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Original Research Paper

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ASSOCIATION BETWEEN BODY MASS INDEX AND HEARING LOSS : A CROSS-SECTIONAL STUDY IN A TERTIARY CARE HOSPITAL.

Dr. Ravi D	Associate Professor, Department of ENT, Mandya Institute of Medical Sciences, Mandya, Karnataka.
Dr. Balaji N K*	Assistant Professor, Department of ENT, Mandya Institute of Medical Sciences, Mandya, Karnataka. *Corresponding Author
Dr. Akshata Nagaral	Junior Resident, Department of ENT, Mandya Institute of Medical Sciences, Mandya, Karnataka.
Dr. Ramya Kenchaiah	Senior Resident, Department of ENT, Mandya Institute of Medical Sciences, Mandya, Karnataka.

ABSTRACT Hearing loss is a growing important global public health concern. Emerging evidence implicates high BMI as a risk factor for hearing loss. Identification of modifiable factors for hearing loss that could be useful to prevent or at least delay the condition. We aimed to assess relation between body mass index and hearing loss and also to asses the parameters closely associated with obesity such as lipid parameters, blood sugars and their association on hearing threshold.In this cross sectional study conducted for a period of 6 months on 460 subjects presented with hearing loss, tinnitus and vertigo. BMI of each individual was calculated and categorized. They were subjected to audiometric evaluation.Overweight (88.1%) and obese participants (85.5%) showed association with hearing loss. Mild and moderate hearing loss was more common in both over weight and obese patients with significant p value (<0.001). BMI categories with deranged RBS, deranged lipid parameters there was association with hearing loss. Our study demonstrated association was found between obesity and hearing loss.We emphasize that obesity and various risk factors associated with obesity may play role in hearing loss, So early screening of obese subjects may provide early diagnosis of hearing loss.

KEYWORDS : Obesity, Association, Hearing Threshold

INTRODUCTION

Hearing loss is a growing important global public concern.Hearing loss is not only restricting individual's ability to communicate and interact, but may also have a negative impact on physical and psycological well-being and quality of life.[1,2] Genetic susceptibility, environmental factors, such as systemic diseases, noise, chemical exposure, tobacco, alcohol, ototoxic medication may also contribute to the variation in the frequency and severity of hearing loss.[3] Identification of preventable or modifiable factors for hearing loss that could be useful to prevent or at least delay this condition should be a top public health priority.[4]

Emerging evidence implicates excess weight and its related cardio metabolic co-morbidities, such as diabetes mellitus and cardiovascular disease (CVD)[5,6] as potential risk factors for hearing loss.Obesity and its co-morbidites including type 2 diabetes mellitus and dyslipidaemia have emerged as a global epidemic.[7]

Inflammation induced by obesity, macrophage infiltration, pro-inflammatory cytokines release may cause end organ damage.[11] Individual with these conditions are likely to have poor micro-vascular circulation that can lead to reduced blood supply to the cochlea, resulting in damage to the hair cells and eventually leads to hearing loss.The relation between hearing impairment and obesity is relatively recent research interest, but is significant as both conditions have the ability to substantially reduce an individual's quality of life.[13]The findings of several epidemiological studies have indicated that elevated body mass index (BMI), in the obesity range and to a lesser extent, in the overweight range, was positively associated with hearing loss.[12]

Hearing loss can be prevented by avoidance or control of obesity and its risk factors. An auditory screening of obese patients at an early stage may provide early diagnosis of hearing loss and may also contribute to create awareness to prevent obesity.[8]The Purpose of the study is to assess relation between body mass index and hearing threshold.To asses the parameters closely associated with obesity such as lipid parameters, blood sugars and their association on hearing threshold.

METHODOLOGY

A cross sectional study was conducted from March 2022 to August 2022 in the Department of Otorhinolaryngology, Mandya Institute of Medical Sciences, Mandya , 460 subjects were recruited. The study plan was approved by institutional ethic committee and informed consent was obtained from all subjects participating in the study. All patients with age group between 10-80 years presenting to Otorhinolaryngology OPD with chief complaints like hearing loss, tinnitus and giddiness were included in the study. The criteria for exclusion from the study were patients with previous history of chronic suppurative ottitis media, ear surgery, neurological and psychiatric diseases, brain tumor, chronic kidney disease, history of exposure to ototoxic substances and occupational noise exposure, radiations and patients with conductive hearing loss.

Height and weight of the subjects included in the study were measured, Body mass index (BMI) was calculated as weight in kilograms divided by height in square meters (Kg/m^2) by Quetelet's formula. According to Asia-Criteria based BMI cutoff values patients were categorized as normal weight(18.5-22.9), over weight(23-27.5) and obese(>27.5).

