ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

Original Research Article

ASSESSMENT OF HEARING STATUS IN SMOKERS – A HOSPITAL BASED CROSS-SECTIONAL STUDY

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ABSTRACT

Background: The negative effects of smoking depend on the exposure history, which includes the age at which the smoking began, the number of cigarettes which were smoked per day, the degree of inhalation, and the cigarette characteristics such as the tar and the nicotine content. However, the results of many studies association with hearing loss are inconclusive and inconsistent. So, the present study was conducted with an aim to assess the hearing status in smokers presenting in ENT OPD of a tertiary care hospital and to identify association/ relationship, if any, amongst hearing loss with smoking.

Methods: The present study being comparative in nature included two groups: case group and control group. Case group included "male smokers"and control group included "male non-smokers who never smoked"of 30 - 60 years age group presenting in ENT OPD. Taking drop-outs and non-follow-ups into consideration the final sample size calculated for case group was160. Similarly, 160 subjects were included in the control group for comparison.The subjects were interviewed using a preformed questionnaire. The hearing examination included an otoscopic evaluation, tuning fork test, and pure tone air-conduction and bone conduction audiometry.P value < 0.05 was considered statistically significant.

Results: In the present study the mean age of cases (smokers) was 51.5 ±13.6 years and control (non-smokers) were 49.6±12.9 years, which was comparable (p>0.05).Overall mean hearing threshold were 19.6 ± 7.8 dB for case group and 8.7±5.8 dB for control group and this difference was statistically significant (p<0.05). The results of the present study reveal high frequency hearing loss for the smokers' group (74.6%) when compared to the control group (52.6%). The chi-square analysis showed that statistically significant difference in the prevalence of hearing loss among smokers and non-smokers (p<0.05).

Conclusions: The findings of the study demonstrate that smoking does affect hearing. When compared to non-smokers, persons with higher smoking severity index experience more hearing loss. The findings indicate that smoking (current or past) is widely prevalent across all socioeconomic and educational classes. The general people need to be made aware of the negative impacts of smoking. Campaigns to raise awareness are urgently needed.

Keywords: Hearing loss, smoking, audiometry, Cigarette, Tobacco

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

INTRODUCTION

One of the greatest psychological stresses is the disruption of human communications, and this burden is often said to be greater than that of blindness and visual impairment. The World Health Organization has estimated that there are approximately 250 million people with hearing disabilities in the world, and hearing loss is the 15th greatest cause of the burden of disease as disability-adjusted life years (DALYs) in both sexes and all ages [1]. Ear disorders are invisible handicaps and psychological stress incurred by hearing loss often goes unrecognized.

Cigarette smoking is a major public health challenge and its prevalence is increasing globally [2]. Smoking increases the risk of cardiovascular diseases, diabetes mellitus, cancers of lungs, bladder, blood, oesophagus and also affects bone health [3]. Smoking aggravates the risk of cataract and age-related macular degeneration [4]. Smoking can weaken a person's immune system, making them more susceptible to illness [5]. Most tobacco users initiate their smoking habit quite young, up to 10 years of age [6]. Besides these, smoking has also been associated with impaired hearing.

Inner hair cells are a complex system of semi-circular tubes filled with fluid and nerve endings. The hair cells are main responsible for detecting sound and transmitting it to the brain for interpretation. The integrity of auditory hair cells depends on healthy blood flow and oxygen supply. Smoking have effect of decreasing the flow of blood and oxygen to the ear [7].Smoking reduces the cochlear blood supply due to vasospasm, atherosclerotic narrowing or thrombus formation in the blood vessels [8]. It has also been suggested that carbon monoxide in tobacco smoke causes rise in carboxy-haemoglobin level in blood, which causes hypoxia in organ of corti resulting in damage to hair cells and subsequent hearing loss [9].

According to a study done on hearing status in smokers, they were 1.69 times as likely to have a hearing loss as the non-smokers [8]. The negative effects of smoking depend on the exposure history, which includes the age at which the smoking began, the number of cigarettes which were smoked per day, the degree of inhalation, and the cigarette characteristics such as the tar and the nicotine content [10]. However, the results of many studies association with hearing loss are inconclusive and inconsistent. So, the present study was conducted with an aim to assess the hearing status in smokers presenting in ENT OPD of a tertiary care hospital and to identify association/ relationship, if any, amongst hearing loss with smoking.

