PREVALENCE OF TASTE BLINDNESS TO PHENYLTHIOCARBAMIDE AMONG SMOKERS

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Abstract: Background & Objectives: Smoking is a major health hazard, yet it is potentially preventable. So it is crucial to find ways of screening individuals who are most susceptible to smoking and prioritizing them for preventive measures. Taste blindness to phenylthiocarbamide (PTC), a bitter chemical, could be a risk factor for developing addiction towards smoking. So the present study aimed to assess the prevalence of PTC taste blindness among smokers. **Materials and methods**: Males in the age group of 20-40 years were selected for the present cross sectional study through house visits. Study participants were asked to describe the taste of commercially available PTC papers. Individuals perceiving it as bitter were considered as "tasters" and the rest as "non-tasters". Fagerstrom nicotine dependence scale was used to assess the nicotine dependence among the smokers. Chi square test was used for statistical analysis of the results and p<0.05 was considered as statistically significant. **Result:** Of the 278 subjects selected, 172 were smokers and 106 were non smokers. There was a significant difference in the prevalence of PTC taste blindness between smokers (44.76%) and non smokers (24.52%). PTC taste blind status was higher among the bidi smokers (58%) than the cigarette smokers (39.34%) which were statistically significant. Bidi smokers (84%) were found to be highly nicotine dependent compared to cigarette smokers (61.4%). Heavy smokers were found to be highly nicotine dependent and taste blind to PTC compared to the Light and Moderate smokers. **Conclusion**: Smokers are significantly taste blind to PTC as compared to non smokers. Individuals with taste blindness may be more susceptible to heavy cigarette consumption and therefore have an increased risk of addiction.

Key Words: Addiction, Nicotine, Smoking, Taste blindness

Abbreviations: PTC, Phenylthiocarbamide

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Introduction:

Tobacco usage is growing at a fastest pace in the low-income countries due to the steady population growth coupled with the tobacco industry, targeting and ensuring that millions of people become fatally addicted each year [1]. India has the second largest group of smokers in the world [2] and the common forms of smoked tobacco used are bidis followed by cigarettes [3]. Despite the valuable measures taken by the government and the society to curb it, smoking prevalence rates continues to spurt up among the present generation.

Scientists are trying to sort out the enigma of why people continue to engage themselves in smoking behaviour which has such dire consequences. Though, behavioural, psychological, environmental and social factors pave a way towards smoking, the principal incentive for development of this addiction is nicotine. The dependency on nicotine can be assessed by, Fagerstrom Test Nicotine Dependence scale (FTND), a reliable tool in different settings and populations [4] that conceptualizes dependency through physiological and behavioural symptoms. Recent studies report that genes related to bitter sensitivity are the crux factors involved in nicotine dependence [5].

Taste, beyond its mere sensory function, is also inextricably associated to a large set of behaviours. The gustatory system is a key contestant in homeostatic systems related with nutrient and fluid intake. Nicotine activates multiple sensory systems [6], including gustatory pathways [7], and is described as bitter tasting substance [8]. Though nicotine has a bitter taste, smokers consistently rate the taste of cigarettes as an important motive for smoking [6], signifying that smokers have reduced sensitivity for bitter taste [9]. This corroborates that a high percentage of smokers are genetically programmed to be unable to taste bitter flavours and so are more receptive to the flavours in cigarettes. Phenylthiocarbamide (PTC), a highly informative, serendipitously discovered genetic marker, is widely being used for gaining insight related to genetic variations regarding taste preferences and habits. It has astounding property that some individuals report it to be exceedingly bitter while others describe it to be tasteless, depending on the presence or absence of the PTC gene. The taste insensitivity to PTC is inherited as Mendelian recessive trait [10] and taste blindness is a term used to define individuals who are unable to perceive the bitterness of PTC. Literature regarding prevalence of PTC taste blindness among Indian smokers is very sparse and has shown contradictory results.

Hence, the present study aimed to measure the prevalence of PTC taste blindness among smokers and its association with nicotine dependence and thus aid in exploring the novel connections between them which has great health implications.

