

# AUDIOLOGICAL FINDINGS AND THEIR CHARACTERISTICS IN SMOKERS: AS SEEN AT AN AUDIOLOGICAL SETUP

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## ABSTRACT

**Objective:** To determine the frequency of audiological findings and their characteristics among smokers in an audiology setup.

**Study Design:** It was a cross sectional descriptive study.

**Place & Duration:** Study was carried out at PGMI/AMC /LGH LAHORE and Iqra Medical Complex, Lahore. The duration of study was 6 months (from October 2017 to March 2018).

**Methodology:** It was a cross-sectional descriptive study in which 200 patients 20-70 years old were included, utilizing convenient sampling method and subjected to audiological assessment as part of routine medical examination. Patients with NIHL (noise induced hearing loss) and identified cases of Otosclerosis and Meniere's disease were expelled from study. Audiological assessment included tympanometry, otoscopy and pure tone audiometry, following demographic data collection including smoking history. Data collected through proforma was analyzed and tabulated using SPSS version 20. Variables particularly studied were otoscopic findings; severity, type and HL configuration as well as tympanometry screening findings.

**Results:** During study 200 patients with M: F ratio of 4.88: 1 were included and the mean age was  $39.85 \pm 1.05$  years. Among these patients, 39% were smokers and 61% were non-smokers while HL was observed among 72.13% smokers and 27.87% non-smokers. Sensorineural hearing loss was found among 72.73% smokers, followed by conductive HL (22.73%) and mixed hearing loss (4.55%). The mild hearing loss was observed among 50% smokers, followed by moderate (40.91%) and severe hearing loss (9.09%). Flat curve was noted among 70.45% followed by sloping among 29.55% smokers.

**Conclusion:** Study concluded that cigarette smoking leads to adverse audiological findings, hence, smoking cessation should be considered to save this vital sensory structure.

**Key Words:** Conductive hearing impairment, Sensorineural hearing impairment.

## INTRODUCTION

In Pakistan, cigarette smoking is one of the frequent addiction with almost 22 million smokers in which majority are men<sup>1</sup>, including 47.6 percent military personnel<sup>2</sup>. A study indicated that every 3rd adult in Pakistan is cigarette smoker, making cigarette a main commodity<sup>3</sup>. Being a major factor of death<sup>4</sup>, smoking is held responsible for death caused by lung cancer (90%), persistent emphysema and bronchitis (75%) while ischemic heart disease (25%) among patients aged less than 65 years. It is believed that smokers loose almost one decade of their life expectancy<sup>5</sup>.

Multiple harmful chemicals are found in cigarette smoke<sup>6</sup>, which go into body tissue through blood, lungs, arsenic, formaldehyde, vinyl chloride, nicotine and

ammonia being tip of the iceberg. Some comprising nicotine are ototoxic and hence can lead to tinnitus, imbalance and HL (hearing loss)<sup>7</sup>.

During several years, proof has gathered about smoking adverse effect on ear<sup>8-10</sup>, whereas absence of such relationship has been reported as well. A study undertaken by Nomura and coworkers showed significant positive relationship between hearing loss and smoking in nine researches compared to six with insignificant relationship<sup>7</sup>. As per Paschoal and colleagues, hearing loss and tinnitus more cases were observed among smokers suggesting injurious effects of the smoking<sup>8</sup>. Since, the smoking is most common in this area of world; hence, it is significant to conduct a study as no study has come up from Pakistan regarding

adverse effects of smoking on ear particularly hearing loss.

The current study was carried out to determine the frequency of audiological findings and their characteristics among smokers.

## METHODOLOGY

It was a cross-sectional descriptive study carried out at Iqra Medical Complex Lahore, Pakistan, to determine the frequency of audiological findings and characteristics among smokers during a period of six months from October 2017 to March 2018. The sample size of study was 200 patients of both sexes, 20 to 70 year old randomly selected and subjected to audiological assessment, as part of a routine periodic health examination following filling of a questionnaire comprising smoking habits and demographic information. Patients with NIHL and identified cases of Otosclerosis and Meniere's disease were not included in the study. Patients were divided into 2 groups. In Group "A" non-smokers while in Group-B smoker were included. The patients who were smoking during the period of assessment were considered as current smokers while who had previously smoked but had stopped were considered as past smokers.

