

Effect of duration and type of tobacco consumed on the Nasal Mucociliary Clearance of adult male smokers – a cross sectional study

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Abstract

Introduction: Nasal Mucociliary (NMC), one of the important protective mechanisms of respiratory tract is affected due to workplace and environmental exposure to dust, thereby exacerbating respiratory diseases. Prolonged NMC is the outcome of the exposure of nasal mucosa to toxic products of tobacco. The present study was planned to evaluate the relationship between the duration and type of tobacco usage on the NMC in adult males.

Materials and Method: After obtaining ethical clearance, the cross sectional study was conducted on 60 male tobacco users (20 - 45 years), working in Housekeeping Department of Saveetha University Campus, Chennai. NMC was measured using Saccharin test. Mean NMC of tobacco users who were categorised based on duration and type of tobacco was compared using one way ANOVA.

Results: Mean NMC of tobacco users was found to be higher (495.64±372.25 secs) than non users (388.11±173.89 secs). Mean NMC of smoked tobacco users was higher (569.26±503.52secs) than smokeless tobacco users(442.34±215.39secs). Among smoked tobacco users, smokers of bidi (667.5±537.16secs) had higher mean NMC than cigarette smokers (247.8±145.8 secs). It was observed that smokers who consumed tobacco for > 5 years and > 1 pack per day had the highest mean NMC (566.54±446.97 secs).

Conclusion: NMC was prolonged in users of tobacco, particularly in users of smoked tobacco (bidi). Also NMC was directly proportional to the duration of tobacco consumption. The authors wish to highlight the need for relevant awareness and education on cessation of the tobacco usage among smokers.

Keywords: Nasal Mucociliary clearance (NMC), Saccharin test, Tobacco, Smoking

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Introduction

Nasal mucosa has many functions like olfaction, heat exchange, humidification, protection of lower airways, mucous secretion, maintenance of nasal neurovascular reflexes and nasal mucociliary clearance (NMC).⁽¹⁾ NMC acts as one of the primary protective mechanisms of the respiratory tract.⁽²⁾ The mucus layer on the nasal epithelium is mobilised to the nasopharynx by the synchronous movement of cilia at a frequency of 7 –16 Hz. ⁽²⁾ NMC remains normal due to the presence of adequate quantity of mucus with appropriate rhinological qualities and adequately functioning cilia. ⁽³⁾ NMC mechanism is impaired by structural abnormalities and pathological disorders of the nose and paranasal sinuses. ⁽¹⁾ NMC is altered in conditions such as asthma, rhinitis, nasal septal deviation (NSD), sinusitis and in smokers.⁽⁴⁾ Disturbances in NMC might result in the accumulation of mucous secretions and cause secondary infections.⁽¹⁾

Tobacco smoking is among the largest preventable causes of premature deaths globally.⁽⁵⁾ In 2010, about 1 million deaths or 10% of all deaths in India were attributed to smoking with 70% of the mortality in the 30–69 years age group.^(6,7) Tobacco consumption was significantly higher in poor and less educated populations and has always posed a serious risk of increase in

the burden of both communicable and non-communicable diseases.⁽⁸⁾

In vitro studies have reported that compounds like hydrogen cyanide, acrolein, formaldehyde and phenols in tobacco smoke are toxic to mammalian cilia.⁽⁸⁾ Exposure of the nasal mucosa to toxic products of tobacco smoke is likely to vary considerably between tobacco users, depending on the tobacco habits – amount and type of tobacco used. Existing literature revealed the evidence of prolonged NMC in smokers when compared to non smokers.^(2,8) However, not many studies are available with regard to the effect of duration of tobacco habit and the type of tobacco consumed on the NMC. Hence, the present study was planned to be conducted on adult tobacco users of 20 - 40 years of age, with the aim of evaluating their NMC and thereafter, correlating it with the duration of the habit of tobacco consumption and the type of tobacco taken.

