Assessment of Nicotine Dependence, Cotinine Level and Carbon Monoxide Levels among Tobacco Users Employed in Private Automobile Companies in Chennai

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Authors' contributions

This work was carried out in collaboration between both authors. Authors MDB designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author RPK managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

Article Information

Original Research Article

ABSTRACT

Background and Aim: Tobacco is a leading preventable cause of death which causes death of six millions each year worldwide. One of the most effective methods of preventing this are tobacco counseling sessions as it provides a platform for the patient and the dental professionals to map out a plan for the patient to lead a tobacco free life. Therefore, the study was conducted to assess nicotine dependence, cotinine level and carbon monoxide levels among tobacco users employed in private automobile companies in Chennai.
Study Design: Cross-sectional study.
Subject and Methods: A cross sectional study of 53 males was conducted among automobile company employees, using simple random sampling technique in Chennai, India. A detailed questionnaire assessing their demographic data, pattern of usage of tobacco, Fagerstrom test for

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Nicotine Dependence was recorded, carbon monoxide levels were recorded using Smokerlyzer, and presence of urine cotinine was recorded. Descriptive statistics and Chi square test were used to analyze the data.

Results: The mean age of the study participants was 31.7±11.32. Prevalence of smoking tobacco (64.20%) was higher among the study participants. Majority of the smoker study participants were highly dependent on tobacco, according to the FNTD scale. No statistical significance was found between dependency on nicotine and carbon monoxide levels among users of smoking tobacco ($p <0.05$). A statistical significant association ($p <0.05$) was found between dependency on nicotine and presence of urine cotinine among smokers.

Conclusion: High level of nicotine dependence was observed in the smoker participants, and cotinine in urine was found to be a prominent marker of nicotine among users of smoking tobacco. Carbon monoxide levels were high among people with higher dependency on smoking.

1. INTRODUCTION

Oral cancer is a major public health concern especially in India as it ranks among the top three cancer types in both incidence and mortality [1]. According to Globocan data 2018, 92,011 new cases of oral cancer were registered in India. Total number of deaths among both men and women amounted to 72,616. Around 80-90% of the oral cancer cases are directly attributed to tobacco. Global Adult Tobacco Survey 2 [2] was conducted in India by Tata Institute of Social Sciences and Ministry of Health and Family Welfare in the year 2016-1017 where tobacco use was monitored in all 30 states and 2 union territories, in the age group 15 years and above. According to GATS 2 survey, 28.6% of all adults use tobacco products both smokeless and smoking forms. Prevalence of tobacco use was found to be lowest in Goa (9.7%), highest in Tripura (64.5%), in Tamil Nadu it was 20.0%. With such high numbers relating to tobacco use and deaths due to cancer, new cases will likely mushroom to 27 million annually by 2030 with deaths hitting 17 million. Such data makes oral cancer an important public health concern and is therefore possible to conclude that the incidence and mortality rates of oral cancer can be reduced by means of health promotion policies, its early detection and the development of a healthy lifestyle [3]. With the scenario given associated with smoking, it is evident that immediate tobacco intervention programs and regulations must be implemented [4]. The tobacco interventions can be categorized under pharmacotherapy and non-pharmacotherapy measures [5] . Pharmacotherapy are known to reduce smoking withdrawals with minimum adverse side effects, and the forms of NRT (Nicotine Replacement Therapy) are available as gum, patches, inhaler, drugs like bupropion, nortriptyline, clonidine, varenicline, mecamylamine and newer drugs like NicVax which works by stimulating the immune system to make antibodies bind to nicotine molecules making them too big to cross the blood brain barrier, preventing them from triggering the nicotinic receptors [6,7]. Coming to non-pharmacotherapy, health education, anti-tobacco counseling and most importantly CBT (Cognitive Behavior Therapy) has been known to be successful interventions [8]. The main components of these interventions include education about and preparation for withdrawal symptoms, identification of smoking triggers, problem-solving and coping skills, and stress management and relaxation strategies [9]. Brief motivational interventions and motivational interviewing strategies focus on exploring smokers' feelings, beliefs, ideas, and values regarding tobacco use in an effort to uncover any uncertainty towards it [10]. Innovative measures, like usage of a mobile phone application based initiative have been adopted in India with the help of the World Health Organization and this mTobacco cessation program helps people by assisting them to quit tobacco through daily and weekly messages sent to their mobile phones [11]. In India, most of the tobacco cessation has been handled by pharmacotherapy measures, very little research has been conducted to assess the effectiveness of behavioral therapy aiding tobacco cessation. Previously, we have successfully completed numerous epidemiological/in-vitro/experimental studies [12-18] for the betterment of our community; therefore this current study aims to assess nicotine dependence, cotinine level and carbon monoxide levels among tobacco users employed in private automobile companies in Chennai.

2. MATERIALS AND METHODS

2.1 Sample Size

The sample size was calculated to be 52 using Gpower 3.1.9.2 at 80% of power and 5% significance level, based on another study conducted by P Sharma et al. [19]. Since we got responses from 53 participants, data was collected accordingly, considering the feasibility of the study.