METHODS and MATERIALS

Study setting and design

This comparative cross-sectional study in ENT OPD of Government Institute of Medical Sciences, Greater Noida for 6 months betweenMay 2021 to October 2021after obtaining the approval of GIMS scientific research committee & GIMS institute ethics committee (GIEC).

Study participants and sampling

The present study being comparative in nature included two groups: case group and control group. Case group included "male smokers"(Cigarette, Bidis, hukkah, cigar, pipe or smoking tobacco in any form)of 30 - 60 years age group presenting in ENT OPD. All the smokers with a history of ototoxic drug use, severe or frequent ear infections, history of ear surgery, familial deafness. patients using smokeless tobacco products, working in noisy environment (Factory workers), subjects with history of alcohol intake, patients having conductive and/ or mixed hearing loss, history of head injury, diabetes mellitus, and hypertension. Control group included age-specific matched and stratified controls (male non-smokers who never smoked) of 30 - 60 years age group presenting to ENT OPD.

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According to latest WHO latest fact sheet of India, prevalence of current tobacco use among adult male smokers (15+ years) GATS 2016–2017 is 19%, so, using sample size calculation formulato estimate proportion (p) in the study population as $N = p(1-p)[(z_{\alpha}+z_{1-\beta})/(p-p_0)]^2 / d^2$where,n is sample size, Z is distribution, p is estimated proportion, d is absolute precision, $p_{0\ is}$ the comparison value and and taking alpha error as 5%, and 12% as absolute precision, the calculated sample size for case group was 143 [11]**.**Taking drop-outs and non-follow-ups into consideration the final sample size calculated for case group was160. Similarly, 160 subjects were included in the control group for comparison. The subjects were included in the study using random sampling technique.

Data collection

The subjects were interviewed using a preformed questionnaire. Smoking history included the duration of smoking. An informed consent was obtained. The hearing tests were carried out in the audiometry sound proof room of Department of ENT & HNS, GIMS, Greater Noida. The hearing examination included an otoscopic evaluation, tuning fork test, and pure tone air-conduction and bone conduction audiometry [4].Audiometry was done by using a GLOBAL REAL audiometer by an experienced audiologist, who was unaware of the subject's smoking status. The hearing test will be pure tone audiometry. The range of the frequencies which were tested was between500-8000 Hz. The audiometric analysis was done to assess the degree and the type of the hearing loss. The instrument was regularly calibrated before use.

By using the audiometric data, the hearing loss was defined as a pure tone average (PTA) of the thresholds at 500, 1000, 2000 Hz. Hearing was considered as normal when pure-tone audiometry (PTA) will be 0–25 dB, mild hearing loss was considered when PTA was 26–40 dB, moderate hearing loss was at PTA of 41–55 dB, and severe hearing loss was for PTA 56 or above.

Definitions

Current smoker: An adult who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes.Every day smoker: An adult who has smoked at least 100 cigarettes in his or her lifetime, and who now smokes every day.Never smoker: An adult who has never smoked, or who has smoked less than 100 cigarettes in his or her lifetime.

Statistical analysis

All categorical variables were reported using percentages/proportions. All continuous variables were reported using mean and standard deviation or median and interquartile range. Student t-test was used to test the difference of mean between groups. Chi-square test was used to test the difference in the proportion between dependent and independent groups. P value < 0.05 was considered statistically significant. Statistical analysis was done using SPSS 20.0 software for Windows (IBM, Armonk, New York, United States).

RESULTS

In the present study the mean age of cases (smokers) was 51.5 ±13.6 years and control (non-smokers) were 49.6±12.9 years, which was comparable (p>0.05). In both groups one fourth of subjects (smokers: 26.8% and non-smokers: 27.5%) were having education status as middle and high school. More than half of subjects in the case group (52.3%) and control group (56.4%) were residing in the rural area. Among smokers, current smokers were 54.4% (87/160) and ex-smokers were45.6% (73/160) (Table 1).

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Table 1. Sociodemographic profile of cases and control.

