



COMPARATIVE STUDY OF PURE TONE AUDIOMETRY IN OBESE & NON-OBESE INDIVIDUALS

Physiology

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ABSTRACT

Background: The world is growing ever fatter. In world's fattest countries, India having 3rd rank. Overweight and obesity is defined as, it is an abnormal or excessive collection of subcutaneous and/or visceral fat which produces a risk to health. Obesity is a bigger problem in India than malaria & TB. In that case obesity in the Indian adolescent kids also rising. Obesity may lead to several complex metabolic complications, including increased insulin resistance, diabetes, respiratory problems, musculoskeletal system disorders, and predisposition to certain forms of cancer, as well as cardiovascular complications, and the psychological effects of low self-esteem, low academic achievement and depression. In recent years, the relationship between obesity and hearing loss has attracted the attention of researchers. It is known that obesity causes dysfunction in many organs and sensorial systems of the body via oxidative stress and lipotoxicity. This lipotoxicity to inner ear cochlear hair cells leads to hearing loss which is permanent. **Aims and Objectives:** The study was done to compare sensorineural hearing loss (SNHLs) in obese with healthy controls. To find out effect of age of individual on hearing, how BMI (Body MASS Index) affect hearing acuity & which frequencies of hearing affected by obese individual. **Materials and Methods:** The present study was conducted on 46 obese patients and 46 non-obese healthy individuals are taken as controls in the age group of 10–40 years. Selection of individuals is done based on inclusion and exclusion criteria. All patients are asked for detailed history and their detailed clinical examination is done. After this, all patient's obesity measured with commonly used index- "Broca's Index". In this method, standard Weight in kilogram & Height in meter. Body Mass Index = [Patient's weight in kg / patient's height in meter²]. Patient's Body Mass index is taken. All subjects underwent pure tone audiometry and findings were recorded and analyzed. **Results:** The obese with SNHL are 84.78% when compared to the control are 52.17% which is highly significant ($P=0.000763$). Obese individual had hearing loss which are progressive in nature and affects hearing in both the sides. The audiogram of obese was suggestive of minimal to mild SNHL which was more toward lower frequencies. SNHL is aggravated with increasing age. In non-obese, SNHL is mainly due to age, but in obese, SNHL is mainly due to poorer control of obesity and not only due to age. **Conclusion:** The obese individuals had hearing loss at lower frequencies more significantly which is bilateral, minimal to mild SNHL as compared to healthy individual of similar age. The Body Mass Index has significant correlation with severity of hearing loss. SNHL is more significant in patients who had increased Body Mass Index (BMI)

KEYWORDS

Obesity; Sensory-neural Hearing Loss; BMI (Basal Metabolic Index); Pure Tone Audiometry

INTRODUCTION

The world is growing ever fatter. In 1975, the underweight greater the obese more than 2 to 1 around the globe. But the ratio turned by 2014. Now there are more obese people than underweight people on Earth. Now a days, average restaurant meal is 4 to 5 times larger than 1950s. If the global trend continues, there is estimation says that, nearly 18 percent of men and 21 percent of women will be obese by 2025. In world's fattest countries, India having 3rd rank. Overweight and obesity is defined as, it is abnormal or excessive collection of subcutaneous and/or visceral fat which produces a risk to health.

[1] [2] (WHO, 2016). Obesity is bigger problem in India than malaria & TB. America had this rising curve of obesity in 1070's. That is where we are today in India - said by Dr. Anoop Mishra, Chairman, National Diabetes, Obesity and Cholesterol foundation. In 1998, the National Institutes of Health (NIH) Expert Panel gives overview on the Identification, Evaluation, and how to Treat Overweight and Obesity in Adults. The World Health Organization (WHO) gives classification for overweight and obesity. [3] The WHO classification, which predominantly applied to people of Asia, assigns increasing risk for comorbid conditions—including hypertension, type 2 diabetes mellitus, and cardiovascular disease—to persons with higher a BMI relative to persons of normal weight (BMI of 18.5 - 25 kg/m²).

Asian populations, however, are known to be at increased risk for diabetes and hypertension at lower BMI ranges than those for non-Asian groups due to predominance of central fat distribution. [4] Consequently, the WHO has suggested lower cut off points for

consideration of therapeutic intervention in Asians: a BMI of 18.5 to 23 kg/m² represents acceptable risk, 23 to 27.5 kg/m² confers increased risk, and 27.5 kg/m² or higher represents high risk [5]. Health problems during childhood and adulthood associated with obesity include an increased risk of diabetes, hypertension, non-alcoholic fatty liver disease, and depression. [6] Obesity may lead to several complex metabolic complications, including increased insulin resistance, diabetes, respiratory problems, musculoskeletal system disorders, and predisposition to certain forms of cancer, as well as cardiovascular complications, and the psychological effects of low self-esteem, low academic achievement, and depression. [7] [8]

In addition, it is reported that obesity starting in childhood is more harmful than obesity starting in adulthood. [9] In recent years, the relationship between obesity and hearing loss has attracted the attention of researchers. The cochlear hair cells of the inner ear are fundamental receptors in hearing function.

