



Original Research Article

Smoking and its effect on hearing status: A hospital based study

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ABSTRACT

Aims : The present study was conducted with the aim to study the effect of smoking on hearing threshold and to compare it with non-smokers, also to evaluate relationship between the duration of smoking and quantity of smoking with degree of hearing loss.

Materials and Methods: It was a hospital based Observational study of six months. The study included 30 male smokers of age group between 20-50 years and 30 age matched nonsmoker males visiting ENT OPD without ear complaints. Both smokers and nonsmokers were interviewed by using preformed preliminary questionnaire. Smoking was ascertained based on questions related to duration of smoking, quantity of smoking. Detailed history, systemic and ENT examination was carried out. Pure Tone audiometry was performed. Type and severity of hearing loss was determined.

Results: There was statistically significant difference in hearing thresholds of smokers and nonsmokers ($p < 0.05$). Mild Sensorineural Hearing loss was seen commonly in affected smokers. Severity of hearing loss was seen to be increased with increase in age of subjects and increase in quantity and duration of smoking which was statistically significant.

Conclusion: Smoking increases the risk of hearing loss. It can be prevented by general awareness and early screening in smokers.

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1. Introduction

Tobacco addiction, both in smoked and non-smoked form, is a common health problem worldwide. According to Global Adult Tobacco Survey 2016-17 (GATS-2), India accounts for 19% men, 2% women and 10.7% of all adults who currently smoke tobacco.¹ According to the World Health Organization (WHO), smoking is the leading cause of death, responsible each year for the death of approximately 5 million people around the world due to cancer, cardiovascular disease, and respiratory disease.²

Hearing is one of the vital functions of the human communication system, especially in the oral language aspect. Impairment of hearing leads to difficulties with communication, like delayed speech development, learning disabilities and social and emotional disorder.³ There are various risk factors for hearing loss like genetic causes, complications at birth, infectious diseases, chronic ear infections, the use of ototoxic medications, exposure to noise, head injury, ageing and so on. Smoking is also considered as one of the risk factors for hearing loss. Tobacco smoking seems to affect the inner ear through several mechanisms. Nicotine present in tobacco can have a direct ototoxic effect and cause cochlear ischemia for increasing the carboxyhemoglobin production, favoring

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vasospasm, promoting atherosclerosis and increasing blood viscosity.⁴ Cochlear blood flow interruption and the consequent reduction in oxygen levels are the main pathophysiological mechanisms responsible for hearing loss in smokers.⁵ Carbon monoxide may also act directly on cochlear metabolism and cause alterations to the action potentials generated by auditory nerve fibers. Another effect reported about the carbon monoxide on the inner ear was the metabolic exhaustion of the succinate dehydrogenase enzyme, implicated in the Krebs cycle of the inner ear cells, especially of the outer hair cells, and the oxidation of nervous structures for the production of free radicals.⁶ Correlation of smoking and hearing loss studied by numerous authors and reported the damaging effects of the tobacco smoke on the cochlea and increase in auditory thresholds among smokers.⁷⁻⁹

Aims of our study were to determine the effect of smoking on hearing threshold of smokers and to compare it with non-smokers, to evaluate relationship between the duration of smoking and quantity of smoking with degree of hearing loss.

2. Materials and Methods

The present study was a hospital based Observational study, conducted in Out Patient Department (OPD) of Otolaryngology of Tertiary Health Care Institute. It was a time bound study of six months and was started after approval from Institutional Ethics Committee.

Males of age between 20-50 years visiting ENT OPD with complaints not related to ear were included in the study by convenient sampling procedure. Individuals were distributed in two distinct groups, 30 individuals in the smoker group who were active smokers for at least 1 year and 30, age matched individuals in the non-smoker group who had never smoked. Individuals who had ear disorders, tinnitus and/or dizziness, hearing loss, prior ear surgery, otoscopic alterations, occupational/ non-occupational noise exposure, ototoxic drug use, head injury, previous ear surgery, hypertension, diabetes mellitus and/or neurologic disease were exclusion criteria for both smoker and non-smoker groups from the study. Both smokers and nonsmokers were interviewed by using preformed preliminary questionnaire. Smoking was ascertained based on questions related to duration of smoking, quantity of smoking. All the individuals participated voluntarily in the study after an informed consent was obtained from each one.

Detailed history, general and systemic examination was carried out. ENT examination including Otolaryngologic examination and Tuning Fork Test was done by ENT surgeon to rule out ear disease. Pure Tone Audiometry (PTA) was done by experienced audiologist using Elkoneda GIGA-3 Audiometer in a sound-proof room by Carhart and Jerger's method (5up and 10 down technique).¹⁰ The

frequencies evaluated, for both ears were 250, 500, 1000, 2000, 4000 and 8000 Hz. We have considered pathological threshold values more than 25 dB at the worse ear. Type and severity of hearing loss was determined on the basis of audiometry.