Materials and Methods:

This was a cross-sectional study conducted in the department of Physiology, Sri Manakula Vinayagar Medical College and Hospital, Puducherry from 2012-2013 After obtaining approval from the Human Research Ethics Committee, considering the prevalence rate of smoking as 30.6% [11], design effect-1, 95% CI and 10% of non-response, the sample size was decided as 327 (calculated by Open Epi Software Version 3.5.4)

378 male individuals were recruited from the population in and around the local area through house visits, satisfying the inclusion criteria of belonging to age group 20-40 years and consuming tobacco in form of cigarettes or bidis. Only those individuals who have the habit of smoking for more than one year were selected. Studies report that bitter taste perception gets significantly influenced by serum levels of sex hormones during the menstrual cycle [12], so female smokers were not explored for the present study. Written informed consent was obtained from all subjects. 78 participants were excluded from the study since they reported to have some form of illness like diabetes, history of nasal obstruction, history of upper respiratory tract infection, if they were ex-smokers or if they were on any kind of medication.

A detailed review of medical history through structured questionnaire and physical examination were performed on the selected individuals. Based on the number of cigarettes smoked per day, they were classified as light smokers (≤ 10 cigarettes per day), moderate smokers (>10 to ≤20 cigarettes per day) and heavy smokers (>20 cigarettes per day) [13]. Nicotine dependence was assessed using the Fagerstrom Test Nicotine Dependence scale, a six item self report questionnaire, which evaluated the dependence as low (0-5) and high (6-10).

300 subjects were asked to taste the commercially available PTC taste strips. Participants were asked if they had smoked, eaten or drunk anything an hour prior to the test; if they had, the test was postponed until an hour had passed. Participants were instructed to rinse their mouth with water, moisten their tongue with saliva and to put the PTC taste strip on their tongue. If they answered that it tasted bad or bitter, they were classified as tasters and if they responded that they did not taste anything, they were classified as non tasters (taste blind). Facial expressions were observed during the tasting process to support their verbal report.

Statistical analysis:-Data entry and statistics were performed using the Microsoft Excel and Epi info version 3.5.4 and $p<0.05$ was considered statistically significant. Chi square test was used to assess the association between various parameters.

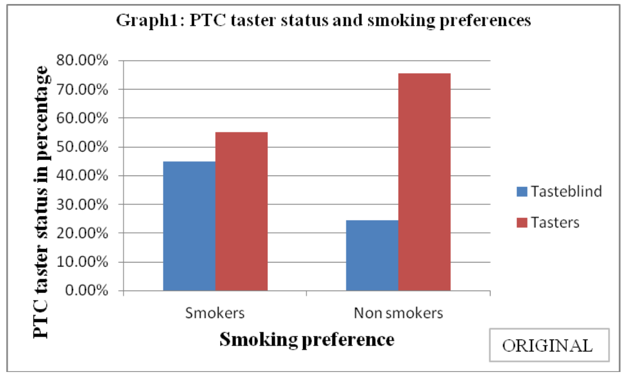
Results:

Out of 300 subjects selected for the study, 22 participants gave a vague response or responded that they did not know how the PTC test strip tasted like. Such subjects were excluded from the study. Of the remaining 278 subjects, 172 (62%) were smokers and 106 (38%) were non smokers. Smokers' nicotine dependency was classified as low and high based on their FTND scoring. If their scores ranged from 0-5, they were classified as low nicotine dependent individuals and scoring of 6-10 were classified as high nicotine dependent individuals. The mean age of the study participants was 31.22±6.7 years.

