tests were utilized as frequent, percentage, mean, and standard deviation. The categorical variables were represented as frequency and percentage. Continuous variables were represented as mean, and standard deviation. As well as inferential statistics were used. Reliability Statistics was assessed using Cronbach's Alpha test. Relationship between categorical variables was tested using Chi-square test. Independent sample t-test was used to test the difference between two mean of continuous variables. Fisher's Exact test was used for correction of chi-square when more than 20% of the cells have expected count less than 5. The difference is considered significant if $p \leq 0.05$. The difference is considered highly significant if $p \leq 0.01$.

4. Results

Table1: Represents demographic characteristics of the studied subjects. It shows that, the age of the studied subjects ranged between 60 to 86 years old. 75.9% of them aged from 60 to less than 75 years, 20.5% from 75 years to less than 85 years, and 3.6% from 85 years and more with a mean of 64.92±10.67, males constituted 57.1% of the studied subjects, 52.7% were married, 47.3% were unmarried, secondary education was found in 36.6% of the studied subjects, 27.7% were illiterate, 16.1% were read and write, basic education was found in 12.5%, university education in 7.1% of the studied subjects, 29.5% had skilled work, 29.5% were house wives, 28.6% were employees before retirement and 12.5% had commercial business.

Table 2: Represents medical data and history of hearing impairment of the studied subjects**.** It shows that cardiovascular diseases and its related medications were reported by 54.5% of the studied subjects for each, followed by endocrine diseases and its related medications in 31.3% for each. 63.4% the studied subjects did not have family history of hearing impairment, the duration of it ranged from 1 to more than 10 years with a mean of (4.89±1.43). 45.5% of the studied subjects had hearing impairment (HI) for less than 5 years, 34.8% had HI from 5 to less than 10 years while, 19.7% of them had HI for more than 10 years, 74.1% of the studied subjects have sensorineural HI, 18.8% have conductive HI, 70.5% of the studied subjects had HI in both ears, 17.9% in the left ear and 11.6% of them in the right ear.

Table3: Represents environmental condition and social activities of the studied subjects. It shows that 73.2% of the studied subjects were rural residence, 52.7% living with their spouses, 68.8% of them were living nearby workshops or/and factories, 56.3% were exposed to noise from public transport and communication means, 29.5% were exposed to noise from music and loud sounds, 25.5% of them were exposed to social noise, 75.0% did not participate in social activities, 63.4% did not make visits outside the home, 59.8% preferred to sit alone, 52.7% did not use telephone calls and 82.1% preferred to watch TV and/or listen to radio**.**

Figure 1: Represents severity of hearing impairment among the studied subjects. It shows that, 57.1% of the studied subjects had mild grade of hearing impairment, whereas 34.8% of them had moderate grade and only 8.0% of them have severe grade.

Table 4: Represents cognitive function of the studied subjects. It can be observed from this table that, 43.8% of the studied subjects had mild cognitive function impairment, followed by normal cognitive function in 31.3%, moderate cognitive function impairment in 19.6% and severe cognitive function impairment in 5.4%.

Table 5: Represents levels of balance confidence of the studied subjects. It shows that 71.4% of the studied subjects had high level of balance confidence, whereas 28.6% of them had moderate level of balance confidence.

Table 6: represents the relation between demographic characteristics of the studied subjects and their severity of hearing impairment. It shows that, there was a statistically significant relation between severity of hearing impairment and each of age, sex, marital status, level of education and work before retirement (P=0.000, P=0.008, P=0.000, P=0.03) respectively. 69.4% of the studied subjects who aged 60 to less than 75 years had mild grade of HI, 78.3% of the studied subjects who aged 75 to less than 85 years had moderate grade of HI and 75.0% of the studied subjects who aged 85 years and above had severe grade of HI. In relation to sex, 68.8% of males had mild grade of HI while, 50.0% of females had moderate grade of HI.

Concerning the marital status, 76.3% of the married studied subjects had mild grade of HI while, 52.8% of the unmarried studied subjects had moderate grade of HI. Regarding the level of education, 58.1% of the studied subjects who were illiterate had moderate grade of HI, 73.2% of the studied subjects who had secondary education had mild grade of HI and 62.5% of the studied subjects who had university education had mild grade of HI.

As regards work before retirement of the studied subjects, 54.5% of the housewives had moderate grade of HI, 57.6% of the studied subjects who had skilled work had mild grade of HI, 78.1% of the studied subjects who were employees had mild grade of HI and 57.1% of the studied subjects who had commercial business had mild grade of HI.

Table 7 represents the relation between severity of hearing impairment and cognitive status of the studied subjects. This table shows that, 33.3 % of the studied subjects who had severe grade of HI reported that they had severe cognitive impairment, as well as moderate cognitive impairment and mild cognitive impairment. 53.8% of the studied subjects who had moderate grade of HI reported that they had mild cognitive impairment, 38.5% of them had moderate cognitive impairment and only 7.7% had severe cognitive impairment. While, 54.7% of the studied subjects who had mild grade of HI reported that they had normal cognitive function and 39% of them had mild cognitive impairment. A highly statistically significant negative relation was found between severity of HI of the studied subjects and their cognitive status (P=0.000)**.

Table 8 represents the relation between severity of hearing impairment and the balance confidence of the studied subjects. 100% of the studied subjects who had severe grade of HI reported that they had moderate level of balance confidence. 53.9% of the studied subjects who had moderate grade of HI reported that, they had moderate level of balance confidence and 46.1% of them had high level of balance confidence. While, 96.9% of the studied subjects who had mild grade of HI reported that they had high level of balance confidence and only 3.1% of them had moderate level of balance confidence. A highly statistically significant negative relation was found between severity of HI of the studied subjects and their level of balance confidence (P=0.000)**.