Mature mammalian cochlear hair cells are unable to regenerate. Therefore, damage to these cells results in permanent hearing loss. In a few studies performed through microvascular circulation mechanisms of the cochlea, obesity was defined as a predisposing factor for hearing loss. [10] It is known that obesity causes dysfunction in many organs and sensorial systems of the body via oxidative stress and lipotoxicity. [11] This lipotoxicity to inner ear cochlear hair cells leads to hearing loss. Once these outer hair cells are damaged, they cannot be regenerated and hearing loss is permanent.

AIMS & OBJECTIVES:

The study was done to compare sensorineural hearing loss (SNHLs) in obese with healthy controls.

To find out effect of age of individual on hearing, how BMI (Body MASS Index) affect hearing acuity & which frequencies of hearing affected by obese individual.

MATERIAL & METHOD:

A case control study on 46 obese patients and 46 non obese individuals without any comorbidity with age between 10 to 60 years selected based on inclusion & exclusion criteria. Cases and controls were taken from society and their pure tone audiometry was done in a sound proof room at Asian speech and hearing clinic, Ashram Road, Ahmedabad, Gujarat with HERMES D Digital audiometer by modified Hughson-Westlake procedure (Carhart and Jerger, 1959). Prior informed consent was taken from all the subjects participating in the study & Ethical clearance was also obtained from institution for conducting the study. The minimum hearing thresholds were taken at all frequencies including 250, 500, 1k, 2k, 4k, 8k Hz, in air conduction and only till 4 kHz in bone conduction. Patients were grouped into five different age groups 11-20 years, 21-30 years, 31-40 years in both cases and controls. The average pure tone threshold was taken at 500, 1k Hz & 2k Hz frequencies and calculated & compared between obese and non-obese groups. Patient's Obesity measured with commonly used index- "Broca's Index". [12] [13] [14] In this method, standard Weight in kilogram & Height in meter. Body Mass Index = [Patient's weight in kg / patient's height in meter²] Patient's Body Mass index is taken and classified as below.

Classification of Obesity	BMI (Body Mass Index)
Underweight	<19 kg/m ²
Normal Healthy Individual	19.2 – 24.99 kg/m ²
Overweight	25 – 29.99 kg/m ²
Class I Obesity	30 – 34.99 kg/m ²
Class II Obesity	35 – 39.99 kg/m ²
Class III Obesity	>40 kg/m ²

The severity of hearing loss was graded according to the ASHA. (American Speech-Language-Hearing Association) [15]

Degree of Hearing Loss	Hearing loss range (dB HL)
Normal	-10 to +15
Minimal	+16 to +25
Mild	+26 to +40
Moderate	+41 to +55
Moderately Severe	+56 to +70
Severe	+71 to +90
Profound	91+

Inclusion Criteria:

- Subjects with Overweight and Obesity according to BMI are taken.
- Age of subjects between 10–40 years.
- Non obese controls with same age & gender.

Exclusion Criteria:

- Age: <10 years & >40 years.
- Patient with middle ear pathology.
- Patients having Conductive or Mixed hearing loss.
- Patients having known cause of SNHL. (Congenital hearing loss, Meniere's disease, Labyrinthitis, Temporal bone fracture, Syphilis, Meningitis)
- Patients with history of ototoxic drugs.
- Patient with Hypertension, Cardiac disorder, Renal failure.
- Past history of head/ear trauma.
- Past history of ear surgery.
- Past history of occupational noise exposure.
- Patients with oedema, ascites, pregnancy.

DISCUSSION:

On the basis of above study, it is seen that obesity is known to cause bilateral progressive SNHL with most of them have mild degree of hearing loss.[16] Increased risk of obesity due to modern lifestyle & genetic activation, it also increases risk of hearing loss. As age increases it also increases risk of hearing loss. Presbycusis patients develop hearing loss, was slow & increased as age increases. Obese patients also show hearing loss as presbycusis but it occurs in early ages and frequencies affected are different. Our study shows that