Materials and Method

Ethical clearance was obtained from the Institutional Review Board (IRB) and Institutional Ethics Committee (IEC) of Saveetha University (009/07/2016/IEC/SU). The study participants comprised of 60 adult males of 20-40 years of age, working in the House keeping Department of Saveetha University Campus, Chennai. The exclusion criteria comprised

of presence of any upper respiratory tract infections, COPD or systemic illnesses (diabetes mellitus and hypertension etc.) or intake of medications like antihistaminics and antidepressants 6 weeks prior to the study. Other exclusion criteria included ex-smokers, smokers of less than one year duration and presence of deviated nasal septum, nasal polyp and nasal allergy. Detailed history regarding their tobacco usage habits (self-reported) as to the duration of tobacco usage in years, form of tobacco used (e.g., smoked/smokeless tobacco) and the amount of tobacco consumed per day was elicited.

Saccharin test is considered to be the standard method of measuring NMC. The saccharin test was carried out on all subjects as described by Andersen et al., in 1974 and later modified by Rutland and Cole.^(9,10) The examiner placed the saccharin particle (0.5 mm size) approximately 1 cm behind the anterior end of inferior turbinate. The patient was comfortably seated with head fixed at 10 degrees to avoid the particle from shifting into the posterior nasal cavity. The patient was not aware about the nature of particle. The subject was instructed not to snuff, eat, drink or swallow and was requested not to cough or sneeze. The room environment was kept free of dust and not breezy. The time elapsing until the first experience of sweet taste at posterior nasopharynx was recorded as NMC time in seconds. In the present study, the test was performed by a single investigator to avoid observer bias. The study subjects were requested to avoid smoking from 10 pm (previous night) to 9 am (next day), following which the test was performed. Defaulters were excluded from the study. The test was done on all subjects between 9 and 11 am in the same venue to avoid bias in terms of time elapsed from the last smoke and environmental influences.

After data collection and entry, statistical analyses was performed using Statistical Package for Social Sci-

ence (SPSS) version 17.0. Chi Square test was used to compare the mean NMC of all adult male tobacco users. The study population was divided into groups based on the duration of tobacco habit and the type of tobacco used. The mean \pm SD of NMC of the groups was compared using Kruskal Wallis test.

Results

The total number of participants involved in the study were 60 adult males of the House keeping Department. (n=60) (Table 1) presents the pattern and duration of smoking among the study subjects. About 50% of the study participants were non smokers. Among the tobacco users, 21.7% used smokeless tobacco, another 21.7% used smoked form of tobacco while 3.3% used both forms of smoked and smokeless tobacco.

NMC was prolonged in tobacco users (495.64 ± 372.25 secs) when compared to the non users (388.11 ± 173.89 secs), although not statistically significant. The users of smoked tobacco (569.26 ± 503.52 secs) had a higher NMC when compared to the smokeless tobacco (442.34 ± 215.39 secs). Further, amongst the smoked tobacco users, the smokers of bidi (667.5 ± 537.16 secs) had a higher NMC when compared to the cigarette smokers (247.8 ± 145.8 secs).

Comparison of all groups of users and non users based on the type of tobacco consumed using chi square test showed higher NMC among users of smoked tobacco. However, the Chi square analysis did not reveal any statistical significance. (T- II) Further, comparison of all groups of users and non users based on the duration of tobacco usage showed an increase in NMC as the duration of the habit also increased. (T-III) Users who consumed tobacco for more than >5 years and >1 pack/day had the highest mean NMC. However, the differences were not statistically significant.

Table 1: Descriptive Statistics of pattern and duration of tobacco use among study participants (n=60)

Smoking status	<5 years n (%)	>5 years but <1 pack/day n (%)	>5 years and >1 pack/day n (%)	Total n (%)
Non Users of tobacco	-	-	-	32 (53.3)
Uses smokeless tobacco	2 (15.4)	6 (46.2)	5 (38.5)	13 (21.7)
Smokes tobacco	2 (15.4)	1 (7.7)	10 (76.9)	13 (21.7)
Smokes and uses smokeless tobacco	0	0	2 (100)	2 (3.3)
Total	4 (6.7)	7 (11.3)	17 (28.3)	60

