Is tobacco smoking correlated with Hearing loss? A Comparative Observational Study in healthy adult males

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ABSTRACT

Objective: To determine the correlation of hearing loss with tobacco smoking in healthy adult males.
Study Design: Comparative observational study
Place and Duration: Power laboratory of Physiology Department, LUMHS Jamshoro, from 7th July 2016 to 7th December 2016.
Methodology: Total 238 students and employees both smoker and non-smokers were studied with Audiometer MAICO® -MA 39 (Berlin Germany) used for audiometry. Controlled intensity pure tones were produced to the one ear at a time and least volume required to hear each tone was graphed. The air conduction threshold was measured and graphs were plotted on audio gram.
Results: Mean of hearing loss degree was significantly higher 45.23±4.12 decibels of smokers as compare to non-smokers 27.11±3.22 decibels, p-value 0.021. Positive correlation was found between hearing loss and smoking frequency; r=value 0.266. Positive correlation was found between hearing loss and duration of smoking r=value 0.245 and p-value 0.01.
Conclusion: Tobacco smoking has adverse effects on hearing status. Hearing loss had significant positive correlation with prolonged duration of smoking and elevated quantity of smoking.
Keywords: Adult, Males, Tobacco, Smoking, Hearing loss, Correlation

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INTRODUCTION

Tobacco smoking and related items is quiet common throughout the world. Around 1.3 billion population of the world is involved in tobacco smoking[1]. It is a fact that smokers are more prone to adverse outcome including vascular diseases, periodontal diseases, COPD, hypertension, cardiac diseases, osteoporosis and impotence. Latest research studies have shown that smoking has its injurious impact on hearing and the endocrine system[2].

Smoking is complex medium of about 4000 different constituents particularly in gaseous and others phases. Gaseous phase contains mostly nitrogen 73%, 10% oxygen, 9.5% carbon dioxide and 4.2% carbon monoxide including ammonia, nitrogen oxides (including nitric oxide, NO), nitrosamines, hydrogen dioxide, hydrogen cyanide, volatile sulphur-containing compound, acetaldehyde, hydrazine, hydrocyanic acid, vinyl chloride, and acroleid. While particulate phase contains water, tar and nicotine[3].

Tobacco, especially its content nicotine has numerous harmful effects and may cause dangerous risk for dependence. The negative impacts of smoking on a human body depends on multiple factors, which include the age at smoking time, frequency of smoking, severity of inhalation smoking particulates like tar and contents of nicotine[4,5]. Evidence suggests that the likelihood of hearing loss may be two times more in smokers than in the non-smokers. Smoking is the common cause of several disease of respiratory system, cardiovascular system including hearing function[6].

Meta-analytical studies which were conducted in Japan and Korea also came with similar evidence of association between smoking and hearing loss[7,8]. Smoking may accelerate the age

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related hearing loss (presbycusis), as was demonstrated in various studies[7,9]. The literature suggests that smoking is an independent risk factor for atherosclerosis, which in turn may affect the vascular supplying the auditory system. Smoking reduces the blood supply due to vasospasm, the atherosclerotic narrowing of the blood vessels and by the thrombotic occlusions induced by nicotine[10,11]. Therefore, in the measured frequencies, the percentage of the hearing loss was greater for the smokers[12].

Mostly studies conducted on very small data and association still controversial, and these studies showed requirement of further studies on this association[13-15]. This study has been conducted to evaluate the correlation of hearing loss with tobacco smoking in healthy adult males. So this study was conducted with an objective to determine the correlation of hearing loss with tobacco smoking in healthy adult males.

METHODOLOGY

This Comparative observational study was conducted at Power laboratory of Physiology Department, LUMHS Jamshoro from 7th March 2016 to 7th December 2016 after approval from Ethical committee of institution. Convenient sampling technique was used for all study participants. All the smokers males aged 20 to 35 years, who are studying and working at LUMHS Jamshoro, with history of smoking for at least five years were included and non-smokers males who are studying and working at LUMHS Jamshoro were selected as controls. The subjects not willing for study, history of smoking duration less than five years, history of taking ototoxic drugs, re-current ear infections, congenital ear anomaly, conductive deafness, known case of diabetes and hypertension were excluded from the study.

