

## Nasal muco-ciliary clearance in snuff users

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### Abstract

The inhalation of nasal snuff (powdered tobacco) is widely prevalent in the Indian sub-continent. The effect of snuff application on the nasal mucociliary clearance (NMCC) time has been suspected but not demonstrated before. In this study the saccharin test is used to demonstrate the rate of nasal mucociliary clearance among chronic snuff users. The study demonstrates the depressant action of snuff on the nasal mucociliary clearance rate. A pharmacological and pathological basis for the depressant action of snuff on the NMCC rate is hypothesised on the basis of the results obtained.

**Key words:** Tobacco, smokeless; Mucociliary clearance; Saccharin, test.

### Introduction

The nasal inhalation of 'snuff' or powdered tobacco is a common and prevalent form of addiction in all parts of the Indian sub-continent. In India 2.8 million kg of tobacco are used as snuff powder per year giving an average consumption of 1.1–1.2 kg per adult consumer per year in India (Sanghvi, 1989).

While the inhalation of snuff has received little attention, the smoking of tobacco has been known to be harmful for many years. The depressant effect of tobacco smoke on ciliary activity has been demonstrated by various authors (Kensler and Battista, 1963; Dalham, 1966). Ide *et al.* (1959) and Auerbach *et al.* (1962) found significant differences in the histopathology of tracheal and bronchial epithelium between smokers and non-smokers. These changes are believed to be responsible for the increased morbidity among smokers. However, no study has been done to determine the effect of the local application of tobacco on the ciliary activity of the nasal epithelium.

This study attempts to correlate the effect of local snuff application on the muco-ciliary activity of the nasal epithelium.

### Materials and methods

25 subjects who were active users of snuff were selected for this study (14 males (56 per cent) and 11 females (44 per cent)). The subjects ages were two (8 per cent) less than 19 years, nine (36 per cent) between 20–29 years, four (16 per cent) between 30–39 years, two (8 per cent) between 40–49 years and eight (32 per cent) more than 50 years. The subjects chosen used a minimum of 20 grammes of nasal snuff per day for a minimum period of two years. As a control group 25 subjects were selected who had never used nasal snuff. All 50 subjects selected were not smokers and had not suffered from any nasal or upper respiratory tract diseases in the recent past or during the

period of study. After a detailed history had been taken, the nasal cavities of the snuff users were douched with normal saline to remove all traces of snuff powder from the nose. The patients were then examined and tested with the nose being free of snuff powder. This was done not only to record the state of the nasal mucosa but also to avoid the mechanical obstruction to the course of mucus flow by the physical presence of large quantities of snuff powder.

The nasal mucociliary clearance (NMCC) was determined by the saccharin test (Stanley *et al.*, 1984). All 50 subjects were tested on two occasions with an interval of one week between the two tests. A 1 mm diameter particle of saccharin was placed on the surface of inferior turbinate 1 cm behind its anterior end. The subject was instructed not to sniff, sneeze, smoke, eat or drink during the test and was asked to swallow once every 30 seconds and to say when he/she perceived the sweet taste. If no taste was perceived after 60 minutes the test was stopped and the ability of the patient to taste saccharin placed directly on the tongue was verified. The tests were carried out under conditions of room temperature and humidity as it has been shown by Procter *et al.* (1979) that temperature and relative humidity within the normal atmospheric variations, have no significant effect on the NMCC.

Statistical analysis was performed by the use of Student's unpaired t-Test for testing equality of means. The average NMCC time of the two study groups, namely the control group and the snuff-users group, was calculated. The Student's test was used to statistically compare the NMCC timings of the two groups. A confidence limit of  $\pm 2$  S.D. or a probability (P) of 0.05 was used in the Student's test.

### Results

The NMCC timings of subjects in the control group is shown in Table I. The timings ranged from 8–19 mins. The mean timing was 11.12 min with a standard deviation of 1.3 min.

TABLE I  
NMCC TIMINGS IN NORMAL SUBJECTS (CONTROL GROUP)

Average timing	No. of subjects
9–10 minutes	8 (32%)
10–11 minutes	6 (24%)
11–12 minutes	9 (36%)
more than 12 minutes	2 (8%)

The timings among snuff users is shown in Table II. They ranged from 24–35 mins. The mean timing among these subjects was 29.06 mins with a standard deviation of 2.98 mins.