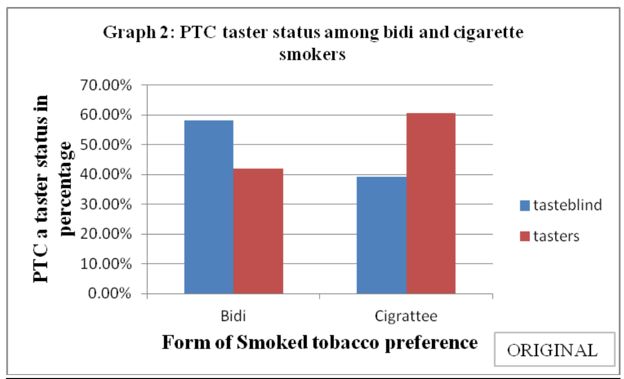
Out of 172 (62%) smokers, 95 (55.23 %) were tasters and 77 (44.76%) were taste blind, depicted

in graph 1. Among the 106 (38%) non smokers, 80 (75.47%) were tasters and 26 (24.52 %) were taste blind. The prevalence of PTC taste blindness among smokers was 44.76% and the difference in the PTC taster status among smokers and non smokers was found to be statistically significant. (χ^2=8.7912, p=0.003)
Of the 172 smokers, 50 (29.06%) smoked bidis and 122 (70.93%) smoked cigarettes. Among the 50 bidi smokers, 29 (58%) were taste blind to PTC and 21 (42%) were tasters and out of 122 cigarette smokers 48 (39.34%) were taste blind to PTC and 74 (60.60%) were tasters. The difference in the PTC taster status among bidi and cigarette smokers was found to be significant. (χ^2=7.2265, p= 0.007) (Graph2)
Of the 50 bidi smokers, 84% (45) had high nicotine dependence and 16% (5) had low nicotine dependent individuals. Among the 122 cigarette smokers, 61.4% (72) were high dependent and 38.52% (50) were reported as low nicotine dependent individuals. The difference in nicotine dependency status among bidi and cigarette smokers was found to be significant. (χ^2=13.27, p= 0.0002) (Graph 3)
Out of 172 smokers, based on the number of cigarettes smoked per day, 90 (52.32 %) were as light smokers, 66 (38.37 %) were moderate smokers and 16 (9.30 %) were heavy smokers. Among the 90 light smokers, 35 (39%) showed low dependency to nicotine and 55(61%) showed high dependency and among the 66 moderate smokers, 17 (25.75%) showed low dependency to nicotine and 49 (74.24%) showed high dependency. Among the reported 16 heavy smokers 3 (18.75%) showed low dependency and 13 (81%) showed high dependency. The nicotine dependency among the different types of smokers was found to be statistically significant. (χ^2=9.5531, p= 0.008)
Among the 117 nicotine high dependent individuals, 61(52.13%) were taste blind and 56 (47.86%) were tasters. Out of 55 nicotine low dependent individuals, 16 (29.09%) were taste blind and 39 (70.90%) were tasters. The nicotine dependency and PTC taste blind status was found to be statistically significant. (χ^2=10.976, p= 0.0009) Thus prevalence of taste blindness was relatively high in smokers with high nicotine dependence. (graph 4)

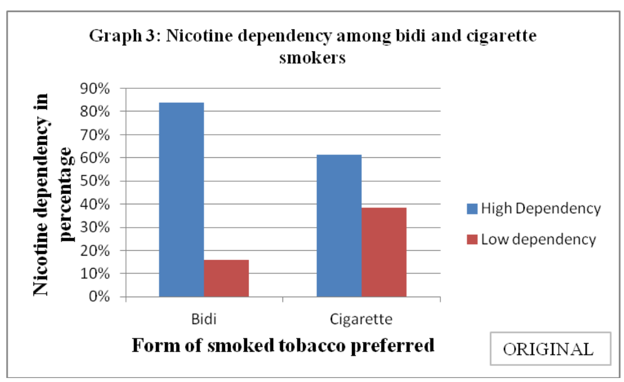
Graph 1 represents the percentage distribution of tasters and taste blind status among smokers and non smokers.