A thorough Ear, Nose and Throat examination including Otoscopic examination was done. Patients were subjected to Pure Tone Audiometry. Also relevant blood investigations like Lipid profile and Random Blood Sugar were done.Pure Tone Audiometry was carried out in a sound proof room using an Interacoustic Clinical Audiometer (Model AD 629).The hearing threshold levels were determined in decibels. The average hearing thresholds for both ears were measured for frequency 250Hz to 8000Hz and was used for analysis.

Hearing loss is defined as a hearing threshold >26dB. The severity of hearing loss is classified as Normal (<25dB),

Mild(26-40dB), Moderate(41-55dB), Moderately severe (56-70dB) and Severe (71-90dB) in accordance with the International Classification for Standards. Association and severity of hearing loss was assessed in each group of subjects categorized based on BMI.Association was also assessed for deranged lipid parameters and blood sugars.

Statistical Analysis

All data collected were entered in Microsoft Excel sheet and were statistically analyzed using https://www.openepi.com/RbyC/RbyC.htm . Analysis was done using descriptive statistics like percentage and inferential statistics like Chi Square test. p value <0.005 was considered statistically significant.

RESULTS:

A total of 460 subjects were recruited for the study.Of the 460 subjects, 210 (45.7%) were males and 250 (54.3%) were females. Mean age among subjects was found to be 50.9 +/- 10.48 years.

Table 1. Hearing Loss In BMI Categories And Its Demographic Distribution.

		Hearing loss (%)	Normal Hearing (%)	Total(N=460)	P value*
Weight	Normal weight	45(42.5)	61(57.5)	106	< 0.001
	Over weight	245(88.1)	33(11.8)	278	
	Obese	65(85.5)	11(14.5)	76	
Age	10-44 year	81(71.0)	33(28.0)	114	0.804
	45-80 year	250(72.3)	96(27.7)	346	
Gender	Male	158(75.2)	52(24.8)	210	0.121
	Female	203(81.2)	47(18.8)	250	

*chi square test

Out of 460 subjetcs the rates of hearing loss in the Normal weight, Over weight and Obese subjects were 42.5%, 88.1% and 85.5% respectively. There was no significant association found between age,gender and hearing loss.

Table 2. Comparison Of BMI Categories With Degree Of Hearing Loss.

Hearing Loss	BMI			Total	P Value*
	Normal Weight(%)	Over Weight (%)	Obese (%)		
Normal (<25dB)	55(51.9)	30(10.8)	11(14.5)	96	<0.001
Mild (26-40dB)	40 (37.7)	132(47.4)	9(11.9)	181	
Moderate (41-60dB)	7 (6.6)	99 (35.7)	38(50)	144	
Moderately Severe (61-80dB)	2 (1.9)	10(3.6)	17(22.3)	29	
Severe (>81dB)	2 (1.8)	7(2.5)	1(1.3)	10	
Total	106	278	76	460	

*Chi Square test was used

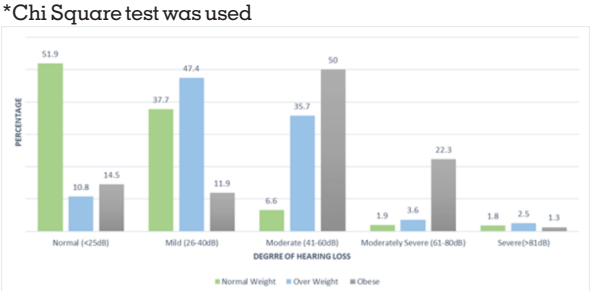

Figure 2: Distribution Of Degree Of Hearing Loss Among BMI Categories.

On applying Chi-square test, it was found to be statistically significant (p-value <0.001) that increase in BMI is associated with increase in degree of hearing loss.

Mild (47.4%) to Moderate (35.7%) hearing loss in over weight subjects and moderate (50.0%) to moderately severe(22.3%) hearing loss was common in obese individual.

Table 3. Comparison Of Severity Of Hearing Loss In Terms Of Average Of BMI

Hearing loss	BMI(Mean+/-SD)			Total
	Normal Weight	Over Weight	Obese	
Normal	20.96+/-0.87	24.15+/-1.25	28.64+/-0.53	96
Grade 1	21.48+/-0.79	26.54+/-1.3	28.3+/-0.92	181
Grade 2	21.47+/-.59	25.65+/-1.28	27.9+/-0.52	144
Grade 3	20.9+/-1.97	25.75+/-1.62	28.56+/-0.86	29
Grade 4	24.2+/-2.64	24.82+/-1.79	29.4	10
Total	106	278	76	460
P Value	<0.001	<0.001	<0.001	

SD=Standard Deviation, * ANOVA test

On applying ANOVA test, it was found to be statistically significant (p-value <0.001) that Over weight subjects were having mild to moderate hearing loss and obese subjects were having moderate to moderately severe hearing loss.

