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Prevalence of Tobacco and Arecanut Use and Associated Oral Mucosal Lesions Among Adolescent School Children of Mathura City

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Introduction: Tobacco use is a leading cause of preventable morbidity and mortality worldwide, with initiation commonly occurring during adolescence. India faces a rising burden of tobacco- and areca nut–related oral health problems, often beginning in youth. This study aimed to assess the prevalence of tobacco and areca nut use and their association with oral mucosal changes among school-going adolescents in Mathura city.

Methodology: A cross-sectional descriptive study was conducted among 1,017 adolescents in Mathura using the WHO Oral Health Survey Form (2013). A structured, closed-ended questionnaire assessed smoking, smokeless tobacco, and areca nut use. Oral examinations were performed to detect mucosal lesions. Data were analyzed using descriptive statistics with SPSS v23. Ethical approval was obtained from the Institutional Ethics Committee of K.D. Dental College and Hospital, Mathura.

Results: Overall, 10.3% of students reported smoking, with higher prevalence among males (8.2%) compared to females (2.2%). Initiation clustered in mid-adolescence, with 7.1% starting at 14–15 years. Bidi/hookah use was reported by 11.4%. Smokeless tobacco was used by 7.2% of participants (5.5% males, 1.7% females), typically on an occasional basis. Areca nut use was more common, reported by 18.7% (12.2% males, 6.5% females). Despite these habits, no oral mucosal lesions were observed among participants.

Conclusion: This study highlights notable experimentation with tobacco and high prevalence of areca nut use among adolescents in Mathura, particularly among males. While daily tobacco consumption was low and no lesions were detected, early initiation patterns underscore future risks for oral potentially malignant disorders (OPMDs). Preventive school-based interventions, culturally sensitive awareness programs, and inclusion of areca nut in tobacco control policies are urgently needed to reduce long-term health impacts

Introduction

One of the most significant threats to global health today is the tobacco epidemic. It stands as the primary cause of preventable illnesses, disabilities, and fatalities worldwide. The World Health Organization estimates that approximately 5 million individuals die prematurely each year due to tobacco use, and this number is projected to rise to 10 million deaths annually by 2030, with about 7 million of those deaths occurring in developing nations. India is expected to experience the highest increase in tobacco-related deaths, many of which will happen during the productive years of adult life due to addictions formed in youth [1]. Based on the National Survey on Drug Use and Health, almost all tobacco usage starts during childhood and adolescence [2]. Preventing the use of tobacco products among young people is essential to reducing illness and death since nearly all tobacco use begins in youth or young adulthood; about 90% of adult cigarette smokers initiate their habits before turning 18 [3]. The adolescent and late childhood years are particularly influential, as

students frequently try new activities due to peer pressure and the influence of their parents [4]. Certain new trends in substance use have surfaced, with the prevalence of multiple substance usage and an increase in tobacco habits among teenage girls [5]. They are particularly vulnerable to developing substance use habits, especially regarding tobacco and alcohol, due to their easy access and disposable income [4]. Substance abuse has permeated various sociocultural and economic levels, resulting in decreased productivity [6]. In recent times, tobacco products have diversified to incorporate a range of smoked, smokeless, and electronic options. In India, the most frequently used tobacco items are smokeless varieties like paan or paan masala containing tobacco, khaini, mishri, and snuff; however, smoking alternatives such as cigarettes, bidis, pipes, and hookah are also prevalent and commonly used [7]. The Indian Government, through the Cigarettes and Other Tobacco Products Act (COTPA), has imposed restrictions on the sale and advertising of tobacco by prohibiting its sale near educational institutions and banning advertising of tobacco products, even at retail outlets [8]. Nevertheless, young adolescents still find it easy to obtain these tobacco products. Areca nut is widely consumed by adolescents in India, either alone or mixed with tobacco, in various forms. The primary risk factors for developing oral precancers and oral cancer are linked to the use of tobacco and areca nut. India’s issue with tobacco is likely more complicated than that of any other nation globally, resulting in a significant burden of diseases and deaths related to tobacco [9]. Numerous studies have been reported of tobacco and areca nut use among adults and adolescents from several states of India. However there is a paucity of data in the literature of tobacco and areca nut use among young adolescent school going children in the region of Mathura, western part of Northern state of Uttar Pradesh.