2.2 Sampling Methods

Simple Random sampling technique was used to select the automobile companies.

2.3 Study Design

Cross-sectional study.

2.4 Inclusion Criteria

Participants who were above 18 years of age were included in the study with a habit of smoking for more than 1 year, and willing to take part in the study.

2.5 Exclusion Criteria

Participants who have started smoking and those who are not willing to take part in the study.

2.6 Study Methods

The study was conducted among employees of automobile companies in Chennai. The automobile companies were selected by simple random sampling. Oral screening camps were conducted in the selected automobile companies and the study participants were identified by the inclusion criteria. A detailed questionnaire regarding demographic, details on their tobacco usage pattern, quitting pattern if any along with reasons were recorded. Nicotine dependence was assessed using Fagerstrom Nicotine Dependence Scale. The Fagerstrom Nicotine Dependence Scale consists of 6 items scored; the overall score was the summation of all the questions. Minimum score was 0, maximum was 10. Based on that, the dependency level was categorized. Carbon monoxide levels in exhaled breath were measured using the portable Smokerlyzer CO monitor where the study participants were asked to inhale, hold their breath into the smokerlyzer, which immediately gave a reading of their CO levels. Cotinine levels in urine were checked using the Rapid cotinine test kit.

2.7 Mechanism of Cotinine Test Kit

The COT Rapid Test Cassette is a rapid chromatographic immunoassay for the detection of Cotinine in human urine at a cut off concentration of 200 ng/ml. The test contains mouse monoclonal anti Cotinine antibody coupled particles and Cotinine protein conjugate. A goat antibody is employed in the control line system. It is based on the principle of competitive binding. Drugs which may be present in the urine specimen compete against the drug conjugate for binding sites on the antibody. Cotinine if present in the urine specimen below 200 ng/ml will not saturate the binding sites of the antibody coated particles in the test. The antibody coated particles will then be captured by immobilized cotinine conjugate and a visible colored line will show up in the test line region. The Interpretation of the test is considered negative, if two lines appear. One colored line in the control line region and another apparent colored line in the test region, Positive when one colored line appears in the control line region. No line appears in the test line region and is considered. Invalid if the control line fails to appear. The only condition in which cotinine could come positive in the test is if the body has processed nicotine. This assay provides only a preliminary analytical test result. More specific alternate chemical methods like Gas chromatography and mass spectrometry must be used to obtain a confirmed analytical result.

2.8 Mechanism of Smokerlyzer

It is an instant and non-invasive tool to biochemically establish the smoking status in an individual, while acting as a motivational visual aid for the smokers. It provides instant results in exact ppm for %COHb and %FCOHb.

2.9 Statistical Analysis

Statistical analysis was done using SPSS Version 23.0. Descriptive statistics were used to report the demographic data. Chi square test was used to analyze the association between the education and tobacco variables.

3. RESULTS

The study was conducted to assess the tobacco dependence after behavioral intervention among automobile factory employees in Chennai. The

study consisted of 53 male automobile company employees. The demographic data of the study participants included age, marital status, and education level v/s profession (Table 1). The mean age of the study participants was 31.7±11.32. The distribution of study participants based on the form of tobacco used is given in Fig. 1. A detailed questionnaire regarding their reason for use of tobacco (Fig. 2), source of purchase of tobacco (Fig. 3), order of purchase of tobacco (Fig. 4) was recorded. The participants were categorized based on their tobacco dependence level, according to the Fagerstrom Nicotine Dependence Scale (Fig. 5). Among the study population, 34% had attempted to quit tobacco and 66% had never attempted to quit tobacco (Fig. 6). About 75% of the smokers cited "awareness about health problems during educational programs/media, and 66.7% of the smokeless tobacco users cited "existing health problems" (Fig. 7). Reason for relapsing back into the habit among smokers and smokeless tobacco users is depicted in Fig. 8. There was no statistical significance between dependence on nicotine and carbon monoxide levels among the users of smoking tobacco (Table 2), however a statistically significant association (p<0.05) was found between dependence on nicotine and presence of cotinine among users of smoking tobacco (Table 3). No statistical significance was observed between the form of tobacco used and dependence on nicotine (Table 4). Though, attempting to quit tobacco was seen more among smokers than smokeless tobacco users, no statistical significance was seen (Table 5).