presence of SNHL in obese patients was highest among 11-20 years of age group which is followed by 21-30 years age group which is adolescent age group. WHO says that Adolescence is the phase of life between childhood and adulthood, from ages 10 to 19. It is a unique stage of human development and an important time for laying the foundations of good health. Adolescents experience rapid physical, cognitive and psychosocial growth. [17] [18] Obesity in the Indian adolescent kids also rises. There was no pattern of increasing no. of SNHL with increase in age as seen in control group which suggest that other factors also contribute to SNHL in obese, not only the age. This study shows that as BMI is higher, it is associated with higher hearing thresholds particularly for lower frequencies than higher frequencies. This study is associated by Anil K. Lalwani et al., observed that obesity in adolescent participants to NHANES 2005–2006 are associated with higher hearing thresholds across all frequencies, particularly more in lower frequencies. [19] While some studies rule out the association such as Sameer Ahmed et al, demonstrated that obesity has a notable relationship with the presence and degree of hearing loss in adolescents, particularly in the high frequencies. In individuals with higher BMI, acquired hearing loss, though mild can be progressive and in the presence of multiple risk factors like hypertension, cardiovascular diseases, type 2 diabetes, dyslipidemia can lead to moderate to profound hearing loss. This affects quality of life, decreased productivity and in turn financial burden to the individuals. In spite of the importance of hearing in everyday life, mild hearing loss is often unnoticed and undertreated. Because higher BMI directly and indirectly (Type 2 DM, cardiovascular diseases, dyslipidemia) affects hearing and is a modifiable risk factor, the present study intends to sensitize the society.

RESULT:

	SNHL+	SNHL-	Total
Obesity+	39	7	46
Obesity-	24	22	46
	63	29	92

ODDS RATIO = $39 \times 22 / 24 \times 7 = 5.017$

SNHL among Obesity is 5.017 times higher than non-Obese.

Chi square test = 9.8697

p Value = 0.000763 (p < 0.05 - Significant)

Age	Obese		Non-Obese	
	SNHL +	SNHL -	SNHL +	SNHL -
11 - 20 Years	17	2	1	16
21 - 30 Years	11	3	1	12
31 - 40 Years	12	1	2	14

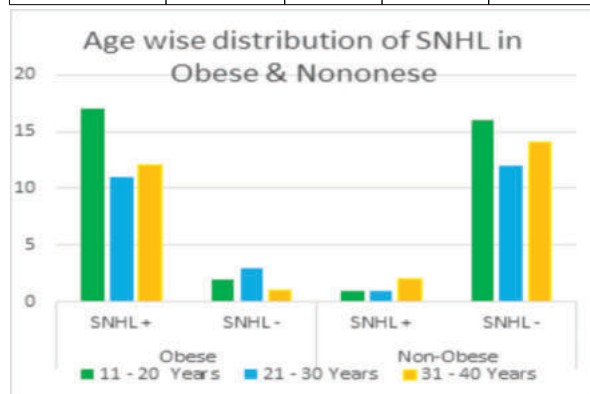


Figure: Age wise distribution of SNHL in Obese & Nonobese

	Normal	Minimal to Mild	Moderate to Severe
Obese+	3	24	10
Non-Obese -	18	19	2

χ^2 test = 16.5879

P value = 0.00025 (<0.05)

	Non-Obese	Over weight	Obesity I	Obesity II	Obesity III
Normal	10	2	1	1	1
Mild	3	9	10	11	15
Moderate	1	2	1	4	3
Severe	1	1	1	1	1

χ^2 test = 30.1854

P value = 0.002618 (<0.05)

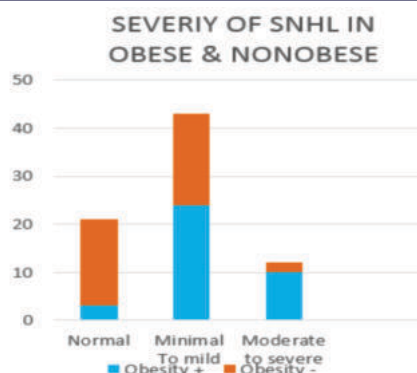


Figure: Severity of SNHL in Obese & Non-Obesity

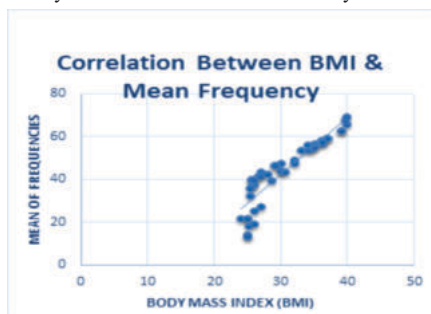


Figure: Severity of SNHL in Obese

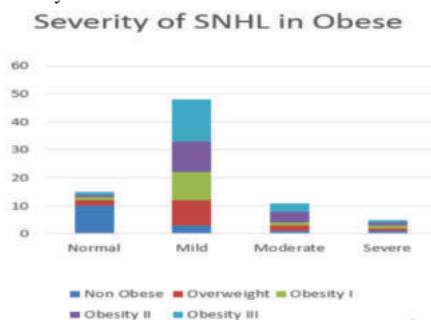


Figure:Correlation between BMI (Body Mass Index) and mean frequency

CONCLUSION:

Obesity is known to cause SNHL which is progressive in nature and affects both the sides simultaneously. Most of them have minimal to mild degree of hearing loss.

In adolescence, risk of obesity increases due to modern lifestyle and genetic activation and hearing loss also increases.

Our study also shows that as Body Mass Index increases, there are increased hearing thresholds. Study also shows that obese individuals have SNHL at lower frequencies than higher frequencies.

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