Table 2: Comparison of NMC among male smokers with different forms of tobacco usage

Smoking status	NMC (secs)		Chi square, p value
	Mean	Standard Deviation	
Nonsmoker	388.11	173.89	2.065, 0.559
Uses smokeless tobacco	442.34	215.39	

Smokes tobacco	569.26	503.52	
Smokes and uses smokeless tobacco	363.60	0.85	

Table 3: Comparison of NMC among participants with varying duration of tobacco use

Duration of tobacco use	NMC (sec)		Chi square, p value
	Mean	Standard Deviation	
Non user	388.11	173.89	4.457,0.216
<5 years	292.95	149.55	
>5 years but <1 pack/day	439.29	185.20	
>5 years and >1 pack/day	566.54	446.97	

Discussion

Mucociliary clearance may be disturbed by factors including increased mucus production, abnormal mucus quality/quantity and abnormal ciliary activity, consequent to chronic smoking which in turn causes stagnation of the secretions in the sinuses.⁽⁸⁾ The mucus production mechanism in the nasal cavity is often associated with profound changes when exposed to smoke. Depending upon the concentration of smoke and impairment of cell regeneration in the respiratory epithelium, there is a reduction in the cellular viability, induced by apoptosis.⁽¹²⁾ Literature search revealed a strong relationship between NMC and the use of tobacco. The present study aimed at exploring the influence of duration and type of tobacco consumed on NMC.

In the present study, the mean values of NMC were found to be higher in tobacco users when compared to non-users. The mean NMC in healthy subjects reported by Yadav et al was concurrent with the present study results.⁽¹³⁾ Similar results were also reported by Stanley PJ et al, where the NMC was more delayed in smokers than non-smokers. The mucus layer present on the ciliated epithelium display two properties, viscosity and elasticity. The outer thick and viscoelastic layer, where the cilia do not strike directly, is found over layer of watery serous fluid (sol layer). The movement of cilia is facilitated by the lower layer which in turn alters the movement of the viscous layer on top.⁽¹¹⁾ When the movement of the mucus layer is slowed down, the mucus becomes more viscous and stagnates, resulting in bacterial proliferation. This plays a major role in pulmonary, sinonasal and laryngeal diseases that leads on to substantial morbidity and increased cost to patients as well as the society.⁽⁸⁾

The NMC in smokers of bidi was prolonged when compared to cigarette smokers in the present study. A contrary finding was found from a study conducted by Manu KB et al, where the mean NMC value of cigarette smokers was 481.2 ± 29.83 .⁽²⁾ The NMC in users of smoked tobacco was found to be higher when compared to users of smokeless tobacco. There were no studies to

substantiate the differences between the NMC in users of smoking and smokeless tobacco.

In the present study, when the NMC among the participants was compared, it was found that the mean NMC value was the highest in people who smoked tobacco whereas it was the least in people who used both smoking & smokeless tobacco. The spurious increase that has been reported in the non-users group could be attributed to the extremely small number of only 30 smokers, who were further subdivided into groups based on the type of tobacco used.

The effect of duration of tobacco usage on NMC of all groups of users and non-users was compared and it revealed that those who consumed tobacco for > 5 years and > 1 pack per day had the highest mean NMC. Similar findings were reported by Manu KB et al & Ranga et al, who also reported a prolonged NMC as the duration and number of cigarettes smoked increased.^(2,14) However, Prasit M et al did not observe any significant difference between the groups of varying durations.⁽¹⁵⁾

Conclusion

NMC of tobacco users was higher when compared to that of non-users. Further, the users of smoked tobacco had a higher NMC when compared to smokeless tobacco. Among the smoked tobacco users, the NMC of bidi users was higher when compared to cigarette users. Further, comparison of all groups based on duration of tobacco usage showed an increase in NMC as duration of habit also increased. Results of present study could be of help to the physician to advocate adequate preventive and apt therapeutic measures with regard to impaired respiratory immunity. The study has motivated authors to provide the smokers employed in the House Keeping Department with relevant awareness and education on cessation of smoking habit and ill effects of prolonged smoking on their respiratory health.

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