

## Effect of active smoking on the tympanometry findings in adult men.

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### Summary:

**Background:** Tympanometry findings are considered by many investigators to be associated with passive and active smoking.

**Patients and methods:** One hundred forty healthy adult men aged (20-50 years). 70 smokers and 70 non-smokers were recruited for the study. The examination included otoscopy, and screening tympanometry. Smoking history was ascertained by self-report. For each subject, age, smoking status and number of cigarettes per day were noted.

**Results:** There is a tendency for more negative middle ear pressure in smokers than in non-smokers though this difference may not clinically significant. There were no significant differences in ear canal volume, middle ear compliance and presence of Stapedial Reflex in both smokers and non-smokers groups. There was no correlation between middle ear pressure and duration of smoking and number of cigarettes smoked amongst smokers.

**Conclusion;** A definitive study with a larger sample size is needed to explore the effects of smoking on findings of tympanometry in healthy men.

**Key words:** Middle ear pressure (MEP), Ear canal volume (ECV) , middle ear compliance , Tympanometry , active smoking .

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### Introduction

Smoking any form of tobacco, including cigarettes, cigar, pipe, and narghile (Water-pipe) was estimated about 25.7% in men and 1.9% in women in the Iraq. (1) Cigarette smoking may affect hearing through its effects on antioxidative mechanisms or on vasculature supplying the auditory system (2). Tobacco smoke disrupts the normal clearing mechanism of ear canal, facilitating infections organism entry into the body. The resulting middle ear infection can be very painful, as pressure and fluid buildup in the ear. Continued exposure to tobacco may result in persistent middle ear infections and eventually, hearing loss (3). An association between cigarettes smoking and hearing loss among adults have been found in some clinical studies (4, 5, 6, 7). One study found that men who smoked more than one pack (20 cigarettes) per day had worse hearing thresholds at 250 to 1000 Hz than non-smokers, but there was no difference at higher frequencies (5). Other study reported that smokers were more likely than non-smokers to have hearing loss at 4000 Hz, but the size of the effect was small (7). The Baltimore Longitudinal Study of aging (8) found no association between cigarette smoking and the development of a hearing loss in men. There have been few population-based studies of smoking and hearing. In the Health Interview Survey, (9) men who smoked 2 or more packs per day were more likely to report having a hearing loss than non- Smokers. In the Framingham study, (10) which tested

Hearing with audiometry, there was no association between cigarette smoking and hearing loss. Moreover most of these surveys were performed among the elderly. While hearing loss is common among the elderly (11), the young also suffer from hearing impairment. The causes probably arise from a combination of genetic and environmental factors. The purpose of our study was to determine whether active smoking has any adverse effect on middle ear function in Iraqi healthy men aged between 20 to 50 years.

### **Patients and Methods**

We carried out a cross sectional observational study involving one hundred forty healthy men aged  $29.7 \pm 10.23$  (range 20 – 50 years). The men divided into two groups: Smokers group; included 70 smoking apparently healthy men (mean age  $30.25 \pm 10.24$  years) and control (non-smokers) group contained 70 healthy men (mean age  $29.24 \pm 10.29$  years). Women were excluded from the study because of their small number. In both groups the study was excluded the following criteria: History of ear surgery, history of recurrent upper respiratory tract infections, acute upper respiratory tract infection at time of examination, history of cleft palate, abnormal appearance of tympanic membrane and impacted wax in ear canal. All men in both groups completed a questionnaire including their age and smoking status. Smoking was ascertained based on the number of cigarettes per day and duration of smoking (in years) To investigate dosage effects, we estimated the total number of pack-years. Total pack-years smoked were defined as the number of cigarettes smoked per day divided by 20

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cigarettes per pack, then multiplied by the number of years of smoking. Questions were asked about exposure to environmental tobacco smoke. The hearing examination included an otoscopic evaluation, and a screening tympanogram (Tymp87 DANPlex (clinical middle ear analyzer)), uses a probe tone of 226 Hz at 85 dB and sweeps from 200 to 312 dapa at 100 dapa/s. Middle ear pressure, middle ear compliance, ear canal volume and Stapedial Reflex at frequencies 500, 1000, 2000, and 4000 Hz were measure in both ears.