Variables	Smoker		Non smoker		P value
	Mean±SD				
Age (in years)	51.5 ±13.6		49.6±12.9		0.201
	Number	**%**	**Number**	**%**	
Education status					
Illiterate	20	12.4	20	12.4	0.893
Primary school	37	23.4	28	17.2	
Middle and High school	43	26.8	44	27.5	
Intermediate	20	12.4	21	13.1	
Graduate and above	40	24.8	36	22.7	
Socioeconomic status*					
Lower	23	14.4	25	15.8	0.001
Lower Middle	28	17.2	42	26.1	
Middle	43	26.8	34	21.3	
Upper Middle	33	20.6	48	30.3	
Upper	33	20.6	10	6.2	
Residence					
Urban	76	47.4	69	43.3	0.461
Rural	84	52.3	90	56.4	
Smoking Index#					
Light/Mild smokers	26	16.3	-	-	-
Moderate smokers	52	32.5	-	-	-
Heavy smokers	82	51.3	-	-	-

*Modified BG prasad SES classification, # Singh et al. (2012)

Overallmean hearing threshold were 19.6 ± 7.8 dB for case group and 8.7±5.8 dB for control group and this difference was statistically significant ($p<0.05$). Also, mean hearing threshold at various frequency i.e., 500 Hz, 1000Hz, 2000Hz, 4000Hz and 8000 Hz were having statistically significant ($p<0.05$) difference for case and control group (Table 2).

Table 2. Hearing loss threshold at various thresholds among cases and control.

Frequency (Hz)	Hearing threshold (in dB) [Mean±SD]		P value
	Smokers	Non smokers	
500 Hz	18.7±6.3	8.4±4.9	<0.0001
1000Hz	19.2±6.6	9.1±4.3	<0.0001
2000Hz	19.9±8.8	9.9±5.6	<0.0001
4000Hz	20.2±5.2	10.6±4.6	<0.0001
8000 Hz	19.9±6.4	10.9±6.3	<0.0001
Overall	19.6 ± 7.8	8.7±5.8	<0.0001

The results of the present study reveal high frequency hearing loss for the smokers' group (74.6%) when compared to the control group (52.6%). The chi-square analysis showed that statistically significant difference in the prevalence of hearing loss among smokers and non-smokers ($p<0.05$). Depending on current smoking status, the severe hearing loss was observed among 13.8% of smokers and 9.6% of non-smokers; the severe hearing loss was observed among 6.3% of current smokers and 22.6% of ex-smokers.Depending on the smoking severity, the severe hearing loss was observed among 27.2% of heavy smokers and 9.6% of non-smokers. No severe hearing loss was observed among light smokers and

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moderate smokers.The chi-square analysis showed that statistically significant difference in the prevalence of hearing loss among heavy smokers and non-smokers ($p<0.05$) (Table 3).

Table 3. Severity of Hearing loss among cases and control.

Variables	Hearing loss [Number (%)]				P value
Smoking status	**Mild**	**Moderate**	**Severe**	**No Loss**	
Smoker (n=160)	50 (30.9)	47 (29.6)	22 (13.8)	41 (25.4)	0.001
Non-Smoker (n=160)	40 (24.8)	29 (17.9)	15 (9.6)	76 (47.4)	
Current Smoker (n=87)	26 (30.3)	21 (24.0)	6 (6.3)	34 (39.2)	<0.001
Ex-Smoker (n=73)	24 (31.6)	26 (36.2)	16 (22.6)	7 (9.0)	
Smoking severity					
Non-Smoker (n=160)	40 (24.8)	29 (17.9)	15 (9.6)	76 (47.4)	<0.001
Light/mild smoker (n=26)	13 (50.0)	0 (0.0)	0 (0.0)	13 (50.0)	
Moderate Smoker (n=52)	19 (36.0)	21 (40.2)	0 (0.0)	12 (23.3)	
Heavy Smoker (n=82)	18 (21.7)	26 (31.6)	22 (27.2)	16 (19.0)	