Table 1: Demographic characteristics of the studied subjects

Characteristics	N= (112)	%
Age in years		
60-	85	75.9
75-	23	20.5
85+	4	3.6
Mean± SD	64.92±10.67	
Sex		
Male	64	57.1
Female	48	42.9
Marital status		
Married	59	52.7
Unmarried*	53	47.3
Level of education:		
Illiterate	31	27.7
Read and write	18	16.1
Basic education	14	12.5
Secondary education	41	36.6
University education	8	7.1
Work before retirement		
Housewives	33	29.5
Skilled work	33	29.5
Employees	32	28.6
Commercial business	14	12.5

More than one answer

- Unmarried (widow, divorced and single)

Table 2: Medical data and history of hearing impairment of the studied subjects

Variables	N = (112)	%
Chronic diseases #		
Cardiovascular diseases	61	54.5
Endocrine diseases	35	31.3
GIT & hepatic diseases	12	10.7
Respiratory diseases	10	8.9
Renal diseases	5	4.5
Other diseases *	34	30.4
dications taken #		
Cardiovascular drugs	61	54.5
Endocrine drugs	35	31.3
GIT & hepatic drugs	12	10.7
Respiratory drugs	10	8.9
Renal drugs	5	4.5
Other drugs	34	30.4
Family history related hearing impairment		
Yes	41	36.6
No	71	63.4
Duration of hearing impairment (years)		
<5	51	45.5
5- 10	39	34.8
>10	22	19.7
an± SD	4.89±1.43	
Type of hearing impairment		
Sensorineural hearing impairment	83	74.1
Conductive hearing impairment	21	18.8
Mixed hearing impairment	8	7.1
Affected ear		
Both ears	79	70.5
Left ear	20	17.9
Right ear	13	11.6

More than one answer

*Other diseases refers to ophthalmological diseases and oncological disorders

Table 3: Environmental condition and social activities of the studied subjects

Variable	N = (112)	%
Residence in		
Rural	82	73.2
Urban	30	26.8
Living with		
Family (Spouse)	59	52.7
With children	37	33.0
With relatives	10	8.9
Alone	6	5.4
Area of workshops or factories		
Yes	77	68.8
No	35	31.3

Sources of noise #		
Public transport and communication mean	63	56.3
Social noise	45	40.2
Music and loud sounds	33	29.5
Social activities # Participation in social activities		
Yes	28	25.0
No	84	75.0
Visits outside home		
Yes	41	36.6
No	71	63.4
Preference to sit alone because of feeling embarrassed		
Yes	67	59.8
No	45	40.2
Telephone call		
Yes	53	47.3
No	59	52.7
Watching TV or listening to radio		
Yes	92	82.1
No	20	17.9

More than one answer

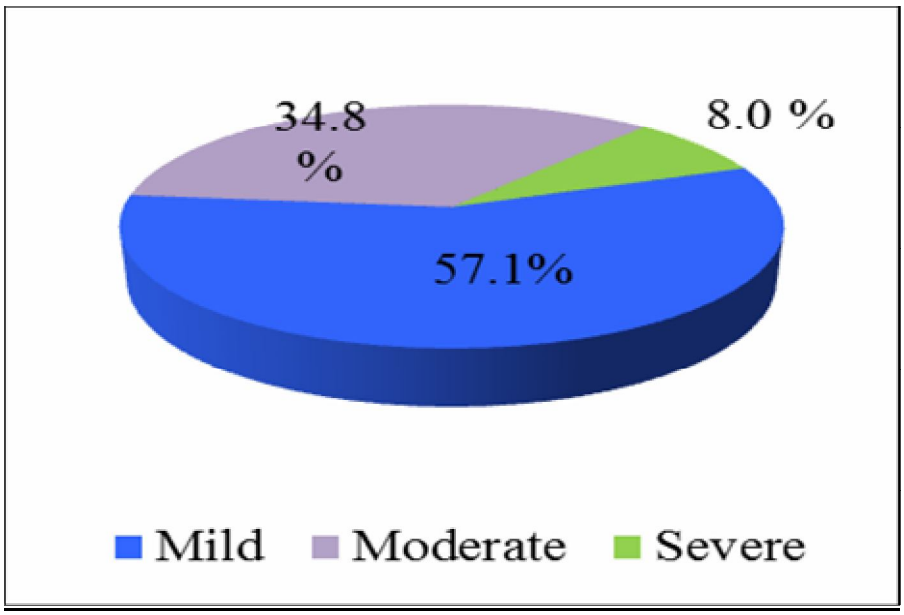

Figure 1: Severity of hearing impairment among the studied subjects

Table 4: Cognitive function of the studied subjects

Cognitive function levels	Score	N = (112)	%
Normal cognitive function	26-30	35	31.3
Mild cognitive impairment	18-25	49	43.8
Moderate cognitive impairment	10-17	22	19.6
Severe cognitive impairment	<10	6	5.4

Table 5: Levels of balance confidence of the studied subjects

Levels of balance confidence	Score	N = (112)	%
Low balance confidence	< 50 %	0	0.0
Moderate balance confidence	50 – 80	32	28.6
High balance confidence	>80	80	71.4

Table 6: Relation between demographic characteristics of the studied subjects and their severity of hearing impairment

