ORIGINAL ARTICLE

PREVALENCE OF HEARING LOSS IN ADOLESCENT SMOKERS
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HOW TO CITE THIS ARTICLE:

ABSTRACT: OBJECTIVE: The effect of smoking on the inner ear especially hearing is to be evaluated. We thought to determine the effects of smoking in a student population who have exposure of smoking for 3 years. MATERIAL AND METHODS: We recruited 100 students i.e. 50 smokers and 50 nonsmokers. The smokers Group had started smoking in teen age and continued the same in the professional college. Distortion Product Otoacoustic Emission was done after applying the inclusion and exclusion criteria. RESULTS: 14/50 had absence/decreased Distortion Product Otoacoustic Emission in smoker group. 3/50 had absence/decreased Distortion Product Otoacoustic Emission in non-smoker category. CONCLUSION: We concluded that, smoking has effect on the inner ear. The effect of smoking can be confirmed, even if the exposure is of 2-3 years duration in young individuals. KEYWORDS: Distortion Product Otoacoustic Emission inner Ear.

INTRODUCTION: Smoking is a popular and widespread activity in the community. Students are no exception to it. Cigarette smoking is well recognized to be associated with different lifestyle and socioeconomic factors which may adversely affect health. Different statistics register that smokers are 70% more likely to develop some form of hearing loss than non-smokers and the loss is directly related to the number of smoking years. Researchers calculated that smokers are 1.5% more likely to develop hearing loss as compared to passive smokers and non-smokers, while passive smokers were 28% more likely to develop hearing loss than non-smokers. People who smoke are more likely to be exposed to noisy work places and leisure activities. In models that included alcohol consumption, education and occupational noise exposure to adjust for potential confounding effects, smoking history remained significantly associated with hearing loss, suggesting that smoking is not merely serving as a marker for other lifestyle factors. The inclusion of leisure time noise exposure or the number of medications used did not alter the results. Every year young people entering professional colleges are increasing. Students are exposed to various types of addictions. Smoking is one of the widespread habits among the student community. Nagley et al¹ have observed that, smoking has a deleterious effect on the outer hair cells of the cochlea in chronic smokers. Gopal et al² has also confirmed their findings in this regard. We undertook a study among our student community to know the effects of smoking, who have started smoking just 2-3 years back. This group of students smoked on an average of less than 20 cigarettes in a day.

HYPOTHESIS: The main goal of this study is to establish the deleterious effect of smoking on the inner ear in the student community.

METHODS: Inclusion criteria: Students who smoked after entering the college or before, on an average of less than 20 cigarettes in a day. Students having external and middle ear pathology; alcohol consumption; tobacco chewing; exposure to loud sounds and chronic use of mobile phones, I-pods were not included.
PROCEDURE: All the male students in the 2nd, 3rd, and 4th year of MBBS, who smoked cigarettes were recruited. These students smoked on an average of less than 20 cigarettes in a day. These students were examined clinically and pure tone audiogram (PTA) was done to these students to rule out middle ear pathology. Distortion Product Otoacoustic Emission was done to these students and findings were noted. The same procedure was repeated to non-smoker group and findings were noted.

RESULT: We chose a total of 100 students, who fulfilled our criteria of 50 students, who smoked less than 20 cigarettes per day and another 50 students who never smoked. The results were tabulated by 2X2 contingency table as follows.

<table>
<thead>
<tr>
<th></th>
<th>DPOAE Absent</th>
<th>DPOAE Present</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoker</td>
<td>14</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Non-Smoker</td>
<td>09</td>
<td>47</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>83</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1

Distortion Product Otoacoustic Emission was absent or decreased in 28% of the students who smoked, whereas DPOAE was absent or decreased only in 6% of the non-smokers. The odds ratio was 6.09; 95% CI is 62 22.8, due to small sample size, but the association is significant.

DISCUSSION: Over the past 40 years, the medical community has recognized the danger smoking presents to hearing health. But because the hearing process is extremely complex, pinpointing how smoking affects hearing is not so simple. This does not mean that smoking does not affect hearing loss – only that how it affects hearing loss is not entirely clear.

The myriad of dangerous chemicals in cigarette smoke, including formaldehyde, benzene, arsenic, vinyl chloride, ammonia, and hydrogen cyanide, may affect both conductive hearing (Middle ear vibrations) as well as inner ear hearing by damaging the hair cells lining the cochlea. They not only impair the hearing mechanism but also can cause tinnitus or affect balance. In many studies, there is also a strong correlation between the number of cigarettes smoked and the degree of hearing loss. In other words, smoking-related hearing loss is dose-dependent.