#### Statistical Analysis

Analysis was conducted using (Winks SDA –version 6.0.5 software –Statistical Data Analysis). All studied variables showed clear evidence of non-normality ( $P < 0.01$ ); hence non-parametric statistical method are used throughout. A Mann-Whitney test was used to compare 70-smokers with the 70 non-smokers for all the variables, except Stapedial Reflex (binary variable). A Chi-square test was used to test for differences between smokers and non smokers on Stapedial Reflex. Spermen's correlation coefficients were calculated to investigate whether, for smokers, there were any correlations between smoking tobacco and tympanometry measurements.

#### Results:

One hundred and forty healthy men took apart in the study; seventy smokers and seventy non-smokers. The mean age of the overall men was ( $29.74 \pm 10.23$  years). The mean age of the smokers group was ( $30.25 \pm 10.24$  year), and the non-smokers group was ( $29.24 \pm 10.29$ ). Table-1 gives the descriptive statistics (mean  $\pm$  standard deviation) and P-value for middle ear pressure, middle ear compliance and ear canal volume for both ears in smokers and non-smokers groups.

**Table 1: Descriptive statistics and P-values for comparisons of smokers and non-smokers groups.**

	Variable	Mean $\pm$ SD		P-Value
		Smokers	Non-smokers	
Right Ear	Ear Canal Volume (ml)	2.63 $\pm$ 0.62	2.66 $\pm$ 0.53	0.98 (NS)
	Compliance (ml)	1.09 $\pm$ 0.63	1.07 $\pm$ 0.58	0.92 (NS)
	Middle ear pressure (dapa)	-1.93 $\pm$ 15.54 -40 to +35*	2.86 $\pm$ 11.72 -25 to 35*	<b>0.001</b> (S)
Left Ear	Ear Canal Volume (ml)	2.59 $\pm$ 0.64	2.61 $\pm$ 0.47	0.96 (NS)
	Compliance (ml)	1.02 $\pm$ 0.60	1.07 $\pm$ 0.65	0.90 (NS)
	Middle ear pressure (dapa)	-1.43 $\pm$ 15.28 -50 to 45* dapa	2.57 $\pm$ 10.20 -25 to 35* dapa	<b>0.001</b> (S)

NS: Non significant, S: Significant, SD= Standard Deviation  
\* Range of the middle ear pressure (dapa)

Evidence of differences between smokers and non-smokers were found for middle ear pressure in both

right and left ears ( $P < 0.001$ ,  $P < 0.001$ ) respectively. Middle ear pressure was higher (i.e. less negative), on average, for non-smokers in both ears. No other differences were found. Table-2 shows the correlation between the numbers of packs-years with tympanometry findings in both ears.

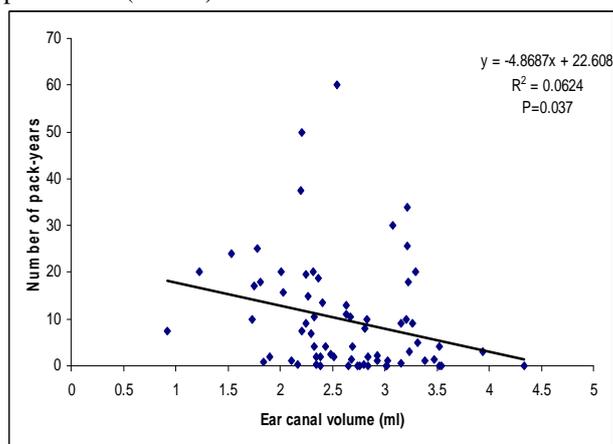
**Table-2: Pearson's correlation between the number of pack-years with tympanometry findings in smokers group.**

	Variables	Pearson's Coefficients	P-value
Right	Number of pack-years with ECV (ml)	-0.249	0.037 (S)
Ear	Number of pack-years with Compliance (ml)	0.108	0.373 (NS)
	Number of pack-years with MEP (dapa)	-0.103	0.394 (NS)
Left	Number of pack-year with ECV (ml)	-0.224	0.062 (NS)
Ear	Number of pack-years with Compliance (ml)	0.011	0.931 (NS)
	Number of pack-years with MEP (dapa)	-0.212	0.079 (NS)

S = Significant. NS = Not significant. ECV= Ear canal volume.