Characteristics	Severity of hearing impairment						FE or χ2 / p
	Mild		Moderate		Severe		
	n	%	n	%	n	%	
Age in years							
60-	59	69.4	21	24.7	5	5.9	FE / (P=0.000)**
75-	4	17.4	18	78.3	1	4.3	
85+	1	25.0	0	0.0	3	75.0	
Sex							
Male	44	68.8	15	23.4	5	7.8	9.08/ (P=0.008)**
Female	20	41.7	24	50.0	4	8.3	
Marital status							
Married	45	76.3	11	18.6	3	5.1	FE / (P=0.000)**
Unmarried	19	35.8	28	52.8	6	11.3	
Level of education:							
Illiterate	11	35.5	18	58.1	2	6.5	FE / (P=0.03)*
Read and write	11	61.1	5	27.8	2	11.1	
Basic education	7	50.0	5	35.7	2	14.3	
Secondary education	30	73.2	10	24.4	1	2.4	
University education	5	62.5	1	12.5	2	25.0	
Work before retirement							
Housewives	12	36.4	8	54.5	3	9.1	FE / (P=0.000)**
Skilled work	19	57.6	13	39.4	1	3.0	
Employees	25	78.1	5	15.6	2	6.3	
Commercial business	8	57.1	3	21.4	3	21.4	

- Statistically significant (p ≤0.05) / ** highly statistically significant (p ≤0.01)

Table 7: Relation between severity of hearing impairment and cognitive status of the studied subjects N = 112

Severity of hearing impairment		Cognitive status							
		Normal cognitive function		Mild cognitive impairment		Moderate cognitive impairment		Severe cognitive impairment	
	n	%	n	%		n	%	n	%
Mild hearing impairment	35	54.7	25	39.0		4	6.3	0	0.0
Moderate hearing impairment	0	0.0	21	53.8		15	38.5	3	7.7
Severe hearing impairment	0	0.0	3	33.3		3	33.3	3	33.3
FE or χ2 / p		FE / (P=0.000)**							

FE:Fisher Exact test ** Highly statistically significant (p ≤0.01)

Table 8: Relation between severity of hearing impairment and balance confidence of the studied subjects N = (112)

Severity of hearing impairment	Balance confidence			
	High confidence		Moderate confidence	
	N	**%**	**N**	**%**
Mild Hearing impairment	62	96.9	2	3.1
Moderate Hearing impairment	18	46.1	21	53.9
Severe Hearing impairment	0	0.0	9	100
FE or $\chi 2$ / p	55.01/ (P=0.000)**			

FE:Fisher Exact test

** Highly statistically significant ($p \leq 0.01$)

5. Discussion

Hearing impairment has significant negative consequences on geriatric patients and their different life aspects and it also negatively affects their partners, health care system and the whole society.

Characteristics of the geriatric patients:

This study included 112 hearing impaired geriatric patients. The demographic background of the present study showed that, the age of the studied subjects ranged between 60 to 86 years old. More than three quarters of the studied subjects aged from 60 to less than 75 years old. This result may be attributed to the hearing impaired geriatric patients who are young-old, are more concerned about their health and more desiring to seek medical examination and advice compared to the middle-old and old- old geriatric patients who are mistakenly considering hearing impairment as a normal age-related change. This is in accordance with two studies done in Egypt by **Awad et al., (2016)**[31] and **Said, (2017)**[32] who reported that the mean age of studied subjects was 68.4 ± 7.4 years. In contrast, a study done by **Martinez-Amezcua et al., (2020)**[19]**,** revealed that the mean age of the studied older adults was 79 ± 4.6 years.

Regarding sex, males constituted more than half of the studied subjects. This could be referred to the involvement of males in occupations with high levels of noise higher than females[33]. This finding is in agreement with other studies done in Egypt by **Said, (2017)** [32] who revealed that two-thirds of the studied subjects were male and by **Quaranta et al., (2015)**[26] who estimated the prevalence of HI in Europe is higher in males than females. In contrast, a study held in USA by **Martinez-Amezcua et al., (2020)**[19] estimated that more than half of the hearing impaired geriatric patients were females.

As regard to marital status, more than half of the studied subjects were married and living with their spouses. This is in line with a study held by **Moser, Luxenberger, & Freidl, (2017)**[34] who reported that the majority of the studied geriatric patients were married or had a partner.

Concerning the educational level, the highest percentage of the studied subjects had only basic education or lower. This result may be due to the effect of low educational level on the healthy lifestyle and the prevention strategies of HI. This is in agreement with a study conducted in Egypt by **Awad et al., (2016))**[31] who reported that more than one half of the hearing impaired geriatric patients were illiterate and another study held in USA by **Emmett & Francis (2015)**[35] reported that near half of the geriatric patients had low education. This is in contrast with a study held in USA held by **Martinez-Amezcua et al., (2020)** [19] who revealed that the majority of the geriatric patients had high educational level.

Regarding the work before retirement, the highest proportion of the working geriatric patients was given for skilled workers. This result may be attributed to that, skilled workers are at higher risk of noise-exposure than other workers. This is in line with the study held in Egypt by **Said, (2017)** [32] who revealed that the majority of the working studied geriatric patients were technical workers and farmers and another study held in Egypt by **Alfauomy et al., (2017)**[36] who revealed that the highest proportion of the working hearing impaired studied subjects were manual and technical workers.

Regarding the place of residence, the majority of the studied subjects were rural residence. This may be attributed to the limited access to health care services in people living in rural areas. This finding is in agreement with the study held in Korea by **Kim et al., (2017)**[37] and a study held in China by **Gong et al., (2018)**[38] who reported that HI is more prevalent in rural areas than urban areas. This in contrast to the study held in Egypt by **Said, (2017)** [32] who revealed that HI is more prevalent in urban areas than rural areas.