While the mechanisms of damage to the auditory system due to smoke inhalation and exposure are unclear, Dr. Katbanma hypothesizes that the following occurs whenever someone smokes a cigarette:

1. Nicotine and carbon monoxide that result from smoking tighten the blood vessels, thus restricting the blood flow and finally depleting oxygen levels to the cochlea, which is suffused with blood. In this mechanism, damage occurs by hypoxia (or lack of oxygen) to the hair cells. The tiny hair cells in the cochlea responsible for translating sound vibration into electrical impulses in the brain are asphyxiated. Nicotine affects the neurotransmitters in the auditory nerve and therefore brain is not informed accurately what kind of sound is being processed. The neurotransmitters that convey sensory information along the auditory nerve to the brain are disrupted by nicotine, limiting their function.
2. Smoking unleashes free radicals in our bodies. If these radicals speed into the tissue and hair cells in our inner ear, permanent damage can result.

3. The auditory nerve is not fully developed until late adolescence, which means that second-hand smoking puts adolescents at increased risk for hearing impairment.

Dr. Erik Fransen, of the University of Antwerp in Belgium, one of the lead researchers, said that the ability to pick out high frequency sounds was damaged in smokers and the obese, although to not as great an extent as those exposed to very loud noise in the workplace. He said: "The hearing loss is proportional to how much you smoke and your body mass index (BMI).

"It starts getting worse once you have smoked regularly for more than one year."

He said that, unlike some parts of the body, once damage had occurred, there was no prospect of recovery.

"Once the damage is done, it's done. It does not repair."

A common term in smoking studies is "pack year." For this study, the authors defined pack year by multiplying the time in years that a person had smoked, by a weighting factor for how many cigarettes a day they had smoked. E.g., less than ten cigarettes a day received a weight factor of 0.5, while more than 20 cigarettes daily had a weight factor of 1.5.

The results showed a "significant" association between the number of pack years and high frequency hearing loss. In their analysis, the authors pointed out that smoking affects the middle ear by irritating the Eustachian tube and the lining of the middle ear (The middle ear also plays a key role in our hearing mechanism because it is home to the auditory ossicles).

**Asian Study of Smoke and Hearing Loss:** Researchers in Asia did a small study of 263 people in a rural area with the goal of examining the combined impact of aging and smoking on hearing loss. None of these people had been exposed too much noise (Noise exposure is a known factor in hearing loss). They found that the prevalence rate of hearing loss for smokers aged 40 and under was 11.9%; but for smokers older than 40, it was much higher-51.3 percent. Among nonsmokers 40 and younger, the prevalence rate was just 6.9%; for nonsmokers older than 40 it was only 29.7 percent. In other words, as the smokers became older, their risk for hearing loss increased exponentially.

**Israeli Study of Smoke and Hearing Loss:** Researchers in Israel did a larger study of 13,308 men between 20 and 68 years old, with the average being 34.6 years old. As with the other studies, this one included current smokers, former smokers, and nonsmokers. What was interesting about the results of this study is that it showed a higher risk of hearing loss in younger adults! Participants over 35 years old had only a 17% risk increment, but participants under 35 had a 43% risk increment. Not only that, the researchers found a "significantly" higher incidence of any type of hearing loss in both the current smokers (11.8%) and past smokers (11.7%) than in people who had never smoked. The ones who had never smoked had only an 8.1% incidence of hearing loss.

The other data revealed by the study was a "non-significant" relationship between the number of cigarettes smoked and hearing loss.

They also found that conductive hearing loss was more common than sensorineural hearing loss 6.1% of the smokers and the same percentage of the former smokers had conductive hearing loss, as did 3.3% of the nonsmokers. Current smokers had a 1.5% incidence of sensorineural hearing
loss; former smokers had a 1.2% incidence, and once again, the nonsmokers had the lowest incidence just 0.7%.

Overall, the researchers found that smoking increases the risk of developing a hearing loss by 45 percent.

**American Study of Smoking and Hearing Loss:** Researchers in the United States have done their own studies of the relationship between smoking and hearing loss. In one American study, 3,753 participants between 43 and 84 years old (Average age was 65.8 years) living in a Wisconsin town self-reported their smoking history as part of a hearing study. The results showed that current smokers were 1.69 times more likely to have hearing loss than people who had never smoked.4

For this study, pack years were determined by dividing the number of cigarettes smoked daily by 20 cigarettes per pack, and then multiplying that result by the number of years a person had smoked. The average number of pack years for current smokers was 34.9, and it was 28.2 pack years for former smokers. Just as with the Israeli study, the American researchers found the amount of exposure appeared to have little impact. Those with the most pack years were only 1.30 times as likely to have a hearing loss as those with no pack years.