Hearing impairment was graded according to the following criteria¹¹

- 0-25dB–Normal
- 26-40dB–Mild hearing impairment
- 41-60dB–Moderate hearing impairment
- 61-70dB–Severe hearing impairment
- 71-90dB–Profound hearing impairment
- 91dB and above–Total deafness

Hearing assessment was done in relation to age of smokers, number of Cigarettes/bidis consumed per day and duration of smoking.

All the data was entered into an excel spread sheet and was double checked for any errors. Compilation of data and statistical analysis was done with the help of Epi-info software 7.2.2.6. In Descriptive statistics, quantitative variables required calculation of mean, standard deviation and percentage. In Inferential statistics, appropriate statistical analysis tests such as t-test and chi square test were used. Level of significance (p value) of less than 0.05 was considered statistically significant.

3. Results

This study included 30 male smokers and 30 age matched non-smoker males of age between 20-50 years. Mean age of smokers was 36.9 +/- 7.67 years and that of nonsmokers was 34.93 +/- 8.32 years. 11 (36.67%) Smokers and 3 (10%) Non-smokers found to have sensorineural hearing loss and the difference was statistically significant ($\chi^2=5.96$, $p=0.01$). As shown in Table 1, Average hearing threshold in smokers was higher i.e. 18.53 +/- 6.75 dB as compared to non-smokers (8.70 +/- 4.76 dB) and this difference was statistically significant.

As shown in Table 2, Mean hearing threshold of smokers was found to be raised in all frequencies and there was significant difference in mean hearing thresholds between Smoker and Non-smoker groups at all frequencies with $p < 0.05$.

As shown in Table 3, hearing level was calculated in both the groups in relation to age. Only 1 subject out of 6 of age group 20-30 years was not found to have hearing loss as compared 7 to out of 13 subjects of age group 40-50 years in smokers. In nonsmokers, no one had hearing loss in the age group of 20-30 years, 1 out of 12 subjects and 2 out of 10 subjects of age group 30-40 years and 40-50 years respectively had sensorineural hearing loss. We found that, as the age increased, the percentage of the affected individuals with hearing loss also increased, with the greater percentages of the smokers being affected in comparison to the non-smokers.

Table 1: Average Hearing Threshold in Smokers and Non-smokers

Parameter	Smokers	Non smokers	P-Value*
Average Hearing Threshold (In dB)	18.53 +/- 6.75	8.70 +/- 4.76	0.0015

* Student t- test used (t= 8.7), p<0.05- statistically significant

Table 2: Comparison of Mean Hearing Threshold at various frequencies in Smokers and Non-Smokers

Frequency (Hz)	Mean Hearing Threshold		p Value ^a
	Smokers Mean +/- SD(dB)	Non-smokers Mean +/- SD(dB)	
500 Hz	17.67 +/- 5.22	7.33 +/- 3.80	0.0005
1000Hz	18.16 +/- 5.50	8.00 +/- 3.20	0.0008
2000Hz	18.83 +/- 7.72	8.83 +/- 4.50	0.002
4000Hz	19.16 +/- 4.43	9.5 +/- 3.50	0.002
8000 Hz	18.83 +/- 5.50	9.83 +/- 5.20	0.004

a- Student t- test used, p<0.05- statistically significant

Table 3: Hearing status in relation to Age in Smokers and Non- Smokers

Smoking Status	Age in years	Degree of Hearing loss			Total
		Normal (0-25 dB)	Mild (26-40 dB)	Moderate (41-60 dB)	
Smokers	20-30	5 (83.33%)	1(16.67%)	0	6
	31-40	8 (72.72%)	2 (18.18%)	1(9.09%)	11
	41-50	6 (46.15%)	5 (38.46%)	2 (15.38%)	13
	Total	19 (63.33%)	8 (26.67%)	3 (10%)	30
Non- Smokers	20-30	8 (100%)	0	0	8
	31-40	11(91.66%)	1(8.33%)	0	12
	41-50	8 (80%)	2 (20%)	0	10
	Total	27 (90%)	3 (10%)	0	30

Table 4: Distribution of subjects according to Hearing Loss in relation to Cigarettes/ Bidis consumed (n=30)