Concerning social activities, three quarters of the studied subjects did not participate in social activities, around two thirds of them did not make visits outside the home, more than half preferred to sit alone due to embarrassment, the majority preferred to spend time watching TV and/or listen to radio and more than half did not use telephone calls. This may be attributed to the impact of hearing impairment on the ability to communicate and/or participate in social activities. This in agreement with a study held in Egypt by **Alfauomy et al., (2017)**[36] who reported that, more than half of the studied subject did not make visits outside the home or use telephone calls and the majority of them preferred spending time watching TV.

Regarding the severity of hearing impairment, mild grade of HI was prevalent among more than half of the studied subjects. While, nearly one third of them had moderate grade. This may be due to the high prevalence of age-related hearing impairment (ARHI) among elderly which is the most prevalent cause of HI that has a very slow developmental disease process. This finding is in accordance with a study held in USA by **Golub et al., (2019)**[39] and other studies conducted in Korea by **Ji-Su, (2015)**[40] and in France by **Cosh et al., (2018)**[41] who revealed that the majority of the hearing impaired older adults had mild grade of HI followed by moderate grade of HI.

As regards to the type of hearing impairment, around three quarters of the studied subjects had sensorineural HI and most of them had HI in both ears. This result is in line with two studies held in Egypt by **Awad et al., (2016))**[31] and by **Alfauomy et al., (2017)** [36] and another study conducted in Pakistan by **Naqi et al., (2020)**[42] who reported that the majority of the studied geriatric patients had sensorineural HI as well as the majority of them had HI in both ears.

Concerning the duration of HI, slightly more than half of the studied subjects experienced HI from ≥ 5 years. This may be attributed to the undetected HI and lack of public or professional interest to diagnose HI. This in agreement with the study held in Egypt by **Awad et al., (2016))**[31] who reported that, the majority of the studied subjects had HI from ≥ 5 years. The present study also reported that, the majority of the studied subjects had no family history of HI. This in line with the study conducted in Egypt by **Alfauomy et al., (2017)** [36] who revealed that, the majority of the studied geriatric patients had no family history of HI.

In relation to the history of other medical diseases and medications consumed by the studied subjects, the majority of them were suffering from chronic diseases and all of them were in compliance to their related medications. This result may be due the greater risks of the most of the chronic diseases medications for being considered as ototoxic medications such as; loop diuretics, antibiotics and non-steroidal anti-inflammatory drugs [43]. This finding is in agreement with a study conducted in Egypt by **Said, (2017)** [32] and a study held in USA by **Golub et al., (2019)**[39] who revealed that the majority of the hearing impaired geriatric patients had chronic illnesses.

An extensive body of literature exists about the devastating consequences of HI on interpersonal communication, cognitive function, physical health and quality of life **(Polku et al., 2018**[21]**; Wilson et al., 2017)**[23]. The present study revealed that, more than two thirds of the studied subjects had impaired cognitive function and most of them had mild cognitive function impairment followed by moderate cognitive function impairment. This finding may be because of considering HI as a strong modifiable risk factor for cognition decline especially with older adults who experiences age-related cognitive changes[44]. Although the definite mechanism is still not confirmed, one of the hypothesized mechanisms described HI to decrease the transmitted signals to the brain which in turn changes the brain structure, the functional brain networks and the behavioral performance of the brain[26].

This result is in line with the result of a study held in USA by **Alattar et al., (2020)**[45] who revealed that**,** the majority of the studied sample had impaired cognitive function and most of them had mild cognitive function impairment followed by moderate cognitive function impairment and another systematic review and meta-analysis study of studies used MOCA held by **Utoomprurkporn, Woodall, Stott, JCostafreda, & Bamiou, (2020)**[46] reported the significant association between HI and cognitive function impairment among older adults. In contrast, a study held in Malaysia by **Mukari, Ishak, Maamor, & Wan Hashim, (2017)**[47] who revealed that, there was a weak relation between low-frequency HI and cognitive function and no relation between high-frequency HI and cognitive function.

Concerning balance confidence of the studied subjects, less than one third of them had moderate level of balance confidence while the majority had high level of balance confidence. This result is in agreement with two studies held in Canada by **Bruce et al., (2019)**[48] and in USA by **Criter & Gustavson, (2020)**[49] who revealed that

the majority of the hearing impaired geriatric patients had high level of balance confidence. Another study conducted in Korea by **Da, Lee, & Lee, (2015)**[50] reported that HI was not associated with a significant decline in dynamic balance ability.

Hearing impairment is affected by several modifiable and non-modifiable factors in terms of demographic characteristics such as; age, sex, marital status, level of education and work before retirement[51]. When studying the relation between the demographic characteristics of the studied subjects and their severity of HI, it was observed that, the severity of HI of the studied subjects increase with increasing age. The present study revealed that, mild grade of HI was prevalent among young old age group while, moderate grade of HI was prevalent among middle old age group and severe grade of HI was prevalent among old-old age group.

This result may be attributed to the accumulated and increased impact of auditory age-related changes and the increasing prevalence of the chronic medical conditions and their related consumed medications with the increasing age which in turn negatively affect hearing function. This is in line with a study held in China by **Li et al., (2021)**[52] who reported that, mild and moderate grades of HI were more prevalent among geriatric patients aged 60 to less than 75, while moderate and severe grades of HI were more prevalent among geriatric patients aged 75 and above. In contrast, a study held in Korea by **Kim et al., (2020)**[53] reported that, moderate and severe grades of HI were the most prevalent forms among young-old subjects.

In relation to sex, slightly more than two thirds of males had mild grade of HI followed by moderate grade of HI, while half of females had moderate grade of HI followed by mild grade of HI. This may be attributed to the longer life expectancy in females and the increased HI severity with aging. Supporting to this result, two studies held in USA by **Martinez-Amezcua et al., (2021)**[19] and by **Deal et al., (2017)**[54] revealed that, there was no difference between the studied females and males that, the majority of both had mild grade of HI followed by moderate and severe grades of HI.