However, in every age group that participated in the Wisconsin study, the prevalence of hearing loss was greater in current smokers than in nonsmokers. When the researchers considered the effect of occupational noise exposure, they found that there was a significant association between smoking and hearing loss for both people who had been exposed to occupational noise, and those who had not been exposed to occupational noise. In their analysis, the researchers theorized that smoking may do "direct" toxic harm to the hair cells that help us to hear.

In this large population-based study, participants who were current cigarette smokers were 1.7 times as likely to have hearing loss as nonsmokers.5 This association was statistically significant after adjusting for the potential confounding effects of age, sex, education, occupational noise exposure, cardiovascular disease, and alcohol consumption. In age-specific analyses, this pattern was consistent for all but the oldest age group, which may be because of the small number of current smokers (n=13) and the effects of selective mortality. The odds of having a hearing loss increased with pack-years of smoking and were higher for nonsmokers living with a current smoker. These results are consistent with early clinical studies reporting decreased hearing sensitivity in smokers compared with nonsmokers, animal studies showing cochlear damage after exposure to cigarette smoke,6 and population-based self-reported data from the Health Interview Survey.7

An important implication is the effect that smoking has on those around us. Studies have shown clear correlations between hearing loss and second-hand smoke. This is particularly troubling when it concerns children, since the auditory system is usually not fully developed until late adolescence.

Recently, a study was on the effect of second hand smoke on the hearing of children. Passive smoking was correlated with development of sensorineural MHL.8 The study group consisted of 411 children, their aged ranged between 5 to 11 years. The inclusion criteria were. iii. Normal speech and language, ii. Absence of any disease or condition that may cause sensorineural hearing loss, Normal middle ear function on the day of hearing assessment.

They were divided into three groups according to the exposure to second-hand smoke at home; Group of “no exposure” whereas no smoker in the family (131 children), group of “mild exposure” whereas the father was the only smoking parent and smoking was prohibited at home...
(155 children), and group of "heavy exposure" whereas the mother was smoking, or the father was freely smoking at home and in the presence of his children (125 children). Audiological evaluation revealed that the prevalence of hearing loss was 3.8%, 4.5% and 12% in the "no exposure", "mild exposure", and "heavy exposure" groups respectively. Significant difference was only detected between the high exposure group and the other two groups. All children with hearing loss had minimal sensorineural hearing loss i.e., threshold of frequencies showing hearing loss were 20 or 25 dB HL. The risk ratio (95% confidence interval) for development of hearing loss in the heavy exposure group compared to those none exposed children was 3.14 (1.18, 8.3) (p<0.05). Smoking may induce sensorineural hearing loss through direct ototoxic effect of nicotine on the hair cells or reducing the cochlear perfusion by either induces vasospasm and arteriosclerosis in the cochlear blood vessels or raising the carboxyhaemoglobin levels, which reduces the oxygen perfusion for the organ of Corti. Study may represent an early stage of hearing loss which would later progress to more severe degrees of hearing loss with continuing exposure to second-hand smoke. This study emphasizes the importance of avoiding exposure of children to passive smoking which may be associated with development of hearing loss or its consequences such as learning disability.

CONCLUSION: Smoking has significant effects on the inner ear. Many studies have showed that, it affects the outer hair cells of the cochlea. This was evident by a significant decrease in DPOAE. Fortunately, none of the smokers had any positive vestibular signs clinically. This again confirms that, smoking (Nicotine predominantly) is cochleotoxic than vestibulotoxic. The effects of smoking on vestibular apparatus has to be evaluated by more studies before coming to any conclusive evidence, that smoking (Nicotine) has nil/less effect on vestibular apparatus.

In our study, we found that, smokers carried 6 times more risk than non-smokers, even though they smoked <20 cigarettes/day. Though the exposure was only 2 -3 years, nicotine affects the cochlear outer hair cells, even though the patients are clinically and audiologically normal.

Dr. Ralph Holme, head of biomedical research at Action on Hearing Loss in the UK - which helped fund the study - believes these latest findings indicate that smoking is also a risk factor for later-life hearing loss. He says:

"Hearing loss is often viewed as an inevitable consequence of aging, but as the research published today shows, this may not always be the case. Giving up smoking and protecting your ears from loud noise are two practical steps people can take today to prevent hearing loss later in life."

So spare yourself the hearing trouble, tone down on those cigarettes and maybe try yoga for relaxation instead.

Smoking may significantly increase your risk of hearing loss. If you are a smoker, you are encouraged to check out the About.com Quit Smoking site, which provides plenty of resources for helping you quit and stay smoke-free. If you have loved ones who smoke, you may wish to show them this article as another reason to try to stop smoking.

REFERENCES:

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