

Effect of Smoking on Hearing Impairment

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Abstract

Background and objectives: Some clinical studies have suggested that cigarette smoking may be associated with hearing loss. The objective of this study is to evaluate the association between smoking and hearing loss and to characterize the type of hearing loss found in smokers. **Methods:** A hospital based cross sectional study conducted on 100 cases aged between 20-50 years, 70 cases were smokers and 30 were non-smokers. All the participants were examined by an Otoscope, a Tuning Fork, Tympanometry and Pure Tone air conduction and bone conduction Audiogram. Audiogram results were analyzed and hearing loss was defined as hearing threshold greater than 25 dB L at one or more of frequencies (0.25, 0.5, 1, 2, 4 and 8 kHz). The type, severity and involved frequencies of hearing loss were analyzed based on the pure tone average. **Results:** The number of cases with hearing loss was 26 cases, 22 of them were smokers and 4 were non-smokers. Smoking significantly increased the risk of hearing loss (p value = 0.04). Smokers were 2.3 times more likely to have hearing impairment as non-smoker. High frequency sensorineural hearing loss was the predominant type among smokers and the severity ranged from mild to severe, mild loss was the most common. The severity of hearing loss was affected significantly by the intensity and the duration of smoking. **Conclusions:** Cigarette smoking affects the hearing ability after exclusions of most possible factors including noise exposure. It increases the risk of hearing impairment with increasing age in a dose related manner.

Keywords: Smoking; Hearing loss; Audiogram; High frequency; Hearing loss

Introduction

Smoking is widespread habit worldwide and has been reported to be the most common addiction among people of different ages¹. Damages caused by smoking on human health are widely reported. A large numbers of studies point to the association of smoking with various health problems like cardiovascular diseases, pulmonary diseases, laryngeal diseases and malignancies²⁻⁴. Some studies showed that smoking can be considered as a risk factor of hearing impairment with widely diverse outcomes^{5, 6}. It is known that hearing loss is more prevalent among elderly and is mostly due to aging process (presbycusis)⁷, but it can also occur in younger population due to variety of causes including genetic, infectious disease, ear infections, ototoxic drugs, exposure to noise, etc.⁸. Adding to those causes smoking may be regarded as one of the predisposing factors of hearing loss among young people⁹. A study conducted among Japanese office workers showed that smoking was highly associated with high frequency sensorineural hearing loss⁶. A Brazilian study had suggested that smoking has negative impact on auditory system, that transient otoacoustic emission was absent in 14% of young smokers and tinnitus was present in about 40% of smokers¹⁰. Some other studies had demonstrated that smoking can accelerate presbycusis^{11, 12}. While no association between smoking and hearing loss found in Baltimore study of aging¹³.

It is hypothesized that the deleterious impact of smoking on hearing may be through direct or indirect ways. Cigarette smoke contains nicotine and other toxic substances like mercury and arsenic, and these substances have direct ototoxic effects on cochlear hair cells¹⁴, as studies using animals have shown presence of nicotine receptors

in the hair cells¹⁵. The indirect effect of smoking is through its ability to increase viscosity of blood and decrease oxygenation resulting in cochlear hypoxia^{16, 17}. It's also thought that demyelination of auditory nerve pathway may result from cigarette smoke¹⁴. The toxicity of smoking is related to the number of cigarette smoked per day, the duration of smoking and the age at which smoking started¹⁸. So, the impact of smoking will be cumulative and permanent¹⁰.

Smoking has many types but in this study only cigarette smoking was considered because the amount of smoking can be measured almost accurately.

The aim of this study was to find any association between cigarette smoking and hearing loss among young people after excluding all possible risk factors for hearing loss like noise, medications, infection, previous trauma or surgery, etc., and to characterize the type of hearing loss among smokers (if present).

Patients and Methods

This study was carried out in otolaryngology outpatient department at Rizgary Teaching Hospital-Erbil/Kurdistan Region/Iraq. It was conducted on 100 male cases aged 20 -50 years and were divided into 3 groups according to their ages: Group 1: 20-29 years, Group 2: 30-39 years and Group 3: 40-50 years. The cases were divided into smokers (S) and non-smokers (NS).