DISCUSSION

The present study was conducted with an aim to assess the hearing status in smokers presenting in ENT OPD of a tertiary care hospital and to identify association/ relationship, if any, amongst hearing loss with smoking.Despite the fact that numerous studies have been carried out to predict the hearing status of smokers, conflicting results across diverse research studies made this study for an Indian population necessary [12,13]. Sensorineural and mixed hearing loss was recorded in 77.5 percent and 18.3 percent of participants respectively in the study by Kumar A et al.,[4]. Greater risks for middle ear and inner ear problems were also found by Gaur et al., [14]. In a study by De Oliveira et al., although the mean hearing thresholds were found to be within normal ranges, smokers had higher hearing thresholds for low frequencies. Additionally, they observed a noticeable rise in thresholds at higher frequencies [15].The results of the present study reveal high frequency hearing loss for the smokers' group (74.6%) when compared to the control group (52.6%).

Although the hearing thresholds were within normal limits for the both groups (19.6 ± 7.8 dB for smokers and 8.7±5.8 dB for non-smokers) butstatistically significant difference was observed between the two groups ($p<0.05$). A dosage response relation at 4000 KHz found by Mizoue et al., suggested that smoking was strongly linked to a higher risk of high frequency loss [16]. Additionally, they described how smoking harms hair cells by an ischemic process, which lowers blood flow to the cochlea by raising carboxyhemoglobin. The nuclei of the cells in the Scarpa's ganglion, peripheral nerves, and the terminal nerve apparatus have changed, according to histopathological research [17]. Smoking tobacco leads to end artery obliteration at the level of the otic end organ, which results in gradual sensorineural hearing loss [18].It is suggested that the reduced sensitivity to low frequencies may be caused by an ischemic process or by the ototoxic effects of nicotine on hair cell activity, which first affects the basal end of the cochlea and then travels to the apical end as smoking duration increases. In a 5-year study of Japanese male office workers who smoked cigarettes, Nakanishi et al., found a strong correlation between smoking and the development of high frequency hearing impairment [19]. According to Cruikshanks et al., smoking cigarettes increased the likelihood of hearing loss in older persons by 1.69 times compared to non-smokers [20].

In present study, the mean hearing threshold at various frequency i.e., 500 Hz, 1000Hz, 2000Hz, 4000Hz and 8000 Hz were having statistically significant ($p<0.05$) difference for case and control group.Despite the fact that both the study group and the control group had normal hearing thresholds, there was a substantial difference between the two groups on the

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

Conventional PTA, however on the Hearing Function Assessment (HFA), the majority of smokers revealed hearing loss. Paschoal et al., reported similar findings, concluding that the smokers had reduced thresholds across all frequencies [12]. According to Ohgami et al., even minimal cigarette use may reduce hearing at 12 kHz. According to cochlear physiology, the closer a sound stimulus is to the cochlea's basal area, the higher its frequency [21].Thus, it is assumed that although HFA examines the basal section of the cochlea, typical audiometry (500 Hz-8000 Hz) mostly evaluates the medial portion [22]. It demonstrates that the damage to the cochlea in smokers starts at the basal end. HFA should therefore be an essential component of the battery of audiological tests.

Smokers are 15.1% more likely than non-smokers to experience hearing loss, indicating that the smoking epidemic has already begun to manifest [23]. With rates dramatically ranging from 20 percent to 60 percent, smoking is becoming more and more prevalent [24]. According to the audiological analyses conducted for this study, there is a noticeable difference between smokers and non-smokers. There is little information on how smoking affects cochlear function. Future studies can focus on the impact of smoking frequency and intensity on hearing sensitivity.

Limitations

The limitation of the present study is that it does not distinguish between hearing loss in smokers and non-smokers whether it is conductive/sensorineural or mixed. Better outcomes will come from identifying the pattern of hearing loss, though. Better outcomes will come from the, large scale research identification of risk factors, estimation of hearing loss in smokers and smokeless tobacco users, consideration of occupational/workplace noise exposure, and blood chemistry.

CONCLUSION

The findings of the study demonstrate that smoking does affect hearing. When compared to non-smokers, persons with higher smoking severity index experience more hearing loss. The findings indicate that smoking (current or past) is widely prevalent across all socioeconomic and educational classes. The general people need to be made aware of the negative impacts of smoking. Campaigns to raise awareness are urgently needed.

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