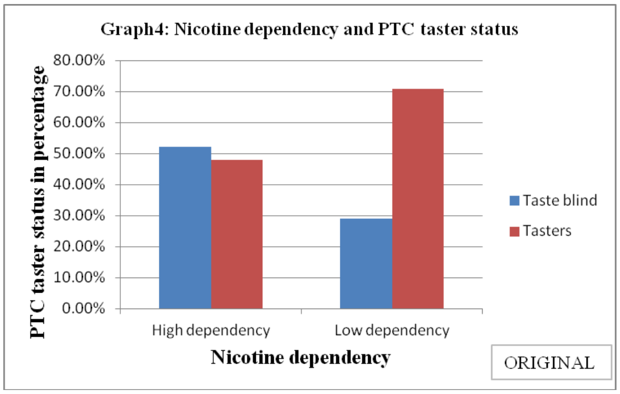
Graph 2 represents PTC taster status among bidi and cigarettes smokers.



Graph 3 represents nicotine dependency among the bidi and cigarette smokers.



Graph 4 represents the PTC taste blind status among individuals with high and low nicotine dependency.



Discussion:

In our study we reported that prevalence of PTC taste blindness among smokers and non smokers was 44.76% and 24.52% respectively. The difference in the PTC taster status among the two groups was found to be statistically significant. In our study, the prevalence of PTC tasting among the non smokers was found to be 75.47% which is in accordance with the previous findings that smokers show significantly higher thresholds for PTC than non-smokers [14]. It is also stated that non-tasters are known to be heavy smokers as they experience less irritation by smoke and lesser taste sensation to nicotine [15], a bitter tasting compound. Few studies have identified the genetic basis behind this mechanism [16, 17, 18].

In our study we found that greater percentages (70.93%) of smokers were habituated to cigarettes while only 29.06% smoked bidis, similar results were reported in a previous study, stating 69.95% were cigarette smokers and 38.04% population smoked bidis [19]. Also the current study reported that a statistically higher percentage of bidi smokers (58%) were taste blind to PTC and significantly high nicotine dependent (84%) compared to that of cigarette smokers who were 39.34% taste blind and 61.4% were reported to be high nicotine dependent.

Bidis, are the hand rolled leaf cigarettes, with significantly higher nicotine concentration than the commercially available cigarettes and capable of initiating and maintaining nicotine dependence [20]. The underlying reason for high PTC taste blindness among the bidi smokers compared to cigarette smoker remains unclear.

In the present study, the percentage of light smokers reporting to be highly nicotine dependent was 61% and among the heavy smokers it was 81%. Also it was found that among the highly nicotine dependent individuals, 52.13% were reported to be taste blind as compared to 29.09% in case of low nicotine dependent individuals. Studies report that nicotine dependence is greater among people, with higher thresholds for bitter taste (non-tasters) than those with lower thresholds [21]. Polymorphisms in bitter taste receptors that reduce the ability to taste bitter substances are positively correlated with nicotine dependence in African American women [22].

Nicotine sustains tobacco addiction, by acting on nicotinic cholinergic receptors in the brain to trigger the release of dopamine, glutamate, and GABA in particular that plays the leading hand in the development of nicotine dependence [23]. Also due to repeated exposure to nicotine, as in case of heavy smokers, phenomenon called neuroadaptation begins that is the number of binding sites on the nicotinic cholinergic receptors in the brain increases, probably in response to nicotine mediated desensitization of receptors [24]. Genetic studies indicate that nicotinic receptor subtypes and the genes involved in neuroplasticity and learning play a part in the development of nicotine dependence [23].

Conclusion:

The study reports that the inherited trait to bitter tasting compounds like PTC is known to have significant association with nicotine addiction. Though our study did not involve genetic analyses, it may be a preliminary step in understanding factors, including genetic, which underlie nicotine dependence and taste preference, but the exact mechanism still needs to be elucidated. Cataloguing the various other physiological and psychological factors that initiate and maintain nicotine dependence requires extensive effort to move forward.

Despite the limitations of small sample size, exclusion of female smokers and not considering other forms of tobacco usage like snuffing, chewing etc, our study could act as prelude for future research attempting at earlier identification of the potential high risk candidates prone for development of smoking habits.

In conclusion, PTC tasting can be used as a simple cost effective screening tool for predicting the vulnerable group and arbitrate them at the earliest stages before becoming victim to this deadly addiction, "smoking".

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