Informed consent was obtained from all cases. A questionnaire was prepared and exclusion criteria were set. Those with history of: ototoxic drug use; medical diseases (cardiovascular disease, diabetes mellitus, hypertension); congenital hearing loss; unilateral hearing loss (a difference of more than 10 dB averaged over the frequencies 0.5, 1, 2 and 4 kHz or 20 dB or more at any single frequency)¹⁹; con-

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ductive hearing loss (characterized by bone conduction thresholds within normal limits with a concurrent gap between poorer air conduction and better bone conduction of 10 dB or more)²⁰; ear infections; previous ear surgery or trauma; exposure to noise (occupational noise like soldiers, ex-soldiers, those working in noisy factories etc.. or non-occupational noise like participating in hunting, using amplified music etc.); were excluded from the study. The non-smoker cases that lived with a smoker person; i.e. exposed to smoking, were also excluded from the study. The details of smoking history were questioned by the number of cigarettes smoked per day (intensity) and the duration of smoking by years. The intensity of smoking was classified into 3 categories: 10 cigarettes/day, 11–20 cigarettes/day, and 20cigarettes/day. The duration of smoking was divided in the same manner into; 10 years, 11–20 years, and 20 years.

All the participants (smokers and non-smokers) were examined by an Otoloscope, a Tuning Fork, Tympanometry and Pure Tone Audiogram. Those with normal Otoloscopic examination and normal tuning fork tests were evaluated with Tympanometry to assess middle ear function. Only cases with type A Tympanometry proceeded through the study. Cases with type B and C Tympanometries were ruled out because having abnormal middle ear function. The basic hearing test was Pure Tone air conduction and bone conduction Audiogram (PTA). The test was performed by an experienced audiologist in a soundproof room. The frequencies tested were 250, 500, 1000, 2000, 4000 and 8000 Hz. First air conduction was performed and hearing thresholds at these frequencies were recorded. Bone conduction was examined if hearing thresholds at the previous frequencies were equal or greater than 25 dB hearing

level (HL). Both ears were evaluated in the same manner. The results were analyzed and hearing loss was defined as hearing threshold greater than 25 dB HL at one or more of the previous frequencies²¹. Hearing loss was classified into 2 types, sensorineural (when bone conduction threshold was >25 dB HL at one or more of previously mentioned frequencies) and mixed hearing loss (when bone conduction thresholds were outside normal limits with presence of an air – bone gap of at least 10 dB HL²⁰. conductive type hearing loss was excluded from the study.

For the purpose of this study, the severity of hearing loss was divided into; Mild (25 – 40 dB HL), Moderate (40 – 60 dB HL), and Severe (> 60 dB HL). Hearing loss was further classified according to the involved frequencies into: Low frequency (250 -2000 Hz) and High frequency (4000 -8000 Hz). Three shapes of Audiogram were expected to be yield; up sloping, flat and down slopping Audiogram.

Data were analyzed using statistical package for social sciences (SPSS, version 22). Relationship between hearing loss and subgroups of age and smoking status was performed by chi square test. Relative risk was estimated with 95% confidence interval (CI). Logistic regression was used to test the effects of age and smoking on hearing, and to analyze the effect of smoking intensity and duration on severity of hearing impairment. P value < 0.05 regarded as statistically significant.

Results

The total number of cases was 100 males, 70 cases were smokers and 30 were non-smokers. The distributions of the total cases according to the smoking status and age are shown in Figure 1 and 2.