Using the Student's t-test to compare the mean timings of the two groups the value of the t-test was found to be 5.49. This is more than the stipulated value of 2.014 (when  $p = 0.05$ ), hence the longer timings among snuff users are statistically significant as compared to the control group.

This implies that compared with the control group the chronic use of nasal snuff has a significant influence on the NMCC.

### Discussion

Under normal conditions the nose is the first line of defence against pollutants in the ambient air. This role of the nose as a filter has today assumed greater importance due to the soiling of the atmosphere with injurious gases and exhaust fumes.

In recent years the nose has also become a convenient route for administration of drugs. This route has been misused by installation of agents such as cocaine and snuff by a large section of the population.

The addiction to nasal snuff is because of the components present in the powder which consists of powdered tobacco. The action of snuff on the nasal mucosa and mucociliary system is thought to be due to the two principle pharmacological agents present in tobacco namely nicotine and lobeline (Jaffe, 1990) and a group of compounds known as the N-nitrosamines (Bhide *et al.*, 1989).

The effects of nicotine and lobeline on the nose are as follows:-

1. An initial increase in quantity of secretions followed by a prolonged decrease.
2. Vasoconstriction of the cavernous sinusoids leading to a reduction in the swelling of erectile tissue of the nose.
3. Vaso-constriction of the arterioles and venules leading to a local ischaemia.

Tachyphylaxis, a phenomenon whereby ever increasing quantities of a drug are required to elicit a given response, also occurs. By systemic absorption of the constituents there is marked stimulation of the CNS leading to addiction.

The second group of agents present in nasal snuff are the N-nitrosamines (Bhide *et al.*, 1989). The nitrosamines present in snuff are:

1. N-nitroso-nicotine (NNN) (136.98 mg/g of snuff).
2. N-nitroso-ana-tabine (NAT) (113.06 microgramme/g of snuff).
3. 4-(N-methyl-N-nitrosamino) 1-(3-pyridyl) 1-butanone (NNK) (110-680 mg/g of snuff).
4. N-Nitroso-pyrrolidine (NPYR).
5. N-Nitrosodimethylamine (NDMA).

Bhide *et al.* (1989) have shown that the purified extracts

TABLE II  
NMCC TIMINGS IN SNUFF USERS

Average timing	No. of subjects
24–26 minutes	4 (16%)
26–29 minutes	9 (36%)
29–32 minutes	8 (32%)
32–35 minutes	4 (16%)

of the above compounds possess carcinogenic effects in mice. There is a decrease in the number of ciliated cells in the nasal mucosa, together with damage to the remaining cilia. there is also a metaplasia of columnar cells to cuboidal and then to squamous epithelial cells.

A close review of the effects of the above agents namely nicotine, lobeline and N-nitrosamines give us a better understanding of the changes occurring in the nasal mucosa of a person chronically using nasal snuff. Not only does the person get addicted to snuff and use more and more to get the desired effect, but because of the delayed NMCC the potential carcinogens remain in contact with the nasal mucosa for prolonged periods of time and in greater concentration. The significant influence exerted by the chronic use of snuff on the NMCC amply supports the above statement. This chronic exposure of the epithelium to potential carcinogens leads to metaplastic changes in the cells of the nasal epithelium and to malignancy.

The suitability of the Saccharin test for measuring NMCC has been validated against other models. In the present study the NMCC found in the control group is similar to those reported by others. The Students' t-test value of 5.49 further validates the saccharin test as a simple and reliable *in vivo* method for NMCC studies in humans.

### Conclusion

Although no published work on the effect of nasal snuff usage on the NMCC could be found in a review of the literature, it is likely that the effect of nicotine, lobeline and nitrosamines on the nasal secretions and epithelium, will lead to a decrease in the NMCC rate. This has been demonstrated in the present study using the saccharin test.

The present material can only study the effect of chronic nasal snuff usage on the NMCC as the observations never took place immediately following snuff application. It is hoped that a better understanding of the destructive changes caused by nasal snuff on the epithelial lining will lead to conclusive evidence of snuff causing nasal epithelial malignancy.

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