MEP= Middle ear pressure.

The number of pack-years of smoking ranged from 0.05 to 60, with an average 9.8 pack-years among smokers group. Smokers group showed smoking an average of  $13.4 \pm 12.6$  cigarettes per day. Figure-1 is a plot of number of pack-years against right ear canal volume, illustrating a significant negative correlation ( $r = -0.25$ ,  $P = 0.037$ ). No other significant correlations were found with other tympanometry parameters (table-2).



**Fig-1; Relationship between the ear canal volume (ml) with the number of pack-years in smokers group.**

Table-3 shows the number of subjects with and without right and left Stapedial Reflex (respectively) in both groups.

**Table-3 : Incidence of Stapedial Reflex in both smokers and non-smokers groups**

Right Stapedial Reflex	Smokers	Non-smokers	Total
Absent	31 (44.3%)	28 (40%)	59
Present	39 (55.7%)	42 (60%)	81
Left Stapedial Reflex	Smokers	Non-smokers	Total
Absent	32 (45.7%)	29 (41.4%)	61
Present	38 (54.3%)	41 (58.6%)	79

There were no significant differences in Stapedial Reflex between smokers and non-smokers. (Chi-square test;  $P = 0.140$  and  $P = 0.56$  for right and left ears.

### Discussion

Many studies have demonstrated the harmful effects of smoking on individual smokers, including an increased incidence of arterial disease, lung cancer and respiratory infections. There are a number of ways in which smoking could affect Eustachian tube function and tympanometry findings including a direct effect of irritants in tobacco smoke on the mucosa of the middle ear and Eustachian tube and increased respiratory tract infection (3, 12). One study was demonstrated impaired ear ciliary function due to tobacco smoke exposure (3). Others found that the valsalva induced tympanometric peak pressure shifts of young smokers were less than those measured among non-smokers. They also observed a similar but less compelling finding among elderly subjects (12). The aim of the present study is to analyze the association between active smoking and the tympanometry findings in healthy men aged 20-to-50 years. Our results show a statistically significant difference between smokers and non-smokers with middle ear pressure in both right ear ( $P < 0.001$ ) and left ear ( $P < 0.001$ ). This effect may not be clinically significant (normal values of up to  $-150$  dapa) in our small sample size of healthy men. The range of the middle ear pressure in smokers and non-smokers in both ears were found clinically limited within the normal values (table-1). These results were in similar with other study on the adult men smoking Narghile (water-pipe) which reported that tympanometric changes were not significant between smokers and non-smokers (13). Results of this study may be partly in agree with the above research findings and may add to the evidence for smoking effects on middle ear pressure to the smoking adults aged 20-50 years. In this study, cigarettes smoking status at the time of hearing examination was determined by self-report, so that to improve our analysis, we calculated the number of pack-years to investigate dosage effects (14). A more specific

analysis of this dose effect, restricted to the smokers group. The results showed that the average number of pack-years was 9.8 (equivalent to  $13.4 \pm 12.6$  cigarette per day). Statistically; the results observed a significant correlation between the number of pack-years and the right ear canal volume ( $p < 0.05$ ) among smokers group. While no effect of active smoking on the middle ear compliance and middle ear pressure ( $p > 0.05$ ). These results may support some of the medical literatures describes a relationship between hearing impairment and smoking by using audiometry, but these reports are equivocal as some researchers found a correlation (15,16,17,18), while others did not (8,19). Moreover, most of these surveys were performed among the elderly. In fact, our data may reflect that cigarette smoking is well recognized to be associated with other life style and socioeconomic factors that may adversely affect health. (20).

**Limitations:** In this investigation, the size of the study population was an obstacle to perform an appropriate analysis, although confidence intervals were quite large for some estimates. Longitudinal studies with improved assessment of smoking, time exposure and also the use of severity levels of auditory damage should be developed to overcome methodological limitations of this study. Despite methodological limitations the study provides evidence that cigarette smoking contribute to increased hearing impairment.

### Conclusion:

There is a tendency for more negative middle ear pressure in smokers than in non-smokers though this difference may not be clinically significant and there were no significant differences in ear canal volume, middle ear compliance and presence of Stapedial reflex in both groups and no correlation between middle ear pressure and duration of smoking and number of cigarettes smoked amongst smokers.

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