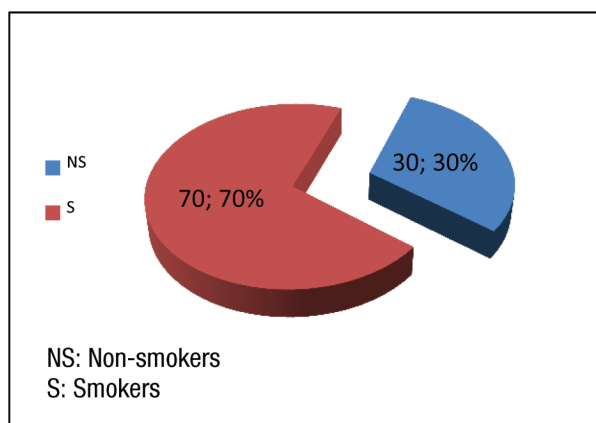


Figure (1): Frequency distribution of cases and their smoking status

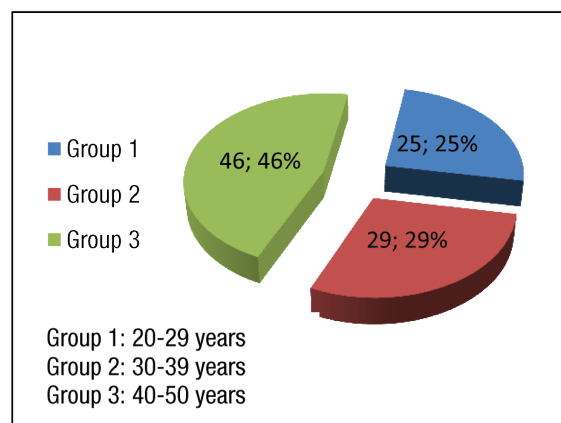


Figure (2): Frequency distribution of cases according to their age groups.

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Hearing loss was found in 26 cases (26%) of the total number, Figure 3.

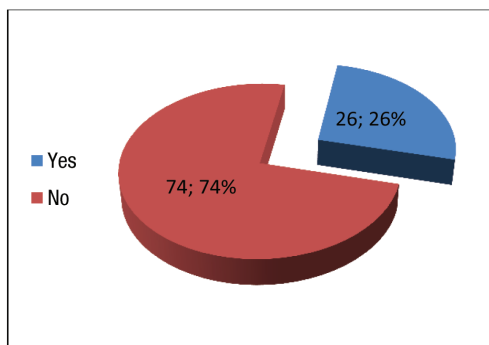


Figure (3): Frequency of hearing loss as total number

From the 26 cases with hearing loss, 1 case (3.8%) was in age group 1, 5 cases (19.2%) were in group 2 and 20 cases (76.9) were in group 3 as illustrated in table 1. 22 cases (84.6%) from those with hearing loss were smokers and 4 cases (15.4%) were non-smokers, Table 2. The prevalence of hearing loss increased with age as 4% of group 1, 17.2% of group 2 and 43.5% of group3 had hearing loss. On the other hand 31.4% of smokers had hearing loss compared to 13.3% of non-smokers.

Table (1): Hearing loss in each age group

		Age*			Total
		Group 1	Group 2	Group 3	
Hearing Loss	No	24	24	26	74
	Yes	1	5	20	26
Total		25	29	46	100

Table (2): Hearing loss among smokers (S) and non-smokers (NS)

		Smoking status		
		NS	S*	Total
Hearing loss	No	26	48	74
	Yes	4	22	26
Total		30	70	100

Using binary logistic regression model to ascertain the effect of the smoking and age on hearing loss, the model correctly classified 73% of the cases. Both smoking (p value = 0.04) and increasing age (p value = 0.004) increased likelihood of having hearing loss.

Hearing loss among non-smokers:

All 4 cases of non-smokers with hearing loss were in age group 3 (30.7% of group 3 had hearing loss) and all had high frequency sensorineural hearing loss down sloping audiogram, 3 cases had mild and one had moderate hearing loss.

Hearing loss among the smokers:

From the 22 cases, 1 case was in age group 1, 5 cases were in age group 2 and 16 cases were in age group 3. In other word 5.2% of group 1, 27.7% of group 2 and 48.4% of group 3 of all smokers had hearing loss.

The type of hearing loss that occurred among smokers was sensorineural in all (95.5%) cases except one case (4.5%) that had mixed loss. All cases had high frequency hearing loss (95.5%), down sloping audiogram (95.5%) except one case that had both low and high frequency hearing loss, and flat audiogram (4.5%).