Table 1. Demographic data of the study participants. majority of the participants (64.2%) were in the age group of 18-34 years, unmarried (60.4%), skilled workers (56.6%)

Variables		N	%
Age	18-34 years	34	64.2
	35-44 years	10	18.9
	45-64 years	08	15.1
	65-74 years	01	1.9
Marital status	Married	21	39.6
	Unmarried	32	60.4
Educational status	Primary school certificate	6	11.3
	Middle school certificate	16	30.2
	High school certificate	17	32.1
	Intermediate or diploma	10	18.9
	Graduate	4	7.5
Occupation Status	Unskilled worker	2	3.8
	Semi-skilled worker	15	28.3
	Skilled worker	30	56.6
	Semi professional	4	7.5
	Professional	2	3.8

Table 2 Association between dependence on nicotine and carbon monoxide level among smokers. Chi square test was done and a higher level of CO was observed among participants highly dependent on nicotine, however no significant association was present

Variables	CO 0-6 ppm N (%)	CO 7-10 ppm N (%)	CO >10 ppm N (%)	Chi square value	p value
Minimally dependent	3(8.8)	2(5.8)	1(2.9)	4.504	0.809
Moderately dependent	6(17.6)	4(11.7)	1(2.9)		
Highly dependent	11(32.3)	3(8.8)	3(8.8)		

Table 3. Association between dependence on nicotine and presence of cotinine among smokers. Chi square test was done and cotinine in urine was present majorly among participants with moderate and high dependence on nicotine, and a statistical significance was observed

| Variables	Urine cotinine present N (%)	Urine Cotinine absent N (%)	Chi square value	p value
Minimally dependent	3(8.8)	3(8.8)	16.485	0.001*
Moderately dependent	11(32.3)	0(0)		
Highly dependent	17(50.0)	0(0)		
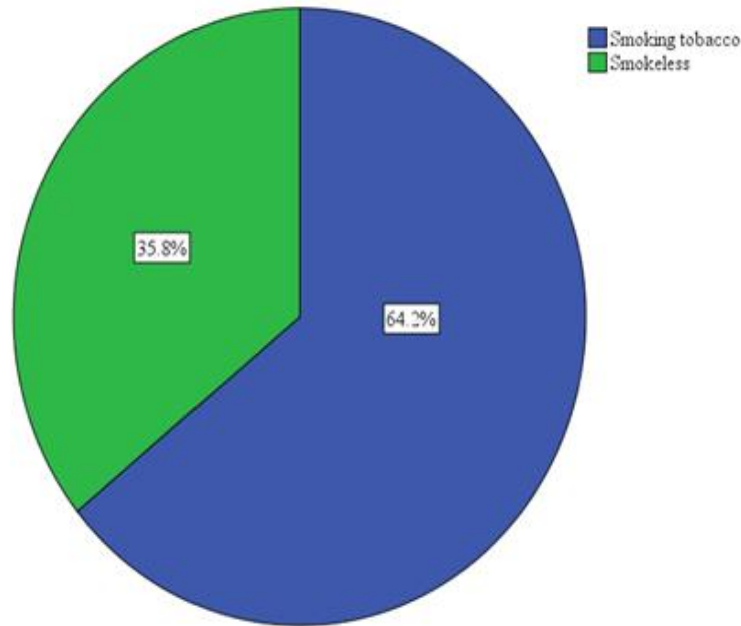
Fig. 1. Distribution of study population based on form of tobacco usage. Among the study population, 64.2% of the study participants were users of smoking tobacco (denoted by blue); 35.8% were users of smokeless tobacco (denoted by green)
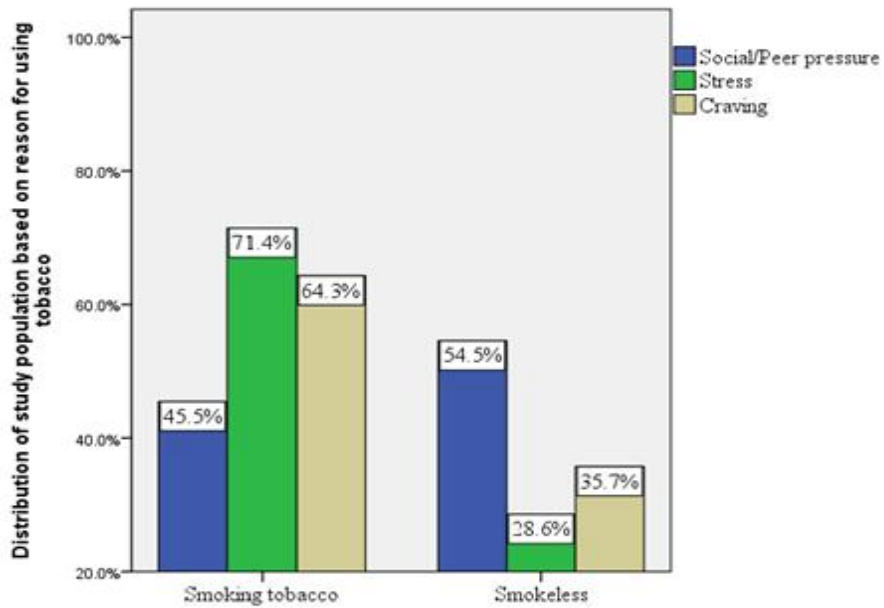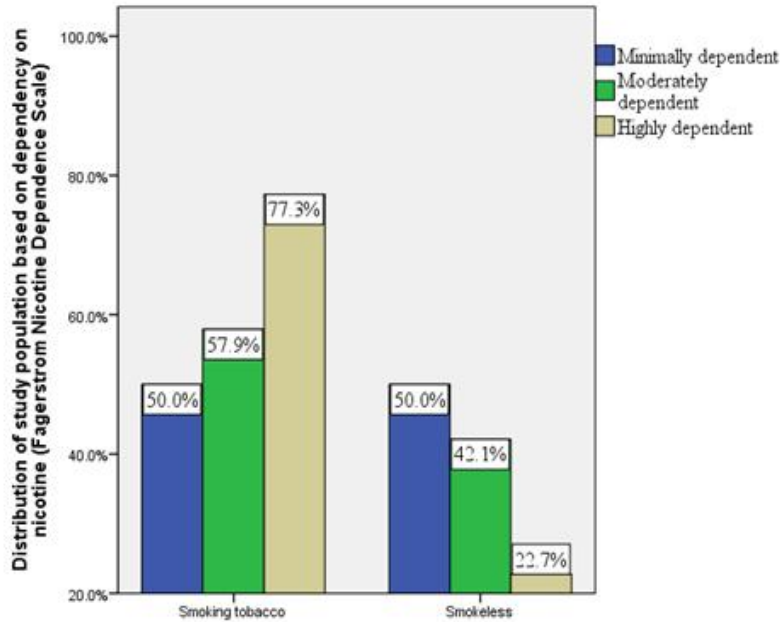