Number of Cigarettes/ bidis per day	Degree of Hearing Loss in Smokers (n=30)			Total No. (%)	P value ^b
	Normal[0-25dB] No. (%)	Mild[26-40dB] No. (%)	Mod[41-60dB] No. (%)		
1-10	09 (100%)	00	00	09 (100%)	0.0024
11-20	05 (83.33%)	01(16.67%)	00	06 (100%)	
20- 30	03 (50%)	02 (33.33%)	01 (16.67%)	06 (100%)	
≥30	02 (36.36%)	05 (45.45%)	02 (18.18%)	09 (100%)	
Total	19 (63.33%)	08 (26.67%)	03 (10%)	30 (100%)	

b- $\chi^2 = 19$, p<0.05- statistically significant

Table 5: Distribution of subjects according to Hearing loss in relation to duration of Smoking (n=30)

Duration of smoking in years	Degree of Hearing Loss in Smokers (n=30)			Total No. (%)	P value ^c
	Normal[0-25dB] No. (%)	Mild[26-40dB] No. (%)	Mod[41-60dB] No. (%)		
<5	11 (91.67%)	01(8.33%)	00	12 (100%)	0.004
5-10	06 (75%)	02(25%)	00	08(100%)	
11- 20	02 (40%)	02 (40%)	01 (20%)	05 (100%)	
> 20	00	03 (60%)	02 (40%)	05 (100%)	
Total	19 (63.33%)	08 (26.67%)	03 (10%)	30 (100%)	

c- $\chi^2 = 8.23$, p value <0.05- statistically significant

Hearing level was calculated in relation to number of cigarettes/bidis consumed per day. Total 9 subjects were smoking ≥ 30 cigarettes/bidis per day of which only 2 (36.36%) had normal hearing and 5 subjects (45.45%) had mild and 2 (18.18%) had moderate Sensorineural hearing loss. Those who were consuming more than 20 cigarettes/bidis per day found to have hearing impairment than those smoking less than 20 cigarettes/ bidis per day. This was statistically significant association as shown in Table 4.

Shows relationship of hearing loss with duration of smoking. All the 5 smokers who were smoking for ≥ 20 years had hearing impairment. Number of subjects with Hearing loss was found to increase with the increase in duration of smoking and was found to be statistically significant ($p < 0.05$).

4. Discussion

Smoking is a well-known risk factor for various health problems. Association of cigarette smoking and hearing loss had been shown in various studies.^{12–14} However, they also suggested the need of more research on this subject. In this study, we compared the auditory thresholds among the smoker and non-smoker groups between 20 and 50 years.

In the present study, hearing threshold in Smokers and non-Smokers was 18.73 +/- 6.75 dB and 8.70 +/- 4.76 dB respectively. This result is in consistent with Pezzoli et al study¹⁵ who found Pure Tone Average (PTA) threshold in smokers as, 12.5 dB in smokers in comparison to 3.7dB in non-smoking subjects. In Shetty A et study,¹⁶ there is a significant difference in Air Conduction and Bone Conduction thresholds between smoker and non-smoker groups at all frequencies in both right and left ear with $p < 0.001$.

In our study, 36.67% smokers found to have hearing impairment which is significantly more as compared to non-smokers (10%). In Kumar A et al study,¹⁷ 65% of Smokers had hearing loss in comparison to 15% non-smokers having hearing loss. Pezzoli et al¹⁵ found, 9 smokers (27%) presented some degree of hearing loss while no one from nonsmoker group had hearing impairment.

In the present study, in smokers' group, 27.27% subjects (18.18% & 9.09% had Mild & Moderate Hearing loss respectively) were affected in 31-40 years age group and 53.85% in 41-50 years age group while in non-smokers group, 8.33% participants were affected in 31-40 years age group and 20% in 41-50 years age group. This is consistent with Sekher B et al study,¹⁸ where in smokers' group, 35% participants were affected in 31–40 years' age group, 40% participants in 41–50 years' age group, and 70% participants in 51–60 years' age group. Whereas, in nonsmokers, 10.0% participants in 31–40 years' age group, 15.0% in 41–50 years' age group, and 40% participants in 51–60 years' age group had hearing loss. In Kumar A et al¹⁷ study, the percentage of the affected individuals increased as the age

increased, with greater percentages of the smokers being affected in comparison to the non-smokers.

In the current study, prevalence of hearing impairment was seen higher in smokers consuming ≥ 20 cigarettes/bidis per day. Similar was the finding in Sharabi et al,¹⁹ Uchida et al²⁰ and Nomura et al²¹ studies. In Kumar A et al study,¹⁷ prevalence of hearing loss was seen higher who smoked > 25 bidis/ cigarettes.

5. Conclusion

From our study, we found that smoking increases the risk of hearing loss. Since smoking is an avoidable and potentially preventable risk factor for hearing loss. There should be hearing healthcare programs for early screening in smokers to identify any hearing impairment and to help to take steps towards bringing awareness amongst the general population about risk of hearing loss due to smoking.

6. Conflict of Interest

The authors declare that there are no conflicts of interest in this paper.

7. Source of Funding

None.

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