Concerning the marital status, more than two thirds of the married studied subjects had mild grade of HI and less than one third of them had moderate and severe grades. While, slightly more than one third of the unmarried studied subjects had mild grade of HI and slightly less than two thirds of them had moderate and severe grades. This may be attributed to the significant role of spouses and family members in initiating and enhancing audiology care[55],[56]. This in agreement with a study conducted in China by **Ye, Zhu, Chen, & He, (2020)**[57] who revealed that severe and profound grades of HI were more prevalent in unmarried elderly subjects than married elderly subjects. In contrast, a study held in England by **Tsimpida, Kontopantelis, Ashcroft, & Panagioti, (2019)**[58] who reported that, moderate grade of HI is more prevalent than severe grade of HI in both married and unmarried subjects.

Regarding the level of education, more than half of the studied subjects who were illiterate had moderate grade of HI and nearly one third of them had mild grade of HI. The majority of the studied subjects who had secondary education had mild grade of HI followed by moderate grade. While, nearly two thirds of the studied subjects who have university education have mild grade of HI followed by severe grade. Low educational attainment is known to be a considerable risk factor for HI[59] **(Nakahori et al.,2020)** and this may be due to the higher educated subjects are more aware of the benefits of follow up and have better capacity to obtain and understand the basic health information and services needed to make appropriate health decisions related to early examinations compared to the lower educated subjects who are lacking of the awareness neither for prevention of hearing impairment nor for importance of the early initiation of audiology care.

This study result is in line with a study held in USA by **Choi et al., (2016)**[60] revealed that moderate and greater grades of HI were more prevalent than mild grade in the older subjects who had lower than secondary education while, mild grade of HI was more prevalent than moderate and greater grades of in the older subjects who had secondary education or higher. In contrast, another study held in USA by **Martinez-Amezcua et al., (2021)**[19] who reported that moderate and severe grades of HI were more prevalent than mild grade of HI in subjects who had secondary education or higher and mild grade of HI was more prevalent than moderate and greater grades of HI in the older subjects who had lower than secondary education.

As regard to work before retirement, the present study revealed that, subjects who had skilled work constituted the largest proportion of the working studied subjects and slightly more than half of them had mild grade of HI and more than one third of them had moderate grade while, the majority of other working studied subjects had mild

grade of HI. This may be attributed to the impact of noise from work on hearing which is expected to increase with time and when combined with age related changes the severity of HI will increase too[61],[62]. This is in agreement with a study held in Australia by **Gopinath, McMahon, Tang, Burlutsky, & Mitchell, (2021)**[63] who reported that, near to half of the studied older subjects had a history of workplace noise exposure, most of them had skilled work and most of them had mild grade of HI followed by moderate and severe grades of HI. Another systematic review held in Norway by **Lie et al., (2016)**[62] including Egyptian workers reported that, the most expected working subjects to have HI were subjects with skilled work.

Both of the cognitive and hearing function undergo age-related changes[64] and impairment in one function of them is associated in a decline in the another function[65]. While the increased severity of HI is also associated with poorer health consequences and poorer quality of life. A highly statistically significant negative relation was found between HI and cognitive function that, the higher the HI, the poorer the cognitive status. This may be justified by the presence of other factors that contribute to the occurrence of cognitive function impairment as reported by the geriatric patients that, three quarters of the them did not participate in social activities, around two thirds of them did not make visits outside the home, more than half preferred to sit alone due to embarrassment and more than half did not use telephone calls.

This is in agreement with two studies conducted in USA by **Alattar et al., (2020)**[45] and by **Lin et al., (2013)**[66] who reported that, the increased severity of HI was associated with poorer performance on cognitive function. Another systematic review study held in Australia by **Taljaard, Olaithe, Brennan-Jones, Eikelboom, & Bucks, (2016)**[67] revealed that poorer hearing function is associated with poorer cognition. This is in contrast to a study held in Holland by **Gussekloo, de Craen, Oduber, van Boxtel, & Westendorp, (2005)**[68] who revealed that HI was associated with lower score of cognitive status but increasing HI not associated with poorer scores.

The present study also revealed that, a highly statistically significant relation was found between HI and balance confidence that, the higher the HI, the lower the balance confidence. This may be attributed to the anatomical proximity between inner ear and vestibular system which has a basic role in maintaining balance that both of them are innervated by the inferior portion of the vestibular nerve. So that, sensorineural hearing impairment is expected to induce vestibular dysfunction which can lead to manifestation of imbalance[69]. This result is in agreement with a study done in Korea by **Bang et al., (2020)**[70] who reported that greater HI is associated with increased postural instability. Another study held in USA by **Martinez-Amezcua et al., (2021)**[19] who revealed that greater HI is associated with lower balance scores.

6. Conclusion

Based on findings of the present study, it can be concluded that, mild grade of HI is the most prevalent grade among geriatric patients followed by moderate grade. Severe grade of HI was found in older age group than the younger age group, in female than males and in those who are illiterate. More than one third of the studied subjects who have moderate grade of HI have moderate cognitive status impairment and all the studied subjects who have severe grade of HI have moderate level of balance confidence.

7. Recommendation:

The following recommendations are made in light of the current study's findings:

Assess the geriatric patients' knowledge and skills they utilize to overcome hearing impairment problems and design an educational program for them about treatment adherence and using hearing aids to improve their cognitive function, psychosocial status and balance confidence.