Fig. 2. Distribution of study participants based on their reason for use of tobacco products. X axis represents the study population based on the type of tobacco used; Y axis represents the distribution of the study population based on reason for using tobacco. Among the users of smoking tobacco, 71.4% cited stress as the reason (denoted by green), among the smokeless tobacco users, 54.5 cited social/peer pressure (denoted by blue) to be the reason for using tobacco
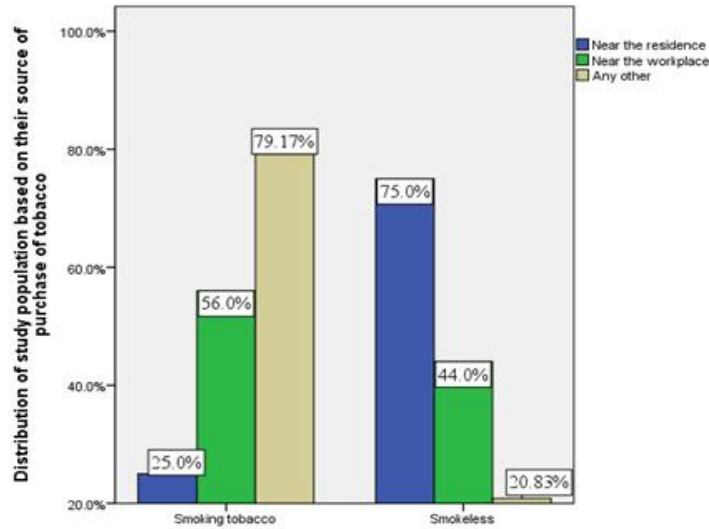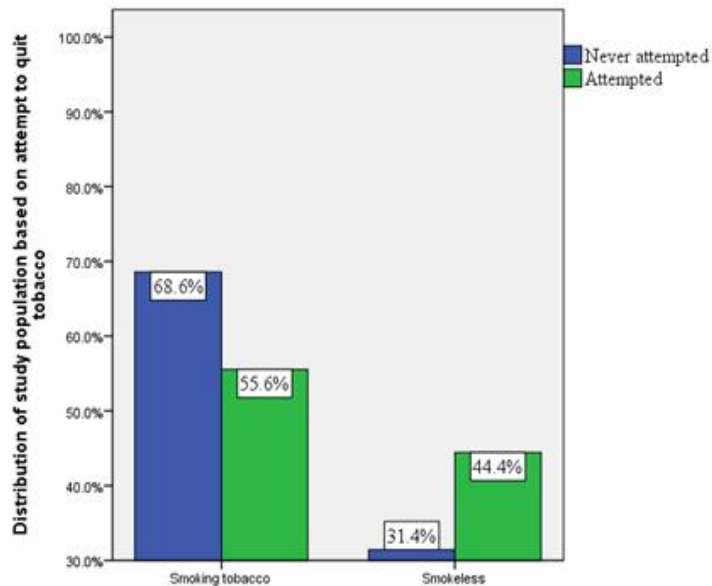
Fig. 3. Distribution of study participants based on source of purchase of tobacco products. . X axis represents the study population based on the type of tobacco used; Y axis represents the distribution of the study population based on source of purchase of tobacco. About 79.1% of the smokers purchased tobacco from any other place than residence and work (denoted by beige); whereas 75% of the smokeless tobacco users purchased tobacco near the residence (denoted by blue)
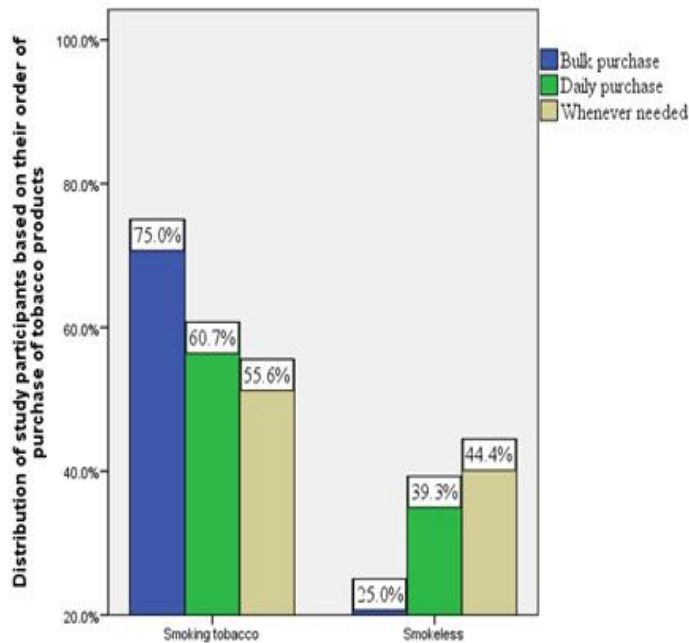
Fig. 4. Distribution of study participants based on order of purchase of tobacco products. . X axis represents the study population based on the type of tobacco used; Y axis represents the distribution of the study population based on order of purchase of tobacco. About 75% of the smokers purchased tobacco in bulk (denoted by blue), whereas 44.4% of the smokeless tobacco users purchased tobacco whenever needed