Audiological assessment was carried out in a sound proof, sealed room and included Tympanometry (Interacoustic), Pure Tone Audiometry (PTA) and Otoscopy with a standardized Clinical PTA (GSI-16, USA) wherein both bone conduction and air conduction tests were carried out under an experienced audiologist supervision, who was not aware about smoking status of patients. In PTA, air conduction was checked at frequencies of 250 to 8000 Hz and among patients where air conduction threshold in one of these frequencies was more than 25 dB level of hearing; bone conduction was examined as well. The patients who had HL were then sent for further assessment and treatment. The audiograms were coded as per shape, type and degree or audiogram configuration namely high tone loss, low tone loss, flat and sloping. 25 to 35 dB was considered mild HL, 40 to 60 dB moderate HL and above 65 dB severe HL.

The collected data was tabulated by Microsoft Excel Worksheet and analyzed through SPSS version 20. Qualitative variables such as sex was presented as frequency and percentage while quantitative variables for example age was presented as mean $\pm$ SD. Variables particularly studied included otoscopy findings,

smoking habits, severity type and HL configuration and tympanometry result. These variables were presented by frequency and percentage and cross tabulation. The data was then compared with literature available from various parts of world and different parts of country and deductions observed were then discussed.

## RESULTS

During study 200 patients were included. Among them, 166 (83%) males and 34 (17%) were females (Figure I). The male-female ratio was 4.88:1 and age range was 37-41 years with mean age 39.85 $\pm$ 1.05 years.

Table-I demonstrates that among 200 participants, 122 (61%) were nonsmokers and 78 (39%) were smokers. Among smokers, 73 (93.6%) were current and 05 (6.4%) were past smokers. Among total 78 smokers, 70 (89.6%) were active smokers and 08 (10.4%) were passive smokers. Among participants, mean consumed number of cigarettes was 18.97  $\pm$  SD 0.90 per day. Average packs per year consumed were 15.37  $\pm$  SD 1.13 while average smoking duration was 16.29  $\pm$  0.85 years (Table II).

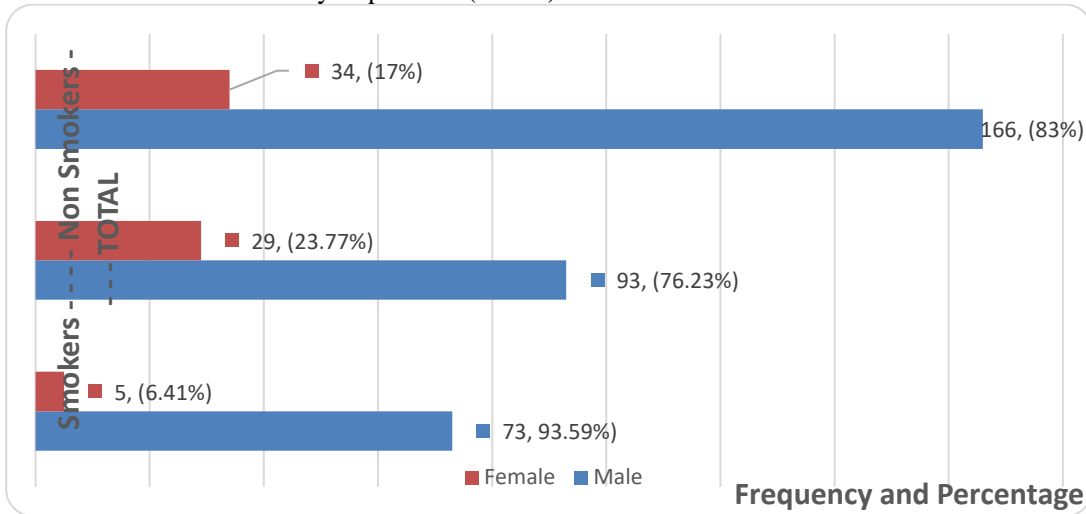
Otoscopy demonstrated normal findings among 64% smokers and 86.07% non-smokers with further abnormal findings among smokers, Otoscopy showed a retracted tympanic membrane among smokers (24.36%) when compared with non-smokers (10.66%) (Table III).