8.References

- Graydon, K., Waterworth, C., Miller, H., & Gunasekera, H. (2019). Global burden of hearing impairment and ear disease. *The Journal of Laryngology & Otology, 133*(1), 18-25
- World Health Organization. (2018). Addressing the rising prevalence of hearing loss. Available at: http://apps.who.int/iris/bitstream/handle/10665/260336/9789241550260-eng.pdf;jsessionid=4597D305385B9DC2FB4A8D251F6D7FB0?sequence=1
- Abdel Hamid, O., Aly, A., Kamel, S., Khatib, O. M. N., & Morad, M., (2007). Prevalence and patterns of hearing impairment in Egypt: a national household survey. EMHJ-Eastern Mediterranean Health Journal, 13 (5), 1170-1180.
- El-Sherbiny, N. A., Younis, A., & Masoud, M. (2016). A comprehensive assessment of the physical, nutritional, and psychological health status of the elderly populace in the

Fayoum Governorate (Egypt). Archives of Gerontology and Geriatrics, 66, 119-126

- El Kady, H. M. (2012). Prevalence of hearing impairment and its correlates among a group of hospitalized chronically ill elderly patients in Alexandria, Egypt. *The Journal Of The Egyptian Public Health Association, 87*(3 and 4), 57-63
- Mabrouk M. (2009). Communication problems of institutionalized elders in Alexandria. Unpublished Master Thesis, Faculty of Nursing. Alexandria University, 2009
- Cunningham, L. L., & Tucci, D. L. (2017). Hearing loss in adults. *New England Journal of Medicine, 377*(25), 2465-2473
- Bent, S., Brennan, S., & McShea, L. (2019). Hearing impairment. In Physical health of adults with intellectual and developmental disabilities (pp. 169-185). *Springer, Cham*
- Hu, W., Wu, J., Jiang, W., & Tang, J. (2018). MicroRNAs and presbycusis. *Aging and disease, 9*(1), 133
- Cheslock, M., & De Jesus, O. (2020). Presbycusis. *StatPearls [Internet]*. Reterived from https://www.ncbi.nlm.nih.gov/books/NBK559220/
- Kuo, P. L., Di, J., Ferrucci, L., & Lin, F. R. (2021). Analysis of hearing loss and physical activity among US adults aged 60-69 years. *JAMA network open, 4*(4), e215484-e215484
- De Almeida Ciquinato, D. S., Doi, M. Y., da Silva, R. A., de Oliveira, M. R., de Oliveira Gil, A. W., & de Moraes Marchiori, L. L. (2020). Posturographic Analysis in the Elderly with and without sensorineural Hearing Loss. *International Archives of Otorhinolaryngology*. DOI: 10.1055/s-0040-1701271
- Maharani, A., Pendleton, N., & Leroi, I. (2019). Hearing impairment, loneliness, social isolation, and cognitive function: Longitudinal analysis using English Longitudinal Study on Ageing. *The American Journal of Geriatric Psychiatry, 27(*12), 1348-1356
- Mick, P., & Pichora-Fuller, M. K. (2016). Is hearing loss associated with poorer health in older adults who might benefit from hearing screening?. *Ear and hearing, 37*(3), e194-e201.
- Mick, P., Parfyonov, M., Wittich, W., Phillips, N., & Pichora-Fuller, M. K. (2018). Associations between sensory loss and social networks, participation, support, and loneliness: Analysis of the Canadian Longitudinal Study on Aging. *Canadian Family Physician, 64*(1), e33-e41
- Yu, A., & Liljas, A. E. M. (2019). The relationship between self-reported sensory impairments and psychosocial health in older adults: a 4-year follow-up study using the English Longitudinal Study of Ageing. *Public health, 169*, 140-148
- Barker, A. B., Leighton, P., & Ferguson, M. A. (2017). Coping together with hearing loss: a qualitative meta-synthesis of the psychosocial experiences of people with hearing loss and their communication partners. *International Journal of Audiology, 56*(5), 297-305
- Loughrey, D. G., Kelly, M. E., Kelley, G. A., Brennan, S., & Lawlor, B. A. (2018). Association of age-related hearing loss with cognitive function, cognitive impairment, and dementia: a systematic review and meta-analysis. *JAMA otolaryngology–head & neck surgery, 144*(2), 115-126
- Martinez-Amezcua, P., Powell, D., Kuo, P. L., Reed, N. S., Sullivan, K. J., Palta, P., ... & Deal, J. A. (2021). Association of age-related hearing impairment with physical functioning among community-dwelling older adults in the US. *JAMA Network Open, 4*(6), e2113742-e2113742
- Ali, M. B. C., Tavakoli, M., & Nassadj, G. (2016). Hearing loss in the elderly: a series of risk factors for imbalance and falling. *Auditory and Vestibular Research, 25*(1), 32-38
- Polku, H., Mikkola, T. M., Rantakokko, M., Portegijs, E., Törmäkangas, T., Rantanen, T., & Viljanen, A. (2018). Hearing and quality of life among community-dwelling older adults. *The Journals of Gerontology: Series B, 73*(3), 543-552
- Sultan, S. (2018). Quality of Life among Hearing Loss Patients in Audiology Out Patient Clinics in Ain Shams University Hospitals. *The Egyptian Family Medicine Journal, 2*(2), 18-31
- Wilson, B. S., Tucci, D. L., Merson, M. H., & O'Donoghue, G. M. (2017). Global hearing health care: new findings and

perspectives. *The Lancet*, *390*(10111), 2503-2515.