Fig. 5. Distribution of study population based on dependency on nicotine. X axis represents the study population based on the type of tobacco used; Y axis represents the distribution of the participants based on dependency on nicotine according to Fagerstrom Nicotine Dependence Scale. About 77.3% of the smokers were highly dependent on nicotine (denoted by beige colour), 42.1% of the smokeless tobacco users were moderately dependent on nicotine (denoted by green colour)

Fig. 6. Distribution of study population based on attempt to quit tobacco. X axis represents the study population based on the type of tobacco used; Y axis represents the distribution of the study population based on attempts to quit tobacco. About 65.6% of the smokers had never attempted to quit tobacco (denoted by blue), whereas 44.4% of the smokeless tobacco users had attempted to quit tobacco (denoted by green)
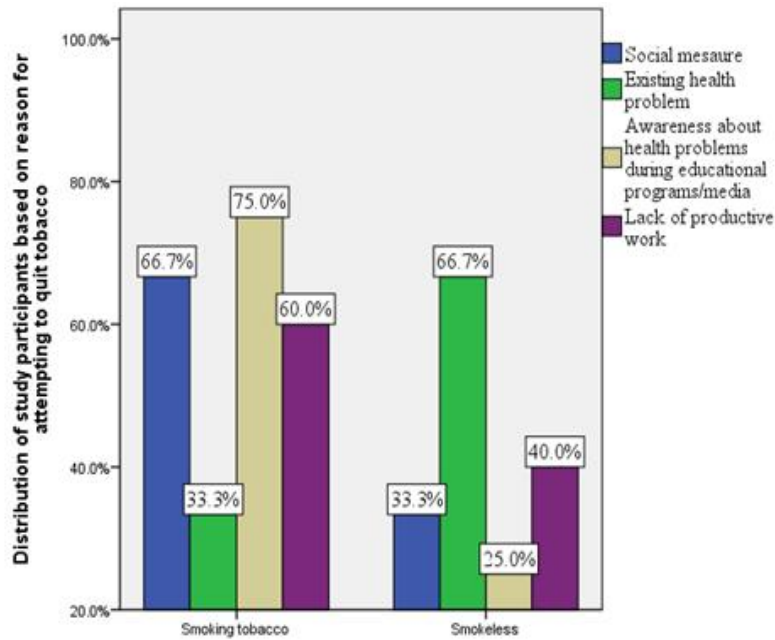
Fig. 7. Distribution of study participants based on their reasons for attempting to quit tobacco. X axis represents the study population based on the type of tobacco used; Y axis represents the distribution of the study population based on reasons for attempting to quit tobacco. About 75% of the smokers cited "awareness about health problems during educational programs/media" (denoted by beige colour); whereas 66.7% of the smokeless tobacco users cited "existing health problems" (denoted by green)
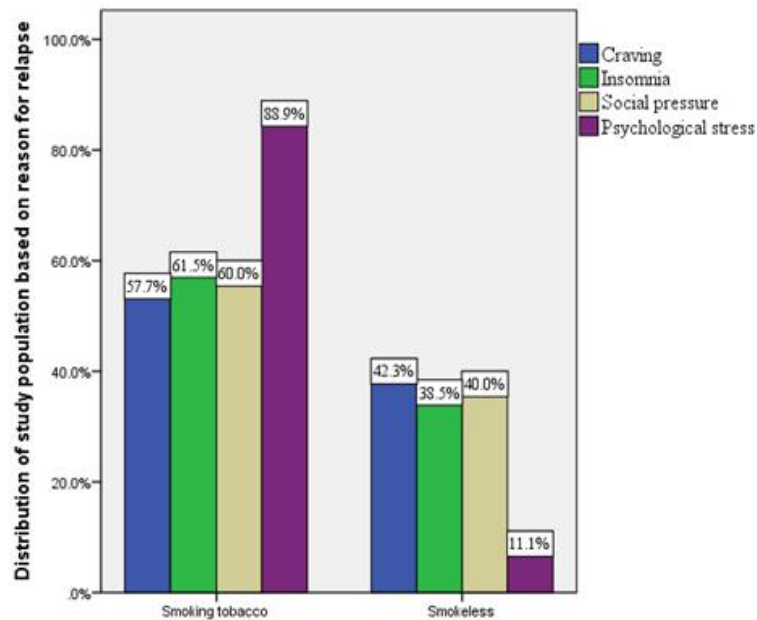