Equal number of smokers and non-smoker subjects were inducted in study for comparison. A detailed history and examination of all participants with specific emphasis to ear examination was done to evaluate the type of smoking, duration, number of cigarettes, trauma, infections, ear discharge or wax, foreign body, and any congenital anomaly. Rinne's test and Webber's test were conducted to rule out conductive deafness. Pure tone audiometry was performed in power lab of physiology department. The evaluation was done on audiometer MAICO 39 made which is commonly used to determine the nature of hearing disabilities. With this audiometer the earphone was connected to an electronic oscillator capable of emitting pure tones ranging from low frequencies i.e. 0.75kHz, 0.5 kHz, 0.25 kHz and 0.125 kHz to high frequencies i.e. 1kHz, 2kHz, 4kHz, 6kHZ, 8kHz. After the test, the results as a graph was plotted on paper i.e. audiogram and then analyzed.

Data Analysis: The data was entered in proforma and analyzed by SPSS version 20.0. Demographic variables assessed as mean, median and percentages. The correlation of deafness with duration of smoking, quantity and age were plotted in graph and assessed with p value.

RESULTS

In this study a total of 238 participants were included. The age ranged between 20 and 35 years with mean age of 29.4±4.2 years in smokers and 30.5±3.7 years in non-smokers. No significant difference was found in smokers and non-smokers according to age; p= 0.867. Among smokers only 1(0.8%) subject was using cigar, 91(76.5%) were using cigarette while 27(22.7%) subjects were using shisha smoking. Majority of subjects (45.4%) used to smoke 16-20 cigarettes per day, while 37.8% used to smoke 05-15 cigarettes per day and 16.8% had a history of smoking more than 20 cigarettes per day. 59(49.6%) subjects were smoking for 5-10 years, 35(29.4%) were smoking for 11-15years, while 25(21.0%) subjects were smoking for >15 years (Table-I).

Table-I: Distribution of smokers according to type, frequency, duration of smoking (n=119)

Variables	Frequency	Percent
Types Of Smoking		
Beery	00	0.0%
Cigar	01	0.8%
Cigarette	91	76.5%
Shisha smoking	27	22.7%
Total	119	100.0%
Smoking Frequency		
05 -15 times/day	45	37.8%
16 -20 times/day	54	45.4%
>20times/day	20	16.8%
Total	119	100.0%
Duration of smoking		
5-10 years	59	49.6%
11-15 years	35	29.4%
>15 years	25	21.0%
Total	119	100.0%

In this study 68(57.1%) smokers had normal hearing, 40(33.6%) smokers had mild (26-40dB) hearing loss, 09(07.6%) had moderate (41-60dB), while 2(1.7%) had severe (61-80 dB) hearing loss, but no case had profound (81dB or greater) hearing loss. Mean of hearing loss degree was significantly higher (45.23±4.12dB) in smokers as compare to non-smokers (27.11+3.22dB), p-value 0.021 (Table-II).

Table-II: Comparison of hearing loss in both groups of smokers and non-smokers (N=238)

Degree of hearing loss	Smokers	Non smokers	P-value
Normal(25dB or < 25dB)	68(57.1%)	99(83.2%)	0.001
Mild(26-40dB)	40(33.6%)	20(16.8%)	
Moderate(41-60dB)	09(07.6%)	00(0.0%)	
Severe(61-80dB)	02(1.7%)	00(0.0%)	
Profound(81dB or greater)	00(0.0%)	00(0.0%)	
Total	119(100.0%)	119(100.0%)	
Degree of hearing loss (Mean+SD)	45.23±4.12dB	27.11±3.22dB	0.001

There was no significant association of hearing loss according to age and type of smoking p-values were quite insignificant as shown in Table-III) In this study positive correlation was found between hearing loss and duration of smoking; r=value 0.445 and p-value 0.01 (Figure-1)**.** Also a positive correlation was found between hearing loss and smoking frequency; r=value 0.266 and p-value 0.001 (Figure-2).