Table 4. Comparison Of Risk Factors Between BMI Categories

Risk Factors	BMI (n)	Hearing loss(%)	Normal Hearing (%)	P Value *
Deranged RBS	Normal Weight (43) Over weight (159) Obese (33)	29(67.4) 144(90.6) 31(96.9)	15(34.8) 15(9.4) 2(3.1)	<0.001
Deranged Lipid Parameters	Normal Weight (17) Over weight (80) Obese (34)	12(70.6) 76(95.0) 28(82.4)	5(29.4) 4(5.0) 6(17.6)	<0.001

*Chi Square Test

On applying Chi-square test, it was found to be statistically significant (p-value <0.001) that BMI categories with deranged RBS,Deranged lipid profile, there was association with hearing loss.

DISCUSSION

This cross sectional study provides findings regarding the possible association of BMI with hearing loss and its severity.The key finding in our study is that rates of hearing loss were significantly higher in over weight(88%) and obese(85%) than the normal weight subjects(42.5%). Increase in BMI associated with increase in degree of hearing loss with significant p value (<0.001). Over weight subjects were having mild (47%) to moderate (35.7%) hearing loss where as obese subjects were having moderate (50%) to moderately severe (22%) hearing loss with significant p value (<0.001) . Risk factors like deranged blood glucose level, deranged lipid parameters in subjects categorized by BMI also showed significant association with hearing loss in this study.

An European multi-center study reported that high BMI was associated with high prevalence of hearing loss.[14] Lalwani et al study found a significant association between obesity with elevated pure tone hearing thresholds.[9] Kim et al has reported a positive relationship between visceral adipose tissue and the average hearing threshold in women, but they did not detect such a relationship in men.[20] Üçler et al. reported an association between obesity and hearing threshold in women aged 18–40 years.[8]Curhan et al. reported that higher BMI associated with increased risk of self-reported

hearing loss.[12] Olga N. Vasilyeva et al showed diabetes had higher pure tone thresholds than non-diabetic controls.[17] M. Bradley Evans et al showed chronic dyslipidemia associated with elevated triglycerides may reduce auditory function.[18] Conversely, Shargorodsky et al. in a study did not find any association between obesity with increased risk of self-reported hearing loss.[21] Hwang JH found no significant relationships between diabetes mellitus , obesity and hearing loss.[4]

Obesity may directly or indirectly affect hearing thresholds. Adipose tissue is considered an endocrine organ, releasing hormones and cytokines and affecting appetite, insulin resistance.[9] Adiponectin is an adipocytokine synthesized and released by adipose tissue is present in low concentrations in obese subjects.[9,15]Adiponectin modulates several metabolic processes, among them glucose regulation and fatty acid oxidation.Serum levels of adiponectin decrease with obesity.[16]Obesity related oxidative stress, obesity induced atherosclerosis may cause reduction in cochlear blood flow and may contribute as other factors for hearing impairment in obese individuals.[19]

CONCLUSION

This study showed statistically significant association between Obesity and Hearing loss. Increase in BMI associated with increase in hearing thresholds and also increase in severity of hearing loss.We emphasize that obesity and various risk factors associated with obesity may play role in hearing loss, which can be prevented by avoidance or control of these risk factors.So early screening of obese subjects may provide early diagnosis of hearing loss.

LIMITATIONS

As it was cross sectional study and was not possible to determine the progression of hearing loss as prior hearing tests are not available. The number of subjects studied was limited. Mechanisms of obesity induced hearing loss were not analyzed.