Fig. 8. Distribution of participants based on reason of relapse. X axis represents the study population based on the type of tobacco used; Y axis represents the distribution of the study population based on reasons for relapse. Among the smokers, 88.9% stated psychological stress (denoted by purple), whereas among the smokeless tobacco users 42.3% cited craving (denoted by blue)

Table 4. Association between form of tobacco used and dependence on nicotine among the study population. Chi square test was done. Among the study population, participants who were smokers were highly dependent on nicotine as compared to smokeless tobacco users, however no statistical significance was observed

Variables	Minimally dependent N (%)	Moderately dependent N (%)	Highly dependent N (%)	Chi square value	p value
Smoking tobacco	6(11.4)	11(20.7)	17(32.0)	3.015	0.221
Smokeless tobacco	6(11.4)	8(15.0)	5(9.5)		

Table 5. Association between form of tobacco and quitting attempt. Among the study population, more participants who were smokers had attempted to quit smoking, however no statistical significance was observed

Variables	Never attempted quitting tobacco N (%)	Attempted quitting tobacco N (%)	Chi square value	p value
Smoking tobacco	24(45.2)	10(18.8)		
Smokeless tobacco	11(20.7)	8(15.0)	0.349	0.380

4. DISCUSSION

Tobacco is an important risk factor for non-communicable diseases, the total burden of which is expected to rise by 75% by the year 2030 [20]. Mostly, epidemiological studies related to tobacco are conducted among rural populations; less evidence exists regarding the tobacco usage pattern, tobacco dependence level among urban dwellers. In the current study, it was observed that the form of smoking tobacco was used more among the study population which correlates to the findings of other studies [21]. Based on the findings of the study, unmarried males had a higher prevalence of smoking, similar to findings of another study [22] however opposing results were found in a study by Kim S et al. [23], where poor economic conditions seemed to have a significant effect on association between marital status and smoking. Another marker of social stratification is education level and profession level, as they are related to healthy practices and behavior. Similar to a study by Hosey et al. [24], Sharma D et al. [25], Gavarsana et al. [26], it was observed that higher education had lesser odds of tobacco use, as they are more likely to understand the ill effects of smoking. Prevalence of smoking tobacco was more than smokeless tobacco in the current study, which could be attributed to geographic variations in the usage of form of tobacco [27]. The reason for using tobacco products among smokeless tobacco users 54.5% revealed that social/peer pressure was the primary reason, similar to a study by Sana Ashraf Danawala et al. [28] whereas 71.4% smokers cited stress to be a primary reason, similar

findings were found in other studies [29] however some studies reported peer pressure to be more prevalent as reason among smokers [30,31]. The current study showed that 56% smokers and 44% smokeless tobacco users purchase tobacco products from their workplace, which emphasizes that stricter laws should be implemented to disallow sale of tobacco near the workplace, to enable a tobacco free environment [32]. Dependency on nicotine according to the FNTD scale revealed 77.3% of the smokers were highly dependent on nicotine, compared to 22.7% smokeless tobacco users, revealing dependence on nicotine was higher among smokers, the results are similar to various other studies conducted [33-35]. The attempt to quit rate was low among the smoker participants compared to the smokeless tobacco participants due to relapse in the habit because of psychological stress being the main reason, which coincides with the findings of another study [36-38], which could be seen as a lack of personal and professional help. However, craving for tobacco was cited as the main reason for relapsing back into the habit among smokeless tobacco users which was similar to a study by Kataria et al. [39]. The lack of tobacco cessation centres around the city is an indication of the low success rate of tobacco quitting [40,41]. In the present study, CO levels were not significantly associated with nicotine dependence, even though CO levels were higher among participants with high dependency. However, studies have revealed significant association between CO levels and nicotine dependence [42,43]. A statistically significant association was found between dependence on nicotine and presence of urine

cotinine among smokers, similar to other studies [44,45], however opposing findings were observed in a study conducted by Asha et al. [46], thus showing urine cotinine to be a significant marker of nicotine in body. Illness caused due to tobacco leads to an increased out of pocket expenditure, tobacco related mortality and morbidity especially in the productive age groups of 24-59 years. Integration of tobacco cessation programs can be helpful in achieving the barriers in tobacco control and decrease the global burden of disease caused due to tobacco.