Results showed statistical association between hearing loss and smoking. Among respondents, 72.13% smokers and 28.87% non-smokers were found having HL. Regarding extent of hearing loss, 50 percent smokers had mild, 40.91 percent moderate and 9.09% had severe hearing loss (Table IV). According to type of hearing loss, among smokers most frequent type was SNHL (72.73%), followed by conductive (22.73%) and mixed hearing loss (4.55%), while in case of nonsmokers however SNHL was most common among (70.59%) though this was followed by almost similar percentage of conductive and mixed HL. Configuration of flat curve was noticed among 70.45% smokers followed by sloping curve among 29.55% smokers. On the contrary among non-smokers sloping curve predominated (88.24%).

Tympanometric evaluation showed mainly normal type A curve among both smokers and nonsmokers followed by a type C curve among 12.82% smokers and 11.48% nonsmokers (Table- III).

**ILLUSTRATIONS**

**Figure-I:** Gender Distribution of Study Population (n=200)



**Table I:** Frequency distribution of Active and Passive smokers \* Current and Past: Cross Tabulation (n = 200)

Category	Smokers (78, 39%)				Non Smokers (122, 61%)		Total (n=200)	
	Current Smoker		Past Smoker		No	%	No	%
Non Smokers	0	0%	0	0%	122	100%	122	61.00%
Active Smokers	70	100%	0	0%	0	0%	70	89.06%
Passive Smokers	3	37.50%	5	62.50%	0	0%	8	10.40%
Smokers	73	93.60%	5	6.40%	0	0%	78	39%

(Note: No = Absolute Frequencies, % - Relative Frequencies)

**Table II:** Smoking Habits

Smoking Habits	Mean	SD	Min	Max	CI 95%
Cigarettes Consumed Per Day	18.97	0.90	17.7	20.77	
Mean Pack Years	15.37	1.13	13.10	17.63	
Duration of Smoking	16.29	0.85	14.59	17.99	

**Table III:** Frequency distribution of Evaluation Test (Otoscopy/ Tympanometry) Findings \* Smokers & Non Smokers. Cross Tabulation (n=200)

OTOSCOPY CHARACTERISTICS		SMOKERS (n=78)	NON SMOKERS (n=122)	TOTAL (n=200)
Normal		50 (64.10%)	105 (86.07%)	155
Retracted TM		19 (24.36%)	13 (10.66%)	32
Bulging TM		5 (6.41%)	2 (1.64%)	7
Fluid Behind TM		4 (5.13%)	2 (1.64%)	6
MIDDLE EAR IMPEDANCE CHARACTERISTICS				
Jerger Graph Ref??	Type A	56 (71.79%)	102 (83.61%)	158
	Type As	2 (2.56%)	2 (1.64%)	4
	Type Ad	2 (2.56%)	1 (0.82%)	3
	Type B	8 (10.25%)	3 (2.46%)	11
	Type C	10 (12.82%)	14 (11.48%)	24
Compliance	Mean	0.69	0.78	0.74
	Standard Deviation	0.04	0.19	0.12

**Table IV:** Frequency distribution of Audiometric Findings/ Characteristics of Smoker and Non Smokers. Cross Tabulation (n= 200)

AUDIOMETRIC CHARACTERISTICS	TEST FINDINGS	SMOKERS		NON SMOKERS	
		No	%	No	%
		(n=78)		(n=122)	
Hearing Threshold	Normal	34	24.46	105	75.54
	Hearing Loss	44	72.13	17	27.87
		(n=44)		(n=17)	
Type of HL	SNHL	32	72.73	12	70.59
	Conductive HL	10	22.73	2	11.76
	Mixed HL	2	4.55	3	17.65
Degree of HL	Mild HL	22	50.00	10	58.82
	Moderate HL	18	40.91	5	29.41
	Severe HL	4	9.09	2	11.76
Curve	Flat Curve	31	70.45	2	11.76
	<b>Sloping Curve</b>	<b>13</b>	<b>29.55</b>	<b>15</b>	<b>88.24</b>

(Note: \* No = Absolute Frequencies, \*\* % - Relative Frequencies)