- Vos, T., Abajobir, A. A., Abate, K. H., Abbafati, C., Abbas, K. M., Abd-Allah, F., ... & Aboyans, V. (2017). Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet, 390*(10100), 1211-1259
- Reed, N. S., Altan, A., Deal, J. A., Yeh, C., Kravetz, A. D., Wallhagen, M., & Lin, F. R. (2019). Trends in health care costs and utilization associated with untreated hearing loss over 10 years. *JAMA Otolaryngology–Head & Neck Surgery, 145*(1), 27-34
- Quaranta, N., Coppola, F., Casulli, M., Barulli, M. R., Panza, F., Tortelli, R., ... & Logroscino, G. (2015). Epidemiology of age related hearing loss: a review. *Hearing, Balance and Communication, 13*(2), 77-81
- Kowalewski, V. C. (2018). The Effect of Hearing Loss on Balance Control (Doctoral dissertation).
- Bédirian, V., Charbonneau, S., Chertkow, H., Collin, I., Nasreddine, Z. S., Phillips, N. A., & Whitehead, V. (2005). The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. Journal of the American Geriatrics Society, 53(4), 695-699.
- ElGaafary, M. M., & Rahman, T. T. A. (2009). Montreal Cognitive Assessment Arabic version: reliability and validity prevalence of mild cognitive impairment among elderly attending geriatric clubs in Cairo. Geriatrics & gerontology international, 9(1), 54-61.
- Myers, A. M., & Powell, L. E. (1995). The activities-specific balance confidence (ABC) scale. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 50(1), M28-M34.
- Awad, S. A., Fahmy, H. D., & El-Fatah, A. (2016). Assessment of the quality of Life Among Hearing Impaired Elderly Patients' in Assiut University Hospital, Egypt. Assiut Scientific Nursing Journal, 4(8), 1-10.
- Said, E. A. (2017). Health-related quality of life in elderly hearing aid users vs. non-users. Egyptian Journal of Ear, Nose, Throat and Allied Sciences, 18(3), 271-279.
- World Health Organization. (2021). World Report On Hearing. Available at: file:///C:/Users/WIN%207/Downloads/9789240020481-eng.pdf
- Moser, S., Luxenberger, W., & Freidl, W. (2017). The influence of social support and coping on quality of life among elderly with age-related hearing loss. American Journal of Audiology, 26(2), 170-179.
- Emmett, S. D., & Francis, H. W. (2015). The socioeconomic impact of hearing loss in US adults. Otology & neurotology: official publication of the American Otological Society, American Neurotology Society [and] European Academy of Otology and Neurotology, 36(3), 545.
- Alfauomy, N., Ibrahim, H., Abd-Alrahman, S., & Abd-El Salam, R. (2017). Hearing Impairment: Cognitive, Functional and Psychosocial Status. Alexandria Scientific Nursing Journal, 19(1), 147-162.
- Kim, S. Y., Kim, H. J., Park, E. K., Joe, J., Sim, S., & Choi, H. G. (2017). Severe hearing impairment and risk of depression: A national cohort study. PloS one, 12(6), e0179973.
- Gong, R., Hu, X., Gong, C., Long, M., Han, R., Zhou, L., ... & Zheng, X. (2018). Hearing loss prevalence and risk factors among older adults in China. International journal of audiology, 57(5), 354-359.
- Golub, J. S., Brewster, K. K., Brickman, A. M., Ciarleglio, A. J., Kim, A. H., Luchsinger, J. A., & Rutherford, B. R. (2019). Association of audiometric age-related hearing loss with depressive symptoms among Hispanic individuals. JAMA Otolaryngology–Head & Neck Surgery, 145(2), 132-139.
- Ji-Su, K. I. M. (2015). Prevalence and factors associated with hearing loss and hearing aid use in korean elders. *Iranian journal of public health*, *44*(3), 308.
- Cosh, S., Carriere, I., Daien, V., Amieva, H., Tzourio, C., Delcourt, C., ... & Sense□Cog Consortium. (2018). The relationship between hearing loss in older adults and depression over 12 years: Findings from the Three□City prospective cohort study. International journal of geriatric psychiatry, 33(12), 1654-1661.
- Naqi, S. A., Ali, S. M., Akhtar, A., Aziz, T., Sajid, T., & Zaman, A. (2020). Evaluation of

elderly patients with hearing impairment. The Professional Medical Journal, 27(10), 2154-2158.