Variation of hearing loss among smokers was mainly in the severity of the loss, as 13 cases had mild loss, 7 cases had moderate and 2 cases had severe loss.

The distributions of the mild, moderate and severe (severity of hearing loss) according to the intensity and the duration of smoking are demonstrated in table 3 and 4 respectively.

Using multinomial logistic regression to see the effects of all variables (age, the intensity and the duration of smoking) on the severity of the hearing loss: both the intensity

Table (3): Severity of hearing loss according to the intensity of smoking (Number Cigarettes/day)

		Intensity*			Total
		≤10	11-20	>20	
Severity	Normal	19	24	5	48
	Mild	1	11	1	13
	Moderate	1	2	4	7
	Severe	0	2	0	2
Total		21	39	10	70

Table (4): Severity of hearing loss according of the duration of smoking in Years

		Duration*			Total
		≤10	11-20	>20	
Severity	Normal	24	20	4	48
	Mild	2	7	4	13
	Moderate	3	1	3	7
	Severe	0	1	1	2
Total		29	29	12	70

and the duration of smoking had statistically significant effect as p value = 0.001 and 0.01 respectively.

Discussion

This study shows that smoking has significant effect on hearing impairment, and smokers were 2.3 times more likely to have hearing impairment as non-smokers. When comparison was done between non-smokers and smok-

ers of the same age groups, none of age group 1 and 2 of non-smokers had hearing impairment, in contrast to smokers who had hearing impairment in 5.2% of group 1 and in 27.7% of group 2.

It is inferred from the above finding that the deleterious effect of smoking on hearing was more obvious in young subjects (<40 years). In older subjects (>40 years) smoking increased the risk of hearing loss by 57%. Thus it is concluded that smoking can accelerate and initiate age related hearing loss earlier.

In Sharabi et al. study²², smoking increased the chance of hearing loss by 45% (1.45 relative risk) and that effect was more pronounced in young subjects (<35 years). Kumar et al.²³ described that 65.7% of smoker had hearing loss vs. 15% of non-smoker (4.38 relative risk) and found that as the age increased greater number of smokers were affected in comparison with non-smokers, in another term smoking accelerated age induced hearing loss. Cruickshanks et al.⁹ described that smokers were 1.7 times more likely to have hearing loss than non-smokers. Nakanishi et al.⁶ mentioned a relative risk of 1.7- 2.2 for high frequency hearing loss. The discrepancy in the relative risks between this study and the mentioned ones may be explained by the difference in the study sample, inclusion criteria and different populations (Mediterranean, Indian, English, and Japanese).

High frequency sensorineural hearing loss was the most common type of hearing loss among smokers and its incidence was significantly lower in non-smokers. Same observation was found in many studies^{6,8,23,24}. Different from these findings was described by Sharabi et al. retrospective cross sectional study²², in which conductive hearing loss was the most common type followed by mild flat curve sensorineural hearing loss.

Kumar et al.²³ confirm the observation that mild hearing loss was the most common type, followed by moderate and to lesser extend severe type, with higher percent of incidence.

An essential finding of this study is that increasing the intensity and the duration of smoking significantly increase the severity of hearing loss. In another term, it is found that smoking of more than 20 cigarettes/day for more than 10 years increased the risk of having more severe hearing loss.

Prabhu et al.¹⁴, Cruickshanks et al.⁹, kumar et al.²³ and Dawes et al.²⁵ all supported the dose related effect of smoking, while Sharabi et al.²² and Sumit et al.²⁴ stated that the intensity and the duration of smoking had no statistically significant impact on auditory thresholds. Limitation of this study is that it was conducted on a relatively small number of subjects and in a limited time.

Conclusions

It is concluded from this study that cigarette smoking affects the hearing ability after exclusions of most possible factors including noise exposure. It increases the risk of

hearing impairment with increasing age in a dose related manner. Young smokers (< 40 years) are more vulnerable to have hearing impairment and their vulnerabilities increase with age. Smokers can have Mild, moderate and to lesser extend severe high frequency sensorineural hearing loss.

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