ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 04, pp.68383-68386, April, 2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

EFFECTS OF SMOKING ON THE AUDITORY SYSTEM

[1,*]Maruthi Krishna Goud, K. and [2]Arpitha

[1]Assistant professor, Osmania University, India
[2]Faculty, Institute Of Speech and Audiology, Sweekaar Academy of Rehabilitation Sciences, India

ARTICLE INFO

Article History:
Received 25th January, 2018
Received in revised form
09th February, 2018
Accepted 28th March, 2018
Published online 30th April, 2018

Key words:
Active smoker,
Passive smokers,
PTA, Tympanometry,
Reflexeometry and OAE.

ABSTRACT

Introduction: Now-a-days the smoking has been increased to a peak level not only in adults but also in youngsters. Smoking has various patho physiological effects among which the effect on hearing sensitivity is one, which has adverse effects on audition.

Aim of the Study: To compare the effects of smoking on hearing sensitivity in active and passive smokers.

Methodology: The study has been carried out on twenty males who have smoke exposure since 2 years, without any history of other health issues and hearing problems. The twenty subjects were divided into two groups in which one consist of 10 active smokers and other consists of 10 passive smokers. All the selected subjects were administered the conventional pure tone audiometry, speech audiometry, immittance, reflexometry, and Otoacoustic emission and the data were recorded.

Results: The following study shows that active smokers have more hearing sensitivity decrement than passive smoking the mean hearing loss in Right ear is 42dB and left ear is 45.5dB in active smokers and in passive smokers 28dB in Rt ear and 23dB in Lt ear. The pure tone audiometric results were correlated with speech recognition thresholds and speech discrimination scores and it shows no much effect on SRT and SDS. Impedance audiometric results also show no effect on middle ear functions and all subjects have shown "A" type tympanogram. Reflexiometric results show that 70% of active smokers are with absent reflexes and 30% of active smokers are with elevated reflexes where as 80% of passive smokers are with elevated reflexes and 20% of passive smokers are with absent reflexes.OAE results show that 50% of the active smokers were passed and 50% were failed where as 80% of passive smokers were passed and 20% were failed. On an average, the active smokers have shown more hearing sensitivity decrement than passive smokers.

Citation: Maruthi Krishna Goud, K. and Arpitha. 2018. "Effects of smoking on the auditory system", *International Journal of Current Research*, 10, (04), 68383-68386.

INTRODUCTION

The link between cigarette smoking and peripheral hearing loss was established over forty years ago, information on the effects of smoking at the cochlear and auditory central nervous system levels has become available only recently. With the modernity the health risk increases following habits which is more prominent in youth with "smoking". The "smoke in" causes physiological changes with different pathophysiology outcomes. Although deleterious effects of cigarette smoking on adult health have been well documented, only recently have clinical studies linked adverse neuro developmental problems to prenatal exposure associated with maternal smoking. However adolescent associated with "smoking" increase the prevalence of hearing loss, not of much literature has given the qualitative and quantitative analysis.

Corresponding author: **Maruthi Krishna Goud, K.,**
Assistant professor, Osmania University, India.

Active smoking is the direct exposure to smoke by inhaling tobacco, use of cigarettes, cigars, pipes and bides etc. On the other hand, passive smoking is involuntary exposure to tobacco smoke. Cigarette smokers are exposed to nicotine directly, as well as a number of additional chemicals including formaldehyde, benzene, arsenic, vinyl chloride, ammonia and hydrogen cyanide via second hand smoke inhalation (CDC 2006).

Studies have correlated the presence of cotinine, a chemical that identified as a biomarker of second hand smoke exposure with upper respiratory tract problems and increased risk for middle ear problems (CDC 2006). It is found that as number of cigarettes smoked per day and pack years of smoking increased, the risk for high frequency hearing loss increased in a dose dependent manner. Whereas low frequency hearing loss remained unchanged along with other patters can be evident.

The spontaneous exposure to the smoke inhaled, nicotine has a chance of damaging to the auditory system, may be causing hypoxia in which both nicotine and carbon monoxide from the cigarette smoke will reduce the oxygen supply to the tissues of auditory system. Although age in itself may produce a decline in hearing over time, the contributions of a variety of risk factors including smoking further perpetuate the hearing loss. There is no direct evidence for the mechanism of damage to the auditory system associated with cigarette smoke exposure. However, different putative mechanisms may play a role in the manifestation of peripheral and central auditory problems associated with nicotine exposure. The first mechanism may be related to hypoxia both nicotine and carbon monoxide in cigarette smoke have been shown to reduce the oxygen supply to fetal tissue by restricting utero-placental blood flow.