- Ganesan, P., Schmiedge, J., Manchaiah, V., Swapna, S., Dhandayutham, S., & Kothandaraman, P. P. (2018). Ototoxicity: a challenge in diagnosis and treatment. *Journal of Audiology & Otology, 22(*2), 59.
- Slade, K., Plack, C. J., & Nuttall, H. E. (2020). The effects of age-related hearing loss on the brain and cognitive function. *Trends in neurosciences*.
- Alattar, A. A., Bergstrom, J., Laughlin, G. A., Kritz-Silverstein, D., Richard, E. L., Reas, E. T., ... & McEvoy, L. K. (2020). Hearing impairment and cognitive decline in older, community-dwelling adults. *The Journals of Gerontology: Series A*, *75*(3), 567-573.
- Utoomprurkporn, N., Woodall, K., Stott, J., Costafreda, S. G., & Bamiou, D. E. (2020). Hearing□impaired population performance and the effect of hearing interventions on Montreal Cognitive Assessment (MoCA): Systematic review and meta□analysis. International Journal of Geriatric Psychiatry, 35(9), 962-971.
- Mukari, S. Z. M. S., Ishak, W. S., Maamor, N., & Wan Hashim, W. F. (2017). A preliminary study investigating the association between hearing acuity and a screening cognitive tool. Annals of Otology, Rhinology & Laryngology, 126(10), 697-705.
- Bruce, H., Aponte, D., St-Onge, N., Phillips, N., Gagné, J. P., & Li, K. Z. (2019). The effects of age and hearing loss on dual-task balance and listening. The Journals of Gerontology: Series B, 74(2), 275-283.
- Criter, R. E., & Gustavson, M. (2020). Subjective hearing difficulty and fall risk. American journal of *audiology*, *29*(3), 384-390.
- Da, H. K., Lee, J. D., & Lee, H. J. (2015). Relationships among hearing loss, cognition and balance ability in community-dwelling older adults. *Journal of physical therapy science*, *27*(5), 1539-1542.
- Scholes, S., Biddulph, J., Davis, A., & Mindell, J. S. (2018). Socioeconomic differences in hearing among middle-aged and older adults: cross-sectional analyses using the health survey for England. *BMJ open*, *8*(2), e019615.
- Li, S., Ye, H., Chen, A., Lan, L., Yang, S., & Ji, F. (2021). Characteristics of hearing loss in elderly outpatients over 60 years of age: an annual cross-sectional study. *ActaOtoLaryngologica*, *141*(8), 762-767.
- Kim, S., Park, J. M., Han, J. S., Seo, J. H., Han, K. D., Joo, Y. H., & Park, K. H. (2020). Age-related hearing loss in the Korea national health and nutrition examination survey. *Plos one*, *15*(12), e0243001.
- Deal, J. A., Betz, J., Yaffe, K., Harris, T., Purchase-Helzner, E., Satterfield, S., ... & Health ABC Study Group. (2017). Hearing impairment and incident dementia and cognitive decline in older adults: the health ABC study. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, *72*(5), 703-709.
- Donaldson, N., Worrall, L., & Hickson, L. (2004). Older people with hearing impairment: A literature review of the spouseis perspective. *Australian and New Zealand Journal of Audiology, The*, *26*(1), 30-39.
- Singh, G., Hickson, L., English, K., Scherpiet, S., Lemke, U., Timmer, B., & Launer, S. (2016). Family-centered adult audiologic care: A Phonak position statement. *Hearing Review*, *23*(4), 16.
- Ye, X., Zhu, D., Chen, S., & He, P. (2020). The association of hearing impairment and its severity with physical and mental health among Chinese middle-aged and older adults. *Health and quality of life outcomes*, *18*, 1-8.
- Tsimpida, D., Kontopantelis, E., Ashcroft, D., & Panagioti, M. (2019). Socioeconomic and lifestyle factors associated with hearing loss in older adults: a cross-sectional study of the English Longitudinal Study of Ageing (ELSA). BMJ open, 9(9), e031030.
- Nakahori, N., Sekine, M., Yamada, M., Tatsuse, T., Kido, H., & Suzuki, M. (2020). Association between self-reported hearing loss and low socioeconomic status in Japan: findings from the Toyama dementia survey. BMC geriatrics, 20(1), 1-7.
- Choi, J. S., Betz, J., Deal, J., Contrera, K. J., Genther, D. J., Chen, D. S., ... & Lin, F. R. (2016). A comparison of self-report and

audiometric measures of hearing and their associations with functional outcomes in older adults. Journal of Aging and Health, 28(5), 890-910.

- Alvarado, J. C., Fuentes-Santamaría, V., Gabaldón-Ull, M. C., & Juiz, J. M. (2019). Age-related hearing loss is accelerated by repeated short-duration loud sound stimulation. Frontiers in neuroscience, 13, 77.
- Lie, A., Skogstad, M., Johannessen, H. A., Tynes, T., Mehlum, I. S., Nordby, K. C., ... & Tambs, K. (2016). Occupational noise exposure and hearing: a systematic review. International archives of occupational and environmental health, 89(3), 351-372.
- Gopinath, B., McMahon, C., Tang, D., Burlutsky, G., & Mitchell, P. (2021). Workplace noise exposure and the prevalence and 10-year incidence of age-related hearing loss. Plos one, 16(7), e0255356.
- Baghel, M. S., Singh, P., Srivas, S., & Thakur, M. K. (2019). Cognitive changes with aging. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences, 89(3), 765-773.
- Uchida, Y., Sugiura, S., Nishita, Y., Saji, N., Sone, M., & Ueda, H. (2019). Age-related hearing loss and cognitive decline—The potential mechanisms linking the two. Auris Nasus Larynx, 46(1), 1-9.
- Lin, F. R., Yaffe, K., Xia, J., Xue, Q. L., Harris, T. B., Purchase-Helzner, E., ... & Health ABC Study Group, F. (2013). Hearing loss and cognitive decline in older adults. *JAMA internal medicine, 173*(4), 293-299.
- Taljaard, D. S., Olaithe, M., Brennan□Jones, C. G., Eikelboom, R. H., & Bucks, R. S. (2016). The relationship between hearing impairment and cognitive function: a meta□analysis in adults. Clinical Otolaryngology, 41(6), 718-729.
- Gussekloo, J., de Craen, A. J., Oduber, C., van Boxtel, M. P., & Westendorp, R. G. (2005). Sensory impairment and cognitive functioning in oldest-old subjects: the Leiden 85+ Study. *The American Journal of Geriatric Psychiatry*, *13*(9), 781-786.
- Kurtaran, H., Acar, B., Ocak, E., & Mirici, E. (2016). The relationship between senile hearing loss and vestibular activity. *Brazilian journal of otorhinolaryngology*, *82*, 650-653. DOI: https://doi.org/10.1016/j.bjorl.2015.11.016
- Bang, S. H., Jeon, J. M., Lee, J. G., Choi, J., Song, J. J., & Chae, S. W. (2020). Association between hearing loss and postural instability in older Korean adults. *JAMA Otolaryngology–Head & Neck Surgery*, *146*(6), 530-534.