Table-III: Association of hearing loss with age groups and type of smoking (n=119)

Variables		N	Mean	Std. Deviation	95% Confidence Interval for Mean		p-value
					Lower Bound	Upper Bound	
	Cigar	1	10.00	.	.	.	
Type of	Cigarette	91	21.76	11.449	19.37	24.14	0.590
smoking	Shisha smoking	27	22.15	12.073	17.37	26.92	
	Total	119	21.75	11.545	19.65	23.84	

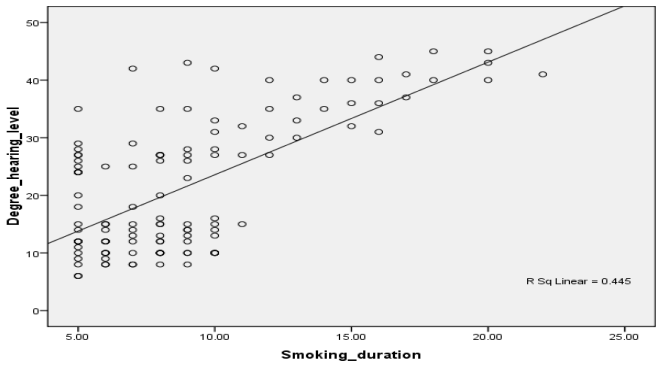

Figure-1: Correlation between hearing loss and smoking duration (n=119)

Correlation is significant at the level of p-value 0.01 r-value = 0.445

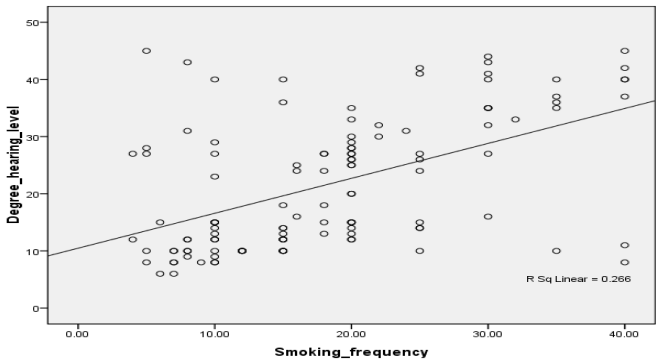

Figure-2: Correlation between hearing loss and quantity of smoking (n=119)

Correlation is significant at the level of p-value 0.001 r-value = 0.266

DISCUSSION

This study was conducted to determine the effects of smoking on hearing in our population, because in recent literature it was found that smoking was significantly associated with severity of deafness[13,14]. Comparing the age, this study shows 26-30 year age group was most common among smokers and non-smokers and mean age was 29.4+4.2years. But, Sumit et al[8] reported mean age of 39.07±11.6 years for smokers and 36.34±12.2 years for non-smokers. Mohammadi et al[15] mentioned mean age of smokers 41.63+ 6.97 years and 42.86+6.07 years of nonsmokers, p = 0.035. These studies showed mean age slightly higher as compared to our study, this difference may be because in those studies age range was high as compared to this study and this variation may due to atmospheric variations. In this study young adults were studies. However according older population frequently smoked cigarette for a longer time than youngers, and therefore prolonged duration of smoking would have affected the circulation of cochlear more and could thereby result in a high prevalence of hearing loss in the older population.