CONFLICT OF INTEREST

None declared

REFERENCES

1. World Health Organization. (2018). Addressing the rising prevalence of hearing loss.
2. Mener, D. J., Betz, J., Genther, D. J., Chen, D., & Lin, F. R. (2013). Hearing loss and depression in older adults. *Journal of the American Geriatrics Society*, *61*(9), 1627.
3. Van Eyken, E., Van Camp, G., & Van Laer, L. (2007). The complexity of age-related hearing impairment: contributing environmental and genetic factors. *Audiology and Neurotology*, *12*(6), 345-358.
4. Hwang, J. H., Wu, C. C., Hsu, C. J., Liu, T. C., & Yang, W. S. (2009). Association of central obesity with the severity and audiometric configurations of age-related hearing impairment. *Obesity*, *17*(9), 1796-1801.
5. Horikawa, C., Kodama, S., Tanaka, S., Fujihara, K., Hirasawa, R., Yachi, Y., ... & Sone, H. (2013). Diabetes and risk of hearing impairment in adults: a meta-analysis. *The Journal of Clinical Endocrinology & Metabolism*, *98*(1), 51-58.
6. Gates, G. A., Cobb, J. L., D'Agostino, R. B., & Wolf, P. A. (1993). The relation of hearing in the elderly to the presence of cardiovascular disease and cardiovascular risk factors. *Archives of Otolaryngology–Head & Neck Surgery*, *119*(2), 156-161.
7. Alberti, K. G. M. M., Zimmet, P., & Shaw, J. (2006). Metabolic syndrome—a new world-wide definition. A consensus statement from the international diabetes federation. *Diabetic medicine*, *23*(5), 469-480.
8. Üçler, R., Turan, M., Garça, F., Acar, I., Atmaca, M., & Cankaya, H. (2016). The association of obesity with hearing thresholds in women aged 18–40 years. *Endocrine*, *52*(1), 46-53.
9. Lalwani, A. K., Katz, K., Liu, Y. H., Kim, S., & Weitzman, M. (2013). Obesity is associated with sensorineural hearing loss in adolescents. *The Laryngoscope*, *123*(12), 3178-3184.
10. Scinicariello, F., Carroll, Y., Eichwald, J., Decker, J., & Breysse, P. N. (2019). Association of obesity with hearing impairment in adolescents. *Scientific reports*, *9*(1), 1-7.
11. Jackson, A. W., Lee, D. C., Sui, X., Morrow Jr, J. R., Church, T. S., Maslow, A. L., & Blair, S. N. (2010). Muscular strength is inversely related to prevalence and incidence of obesity in adult men. *Obesity*, *18*(10), 1988-1995.
12. Curhan, S. G., Eavey, R., Wang, M., Stampfer, M. J., & Curhan, G. C. (2013). Body mass index, waist circumference, physical activity, and risk of hearing loss in women. *The American journal of medicine*, *126*(12), 1142-e1.
13. Dhanda, N., & Taheri, S. (2017). A narrative review of obesity and hearing loss. *International Journal of Obesity*, *41*(7), 1066-1073.
14. Fransen, E., Topsakal, V., Hendrickx, J. J., Van Laer, L., Huyghe, J. R., Van Eyken, E., ... & Van Camp, G. (2008). Occupational noise, smoking, and a high body mass index are risk factors for age-related hearing impairment and moderate alcohol consumption is protective: a European population-based multicenter study. *Journal of the Association for Research in Otolaryngology*, *9*(3), 264-276.
15. Yang, W. S., Lee, W. J., Funahashi, T., Tanaka, S., Matsuzawa, Y., Chao, C. L., ... & Chuang, L. M. (2002). Plasma adiponectin levels in overweight and obese Asians. *Obesity research*, *10*(11), 1104-1110.
16. Achari, A. E., & Jain, S. K. (2017). Adiponectin, a therapeutic target for obesity, diabetes, and endothelial dysfunction. *International journal of molecular sciences*, *18*(6), 1321.
17. Vasilyeva, O. N., Frisina, S. T., Zhu, X., Walton, J. P., & Frisina, R. D. (2009). Interactions of hearing loss and diabetes mellitus in the middle age CBA/CaJ mouse model of presbycusis. *Hearing research*, *249*(1-2), 44-53.
18. Evans, M. B., Tonini, R., Do Shope, C., Oghalai, J. S., Jerger, J. F., Insull Jr, W., & Brownell, W. E. (2006). Dyslipidemia and auditory function. *Otology & neurotology: official publication of the American Otological Society, American Neurotology Society [and] European Academy of Otology and Neurotology*, *27*(5), 609.
19. Loffredo, L., Martino, F., Carnevale, R., Pignatelli, P., Catasca, E., Perri, L., ... & Violi, F. (2012). Obesity and hypercholesterolemia are associated with NOX2 generated oxidative stress and arterial dysfunction. *The Journal of pediatrics*, *161*(6), 1004-1009.
20. Kim, T. S., Park, S. W., Kim, D. Y., Kim, E. B., Chung, J. W., & So, H. S. (2014). Visceral adipose tissue is significantly associated with hearing thresholds in adult women. *Clinical endocrinology*, *80*(3), 368-375.
21. Shargorodsky, J., Curhan, S. G., Eavey, R., & Curhan, G. C. (2010). A prospective study of cardiovascular risk factors and incident hearing loss in men. *the Laryngoscope*, *120*(9), 1887-1891.