5. CONCLUSION

The dependence on nicotine among the employees of automobile companies was high based on the FNTD questionnaire, a statistically significant association was observed between high dependency on nicotine and presence of cotinine, making cotinine a significant marker of presence of nicotine.

6. RECOMMENDATIONS

Tobacco cessation counseling sessions should be encouraged and implemented in routine dental examination among users of tobacco.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Prior to the start of the study, ethical clearance (IHEC/SDC-1801/19/169) was obtained from the Scientific Review Board, Saveetha Dental College.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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QUESTIONNAIRE

Tobacco Cessation Center —Registration Form

Date:	TCC Regd. No:
OPD No:	Referred From:

Informed Consent

| have been informed about the various aspects of this in-depth interview and would cooperate with the therapist to the best of my knowledge. Any treatment initiated would be mutual and after understanding side effects and all other aspects. | am allowed to withdraw from treatment any time after consulting the therapist.

Signature of Therapist   Signature of Participant

Name	
	Male
Age Sex:	female
Address	
Phone number	
Education (no of years of formal education)	
Marital status	Unmarried
	Married
	Widowed
	Separated or Divorced
	Not applicable

Number of years of marriage	
Occupation	Professional or Semi-professional
	Skilled, semi-skilled or unskilled worker
	Retired
	Housewife
	Student
	Other
	Unemployed
No. of years in present service:	No. of working hours per day:
Income per month:	
No. of members in household:	No. of dependents:
Physical activity (no. of hours per week):	

Details of tobacco use

	TYPE (cigarette, beedi, hookah, gutka, khaini, paan, mawa, misri, gul, any other)	Quantity consumed per day (a)	No. of years since habit initiated (b)	Sachet/Cigarette years (a*b)
Smoked				
Smokeless				

Daily tobacco use pattern

Time	Daily triggering factors/ cues (friends, meals, tea breaks, stress, travel, bowel, any other)

Reasons for use of tobacco products:	
Reasons for use of continued daily tobacco products:	
Expense per month on tobacco:	
Source of purchase of tobacco:	Near the residence

	Near the workplace
	Any other
Order of purchase of tobacco	Bulk purchase
	Daily purchase
	Whenever needed
	Sharing with friends

Any money spent on health related problems due to tobacco use:	Yes
	No

Severity of nicotine dependence (as per Fagerstrom Nicotine Dependence / Modified Fagerstrom Nicotine Dependence Scale):	

Previous attempts at quitting tobacco:		
Previous attempts at quitting:	Yes	If yes, when was the most recent attempt made?
	No	
Number of previous attempts at quitting:		

Type of tobacco	Reasons for quitting	Reasons for relapse	Remarks
Smoked			
Smokeless			

Reasons for quitting: No reasons, referred from other dental departments, social measures, existing health problems, awareness about health problems during education programs, lack of productive work, financial reasons, any other

Reasons for relapse: Craving, insomnia, irritability, headaches, constipation, social pressure, lack of productive work or concentration, psychological stress, family tensions, financial tension, chronic illness, pain, any other

Stage of behavior change:	Pre-contemplation
	Contemplation
	Preparation
	Action
	Maintenance
Alcohol Use	Yes
	No
Pattern of alcohol use in last one year	Daily drinking
	Regular drinking (3 or more a week)
	Social drinking (less than 3 a week)
	None

Average no. of units per drinking day:
(1 unit = 30 ml spirit/ 60 ml wine/ half mug beer)

Other substance use: Yes/ No

Substance used	Pattern of use in past one year	Dependence Yes/No	Avg amounts/ units per day	Remarks

Family history of tobacco use in first degree relatives	Smoked	
	Smokeless	
	Both	
	None	
History & symptoms suggestive of:		
Cough	Cough with sputum	Yes/No
	Sputum with blood	Yes/No
Bronchial	Breathlessness	Yes/No
Chest pain	Chest pain	Yes/No
	Hypertension	Yes/No
Others	Cancer	Yes/No
	Diabetes	Yes/No
	TB	Yes/No
	Weight gain	Yes/No
	Weightloss	Yes/No

Physical Examination

Height (cm):	Weight (kg):	Body Mass Index
Pulse:	Systolic Blood Pressure	Diastolic Blood Pressure

Oral Health Status & History of Dental Treatment

Chief dental complaint:

Intra-oral examination:

Oral Condition	Present/Absent	Description
Leukoplakia	Yes	
	No	
Sub mucous fibrosis	Yes	
	No	
Erythroplakia	Yes	
	No	

Investigations:

Biopsy:

Blood investigations:

Any other:

Provisional Diagnosis:

Carbon Monoxide Breath Analysis Test:

CO level_____ppm CO levels: O—6N, 7—10N, >10N	Done
	Not Done

Intervention:

Cold turkey
Behavior counseling
Behavior counseling + NRT (type of NRT_____)
Behavior counseling + Medication
Behavior counseling + Medication + NRT (type of NRT_____)

Instructions on possible side effects & adverse drug reactions have been explained: Yes/No

Details of pharmacotherapy

Follow up details:

F/U visit	Date	Use status	Cotinine Test (Done or not) (+ve or -ve)	CO Breath Analysis (Done or not)	CO level	Treatment	Medication/ NRT
0-2 wks							
2-4 wks							
4-6 wks							
6 wks-3 months							
3-6 months							
6-9 months							
9-12 months							

Treatment:

1. Behavioural counselling	2. Behavioural counselling + medication
3. Behavioral counseling + NRT	4. Behavioral counseling + NRT + Medication

Status:

1. No change   2. Reduced change 3. Stopped use 4. Lost to follow up 5. Relapse (<50% change)   (>=50% change)

Source of Information:

Follow up	Phone call	E – Mail	Mail

Other remarks:

Name of Therapist:

Signature:

Date:

Fagerstorm Nicotine Dependence Scale — Smoking

1. How soon after you wake up do you smoke your first cigarette?

Within 5 minutes	(3 points)
5 to 30 minutes	(2 points)
31 to 60 minutes	(1 points)
After 60 minutes	(0 points)

2. Do you find difficult not to smoke in places where you shouldn't, such as in church or school, in a movie, at library, on a bus, in court or in a hospital?

   | Yes | (1 point) |
   | No | (0 point) |

3. Which cigarette would you most hate to give up; which cigarette do you treasure the most?

   | The first one in the morning | (1 point) |
   | Any other one | (0 point) |

4. How many cigarette do you smoke each day?

10 or fewer	(0 points)
11 to 20	(1 points)
21 to 30	(2 points)
31 or more	(3 points)

5. Do you smoke more during the first few hours after waking up than during the rest of the day?

   | Yes | (1 point) |
   | No | (0 points) |

6. Do you still smoke if you are so sick that you are in bed most of the day, or if you have a cold or the flu and have trouble breathing?

   | Yes | (1 point) |
   | No | (0 points) |

Scoring: 7 to 10 points = highly dependent ; 4 to 6 points = moderately dependent ; less than 4 points = minimally dependent

Modified Fagerstorm Nicotine Dependence Scale — Smokeless Tobacco

The Fagerstrom Test for Nicotine Dependence - Smokeless Tobacco (FTND- ST)

Item	Answers	Points
1. How soon after you wake up to do you place your first dip?	Within 5 mins	3
	6-30 mins	2
	31-60 mins	1
	> 60 mins	0
2. How often do you intentionally swallow tobacco juice?	Always	2
	Termites	1
	Never	0
3. Which chew would you hate to give up most?	The first one in The morning	1
	Any other	0
4. How many cans/ pouches per week do you use?	More than 3	2
	2-3	1
	1	0
5. Do you chew more frequently during the first hours after awakening than during rest of the day?	Yes	1
	No	0
6.Do you chew if you are so ill that you are in bed most of the day?	Yes	1
	No	0

Source: Ebbert JO, Patten CA, Schroeder DR. The Fagerstrom Test For Nicotine Dependence Smokeless Tobacco (FTND-ST). Addictive Behaviours 31(9), 2006, 1716-1721. doi:10.1016/i.addbeh.2005.12.015

Technical Specifications of Carbon Monoxide Breath Monitor

Description of function

The Carbon Monoxide Breath Monitor measures the Carbon Monoxide levels in ppm (parts per million) in breath. It is an instant and non-invasive tool to biochemically establish smoking status in an individual while acting as a motivational visual aid for the smokers.

Technical specifications:

Essential Specifications:

1. It should have color touch-screen display.
2. Response time should be < 30 seconds to 90% FSD
3. Recording and interpreting results should be quick and easy.
4. It should have automatic calibration to ensure accurate results.
5. There should be provision of mouthpieces for excellent and low cost infection control.
6. It should have storage of up to 100 readings and personal profiles.
7. There should be familiar green, amber and red traffic light system for making CO levels instantly identifiable to patients.
8. It should have electrochemical sensor with +5% repeatability and accuracy.
9. Sensor operating life should be 5 years (2-year warranty)
10. Sensor sensitivity should be 1ppm.
11. Its weight should be in < 250gm.
12. H2 cross sensitivity: <12%.

Desirable Specifications:

1. It should be able to provide instant result in exact ppm for %COHB and %FCOHB
2. There should be provision for adults, adolescents and pregnant woman testing mode

Environmental Factors:

1. Operation temperature range should be 0-40 degree Celsius
2. Storage/transport temperature: 0-50°C
3. Operating/storage/transport pressure: Atmospheric +10%
4. Operating humidity: 15-90% non-condensing aprons
5. Storage/transport humidity: 0-95%

Documentation:

User/ Technical/ Maintenance manuals to be supplied in English.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/59733