Comparing the frequency of smoking, our study shows that majority of cases i.e. 45.4% were smoking 16-20 cigarettes daily, while 37.8% subjects were smoking 05-15 cigarettes and 16.8% had history of smoking more than 20 cigarettes per day. Similarly, Sumit et al[8] reported that 35% smokers were found to be smoking 1–10/day, 45% 11–20/day, while 10% had smoking history of > 20 cigarettes/day. On the other hand, Sung et al[12] inconsistently reported that smoker group was divided into 4 sub-groups according to frequency of smoking as pack/year: 0.05–9.9, 10–19.9, 20–29.9, and ≥ 30, and the hearing threshold at 1k, 2k, and 3kHz was significantly high in ≥ 30 pack per years group. Jeffree et al[16] demonstrated inconsistent findings regarding the impact of smoking. The difference of above studies with current study is the selection criteria as in above studies smoking selection criteria was on yearly basis but in this study selection criteria is on daily consumption.

Comparing the duration of smoking, our study shows that majority 949.6%) were smoking for 5-10 years and only 21% were using tobacco for >15 years. Carmelo et al[17] examined smoking for 1–5 years and smoking for >5 years. On the other hand, Sumit et al[8]showed 23 subjects were smoking for 1–5 years and subjects smoking for >5 years were 67 out of 90 cases. In these studies duration was 1-5 years or more than 5 years, while in current study all selected cases had a history of smoking at least 5 years or more. Continued tobacco smoking may result in persistent middle ear infections and eventually, hearing loss.

Comparing the duration of smoking, our study shows that prolonged duration of smoking was significantly associated with severity of deafness p-value 0.01, majority of normal and mild deafness cases were found with duration of 1 to 10 years, smoking more than 10 years of duration was associated with mild to moderate degree of deafness. Nomura et al[18] in a review (1966-2003), mentioned 9 studies reporting positive association between smoking and hearing loss. An earlier study of Sawair et al[19] also found comparable findings. Smoking causes vasoconstrictions in cochlear vessels with subsequent decreased perfusion, elevated plasma viscosity and or the likely creations of carboxyhemoglobin,[20] which worsens hearing loss. Mizoue et al.[21] reported that the hearing loss affects only the cells responsible for hearing to high frequencies, since their position at the end of the nutritive arteries makes them more

vulnerable to ischemic damage. Dengerink and colleagues[22] highlights how smoking modifies hearing response to noise exposure, and characteristics of these effects to nicotine and carbon monoxide. However the clear mechanism is still unclear. Many studies highlighted similar mechanisms of direct ototoxicity of nicotine, cochlear ischemia due to raised carboxy hemoglobin level, and smoking-mediated raised viscosity of blood[23,24].

In current study we found a significant strong positive correlation of severity of the hearing impairment with large quantity and prolonged duration of the cigarette smoking r-value 0.445 and *p*- 0.01. On the other hand, Carmelo et al[17] demonstrated comparable findings and reported that smoking has a significant influence on hearing and this effect is correlated to the quantity of cigarettes smoked daily. Similarly, Pouryaghoub et al[25]and Mohammadi and colleagues[15] found significant association of high smoking quantity and duration with severity of hearing loss. Nomura et al[18] found strong correlation between smoking and hearing loss and some other studies also observed hearing loss higher among smokers[20,26].

To best our knowledge, in this study investigation assessed on large sample in the correlation between tobacco smoking and incident of hearing loss including duration and quantity of tobacco smoking. However our findings indicated that prolonged and large quantity of smoking increased the incident of hearing loss.

CONCLUSION

It was concluded that tobacco smoking had worse effects on hearing status. There was a significant positive correlation of hearing loss with prolonged duration of smoking and elevated quantity of smoking.

Recommendations

- Large scale and multicentral studies are recommended
- Auditory screening of smokers should be carried out at an early stage to prevent hearing morbidity
- Public awareness campaigns should be carried out regarding smoking and possible side effects related with hearing loss

AUTHOR'S CONTRIBUTION

Shaikh SN: Data collection, Manuscript writing
Shaikh K: Manuscript reading, Proof reading
Saeed H: Data Interpretation, Literature review
Aijaz R: Data analysis, Manuscript writing
Talib S: Data **i**nterpretation, Manuscript writing
Haque ZU: Data analysis, Manuscript writing

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