## DISCUSSION

The current study was carried out regarding audiological findings and their characteristics among smokers and found that among 200 cases, the hearing loss was prevalent among 72.13% smokers and 27.87% non-smokers with 39.85 years mean age. A similar study carried out by Sharabi and coworkers demonstrated that hearing loss was prevalent among 4.5% patients aged upto 35 years and among 10.5% patients aged more than 35 years.<sup>9</sup> In present study, most of the patients (50.0 percent) had mild hearing loss, followed by moderate HL (40.9 percent) with flat audiometric pattern (70.45 percent) mostly SN type (72.73 percent) followed by conductive hearing loss (22.73 percent). Likewise mild hearing loss with SNHL and flat curve followed by CHL was observed in a study conducted by Sharabi and coworkers.<sup>9</sup> Kumar and colleagues<sup>11</sup> observed SNHL among 77.5% respondents followed by mixed hearing loss among 18.3% with mild hearing loss (26 to 40 dB loss) being most frequent (56.5 percent) and severe hearing loss being least frequent (2.8 percent). Paschoal CP indicated that smokers had poorer hearing thresholds at 12500 and 14000 Hz<sup>8</sup>, though checking frequencies over 8000 Hz was out of scope this study and most of the cases had flat audiometric pattern.

During study, mean cigarette packs per year were computed as  $15.37 \pm 1.13$  while mean smoking duration was  $16.29 \pm 0.85$  years. Effect of cigarettes quantity smoked was observed to be related to HL however difference was insignificant when adjusted against age, hence, it cannot categorically be determined a “dose” effect. Kumar and teammates<sup>11</sup> reported that HL

severity enhanced with a rise in quantity of cigarettes smoked and duration. Likewise, Nakanishi and associates<sup>12</sup>, showed a dose-dependent association between HL high frequency and number of packs smoked yearly.

Chang and partners<sup>13</sup> noted an important increased threshold among current smokers compared to passive smokers and nonsmokers. Cruickshanks and colleagues<sup>14</sup> also reported that passive smokers were more probable to develop hearing loss when compared with nonsmokers. The result of a relationship with exposure to the environmental tobacco smoke in the house is compatible with the reports of passive smoking effects on sensitivity of hearing. Tallat and fellows<sup>15</sup>, reported in their study that during childhood passive smoking was related to SNHL. Though, it should not be construed as suggesting that the passive smoking has significant impact than the active smoking. In a study, Chang and partners<sup>13</sup> demonstrated that passive smoking was not associated with hearing loss in either high frequencies or speech except in fourth decade.

During present study more abnormal characteristics were noted on otoscopy among smokers when compared with nonsmokers particularly retracted TM was reported among 24.36% smokers as compared to 10.66% nonsmokers. Smoking is believed a risk determinant for OME development and persistent otitis media. In a study Praveen and associates highlighted that post grommet extrusion myringosclerosis was found more among passive smokers when compared with nonsmokers<sup>16</sup>. A study done by Effat KG showed an elevated frequency of atic retractions in the narghile (water pipe) smokers when compared with cigarette

smokers maybe caused by negative intrapharyngeal pressure that is produced during water pipe smoking<sup>17</sup>.

With regard to tympanogram findings, in this research most of the smokers had type B and C graphs when compared with nonsmokers. Among smokers, 10.25% had type B groups when compared with 2.46% nonsmokers. Regarding negative pressure, 12.82 percent smokers presented with type C graphs when compared with 11.48 percent among nonsmokers. Likewise in a study, Hussain reported an increase among smokers in the tendency of negative middle ear pressure when compared with nonsmokers.<sup>18</sup> Although the findings of this study in addition to current study are insignificant. Hussain also reported insignificant differences in both groups like our study<sup>18</sup>, though it is important to mention that frequency and percentage of Type B graph in our study was higher among smokers than nonsmokers. These could be due to tubal dysfunction owing to smoking<sup>19,20</sup>.

Cigarette smoking is believed to be related to socioeconomic factors and lifestyle that could harmfully affect the health. Palmer and coworkers<sup>10</sup> reported that hearing loss additional risk to smokers is small when compared with those of permanent noise exposure.

These data suggest that cigarette smoking is a recognized risk factor for other persistent diseases and an independent risk factor for hearing loss<sup>21</sup>, even passive smoking is one of the risk factors for minimal hearing loss development<sup>15</sup>.

However, hearing loss exact mechanism caused by smoking is unclear, though it can be caused by blood viscosity, hypoxia and vascular obstruction due to constituents of the smoke<sup>22</sup>. In addition, in smoke carbon monoxide can cause decreased oxygen concentration and vasoconstriction in the cochlea<sup>23</sup>.

## CONCLUSION

Study concluded that cigarette smoking unfavorably affects the ear and leads to adverse audiological findings. Probability of audiological preservation and reversal of some changes could be possible and should be examined.

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