The second putative mechanism may pertain to the interaction between nicotine and nicotinic acetylcholine receptors within the auditory system. Nicotine binds to nAChRs that normally modulate the effects of a neuro transmitter called acetylcholine. Since neuro transmitters function as chemical message carriers facilitating communication between cells by binding to the receptors on the cell surface, loss or damage of the receptors in essence would eliminate the modulator influences of the receptors. Evidence that nAChRS are critical components of the auditory pathway from the cochlea to the temporal lobe and the descending auditory pathway. Finally the neuro physiological mechanism that may potentially explain the association between adolescent smoking and neuro cognitive deficits is protracted development of the auditory central nervous system pathways.

Side effects of smoking

Smoking causes many side effects which include the following

- Pre mature aging
- Hearing loss
- Cataracts
- Breathing complications
- Impotence and number of fingers, tooth decay
- Cardio vascular deficits
- Pulmonary deficits

Aim of the study

- To compare the effects of smoking on hearing sensitivity in active and passive smokers.

Need for the study

In literature till date many researches were carried out on smoking effects on hearing but this study highlights the effects of smoking in both active and passive smokers.

- This study helps the audiologist to explore the effects of smoking and helps in management process.
- This study helps the audiologist to create awareness among the people about the positive effects of smoking on audition in active and passive smokers.

According to Kyoko Nomura, Mutsuhiro Nakao, and Takeshi Morimoto in 2004 in their study "Effect of smoking on hearing loss: quality assessment and meta-analysis" found in 15 observational studies that there is a positive association between smoking and hearing loss. It is possible that smoking cessation may be a useful strategy for maintaining hearing acuity. According to Karen J. Cruickshanks, Ronald Klein, Barbara E.K. Klein, Tessy L. Wiley, David M. Nondahl, Ted S. Tweed, in 1998, in their study "Cigarette smoking and hearing loss" done on adults aged 48 to 92 years, have shown that current smokers were 1.69 times as likely to have a hearing loss as non smokers (95% confidence interval,1.31-2.17). Non smoking participants who lived with a smoker were more likely to have a hearing loss than those who were not exposed to a household member who smoked (odds ratio, 1.94; 95% confidence interval, and 1.01-3.74). They concluded that these data suggest that environmental exposures may play a role in age- related hearing loss. If longitudinal studies confirm these findings, modification of smoking habits may prevent or delay age- related declines in hearing sensitivity.

Hypothesis

- Active smoking will cause more decrement in hearing sensitivity than passive smoking.
- There may be a no difference between active and passive smokers.

METHODOLOGY

Twenty males between the ages of 20 years to 30 years participated in the study. All the participants enrolled in the study were selected on the basis of the following selection criteria:

- Age between the 20 to 30 years
- Exposure to smoke since two years
- No known medical or surgically treatable ear related conditions
- No known fluctuating or rapidly progressing hearing loss
- No use of medication that could effect hearing sensitivity
- No other health issues including cognitive and medical or language based
- conditions
- No family history of hearing loss

Instrumentation

Pure tone audiometry was done on the selected subjects to obtain the hearing thresholds and speech audiometry was done to obtain speech recognition thresholds and speech discrimination scores by using the calibrated audiometer ALPS AD 2100, under the calibrated earphones TDH 39P. Bone conduction pure tone audiometry was done for same subjects by using the same audiometer and bone vibrator b72. Acoustic immitance measures and reflexometric measures were obtained by using a calibrated tympanometer. All the testing was done in a double walled sound treated room with ambient noise level according to American National Standards Institute specifications. Otoacuostic emissions were measured by using Biologic ADEAX instrument.

Procedure

Participants were instructed according to American Speech and Hearing Association guidelines for manual pure tone audiometry. The signal was presented for 1 to 2 seconds first to the right ear and hearing thresholds were obtained at octave frequencies ranging from 250 Hz to 8000 Hz. Following the same procedure, the hearing thresholds for left ear were also obtained. Then the bone conduction thresholds were obtained for better ear by using the bone vibrator. Speech audiometry was done by instructing the participants according to American Speech and Hearing Association guidelines. The hearing thresholds for speech were obtained in two methods:

- Speech recognition threshold
- Speech discrimination threshold

SRT was done by using spondee words and SDS was done by using PB words in Telugu. Immitance and reflexometric measures were done to explore any middle ear dysfunctions, by instructing the participants not to swallow and hold the breath. The data for the pure tone audiometry, speech audiometry, immitance audiometry and reflexometry were recorded.

RESULTS

All the Audiometric test results for both active and passive smokers were recorded and tabulated below. Pure tone audiometry was done on all selected subjected which showing correlation with Speech Recognition.

Mode	S.No.	PTA		SRT		SDS		Tympanogram Type		Reflexometry		OAE	
		Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Active Smokers	1	30dB	35dB	20dB	25dB	95%	85%	A	A	Absent	Absent	Pass	Pass
	2	35dB	40dB	30dB	30dB	90%	85%	A	A	Elevated	Elevated	Pass	Pass
	3	30dB	40dB	25dB	35dB	90%	80%	A	A	Elevated	Elevated	Fail	Fail
	4	45dB	55dB	35dB	45dB	85%	80%	A	A	Absent	Absent	Pass	Pass
	5	45dB	40dB	40dB	35dB	90%	85%	A	A	Absent	Absent	Fail	Fail
	6	50dB	50dB	40dB	45dB	95%	90%	A	A	Absent	Absent	Fail	Fail
	7	45dB	50dB	35dB	40dB	90%	90%	A	A	Absent	Absent	Fail	Fail
	8	35dB	45dB	30dB	35dB	90%	90%	A	A	Elevated	Elevated	Pass	Pass
	9	55dB	50dB	45dB	40dB	85%	85%	A	A	Absent	Absent	Pass	Pass
	10	50dB	50dB	40dB	45dB	95%	90%	A	A	Absent	Absent	Fail	Fail
Passive Smokers	1	30dB	25dB	20dB	15dB	95%	95%	A	A	Elevated	Elevated	Pass	Pass
	2	30dB	25dB	20dB	25dB	95%	95%	A	A	Elevated	Elevated	Pass	Pass
	3	30dB	20dB	25dB	20dB	90%	95%	A	A	Absent	Absent	Fail	Fail
	4	35dB	20dB	25dB	15dB	90%	90%	A	A	Elevated	Elevated	Pass	Pass
	5	20dB	25dB	25dB	20dB	95%	95%	A	A	Elevated	Elevated	Pass	Pass
	6	35dB	30dB	25dB	20dB	85%	90%	A	A	Elevated	Elevated	Pass	Pass
	7	25db	20dB	20dB	15dB	90%	95%	A	A	Absent	Absent	Fail	Fail
	8	30dB	30dB	20dB	25dB	95%	90%	A	A	Elevated	Elevated	Pass	Pass
	9	25dB	20dB	20dB	15dB	95%	95%	A	A	Elevated	Elevated	Pass	Pass
	10	20dB	15dB	15dB	15dB	95%	90%	A	A	Elevated	Elevated	Pass	Pass

Threshold and shows that 4 active smoker have mild hearing and 6 active smokers have moderate hearing loss tending towards high frequency loss and 2 passive smokers have normal hearing sensitivity and 8 passive smokers have mild hearing loss. Speech audiometry was done and results show correlation between Pure Tone Audiometry and Speech Recognition Threshold and the Speech Discrimination Scores show good discrimination abilities in all subjects. Impedance audiometry was done in all selected subjects and results are as follows Normal middle ear function with "A" type tympanogram in all subjects. Otoscopic examination reveals normal tympanic membrane in appearance in all passive smokers and two active smokers. Normal middle ear function with 'A' type tympanogram and otoscopic examination reveals dull appearance of tympanic membrane in 8 active smokers. Reflexometric results show that reflexes are present in all subjects except 2 active smokers who show absent reflexes at high frequencies. Otoacoustic emissions show 50% pass and 50% fail results in active smokers and 75% pass and 25% fail results in passive smokers. On the result analysis, all the subjects were with controlled variable, however, result shows few variables, may be due to usage of various types of "SMOKE".

DISCUSSION

The above mentioned results indicate that the effect of smoking on hearing is more in active smokers when compared to passive smokes. Audiological evaluation done on all the selected subjects' shows that the active smokers have moderate hearing loss tending towards the high frequencies and the passive smokers have mild hearing loss. Although both active and passive smokers show effect of smoking on hearing thresholds, the mean hearing loss in Right ear is 42dB and left ear is 45.5dB in active smokers and in passive smokers 28dB in Rt ear and 23dB in Lt ear. The pure tone audiometric results were correlated with speech recognition thresholds and speech discrimination scores and it shows no much effect on SRT and SDS. Impedance audiometric results also show no effect on middle ear functions and all subjects have shown "A" type tympanogram. Reflexometric results show that 70% of active smokers are with absent reflexes and 30% of active smokers are with elevated reflexes where as 80% of passive smokers are with elevated reflexes and 20% of passive smokers are with absent reflexes.

OAE results show that 50% of the active smokers were passed and 50% were failed where as 80% of passive smokers were passed and 20% were failed. On an average, the active smokers have shown more hearing sensitivity decrement than passive smokers.

Clinical implications

- Making the youth to be safe from hearing loss by avoiding smoking
- Helps in management process of hearing loss in active smokers and passive smokers
- Modification of smoking may prevent hearing loss

Limitation: However, the study was carried out on subjects with no health issues and family history of hearing loss, the study was carried out on a small sample of 20 subjects, irrespective of gender.

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