Hence the present study was intended to assess the prevalence of tobacco and arecanut use and associated oral lesions among adolescent school children of Mathura city

Materials and Methods

The present study was school based cross-sectional study which was carried out in a various educational zones of Mathura city in the state of Uttar Pradesh. The data was collected as per the convenience using random sampling methods to assess the prevalence of tobacco and areca nut use and associated oral mucosal lesions among adolescent school going children of class 8^{th} to class 10^{th} in the age group of 13 to17 years. A standard, anonymous, self administered, pretested, questionnaire modified according to Global Youth Tobacco Survey (GYTS) was used in this study. The study was carried out from 16^{th} October to 16^{th} December 2023. Uttar Pradesh is the most populous state of the country with a population of 19.98 crore as per 2011 censes. Also according to 2011 censes the population of Mathura city is 349909.

a. Study Population

The study population was selected by random sampling methodology. The size of the population was calculated by the formula: $n=z.p.q/d^2$

Z= A normal deviate reflects the type I error for 95% the citrical value =1.96

P= proportion to be estimated Q=100-p

d = The accuracy of estimate(how close to the true proportion)

$n=(1.96^2)x12x88/(2)^2$

=4065.6/4

Sample size n= 1016.4

Hence The Sample Size Obtained Was 1017

b. Study Design

This cross sectional study was carried out in various schools of Mathura city. This survey was carried out on students from 8th standard to 10th standard ranging from 13 years to 17 years old . The students present on the day of survey were distributed with anonymous, pretested questionnaire .

c. Obtaining Approval From School

Preliminary visit was made in to the school for approval from the respective school authorities for the conduction of the survey. Prior to the conduction of the survey consent was taken from the respective principal. The purpose and the procedure with the impact of this survey on the society was explained with the help of a letter as well as verbally. Although after all these explanation many educational institutions denied permission for the survey without understanding its importance. This highlights the lack of awareness of the teachers of the educational institutions about the menace of tobacco and their ill effects on the health of children.

Scheduling

The average time for the data collection was about 40 minutes for a single class. In a single day maximum 50 students were examined. The entire survey was performed between 15th October to 15th December 2023.

The List Of School Examined

The survey was done in the following schools of Mathura city.

1. Rajeev international school

2. Ramanlal Shorawala public school

3. Delhi public school

4. Jain intercollege

5. Indian public school

Team and Organisation

All the survey was conducted by the principal investigator and was assisted by two other fellow colleagues who helped to distribute and collect the questionnaire performa.

Sample Inclusion And Exclusion Criteria

All the students who were willing to participate for the survey were distributed the questionnaire

performa. Those students who were not willing to participate were asked to sit and not to disturb the class.

Data Collection

The study was conducted on 1017 adolescents aged between 13 years to 17 years old. An anonymous, self administered, pretested questionnaire which could be completed in 40 minutes was constructed using simple terms. The questionnaire was administered in English for the English medium school and in Hindi for Hindi medium school. All the instructions were given in Hindi and English. After the survey an intra oral examination was done to identify any mucosal changes in the oral cavity. The subjects were examined in the schools where sufficient natural daylight was available and the subjects were positioned in a way to receive maximum illumination. A brief habit cessation counseling was done after the screening to encourage the children to quit the habit. School authorities were further informed regarding follow-up.

The data was collected on occupation and literacy of their parents, amount of money they receive for personal expense. Data were collected on tobacco and areca nut use, the age of initiation of tobacco and areca nut, questions were framed to understand how they initiated tobacco consumption, how many packets of smoking and smokeless tobacco they consume in a day, parental influence or peer pressure was involved or not. Few questions were framed to gather data on public smoking and students' understanding about the awareness of active and passive smoking. The students were instructed to fill the performa honestly without discussing with their friends to avoid bias in the opinion.

Descriptive statistics were obtained and mean, standard deviation, frequency and percentages were calculated. Chi –square test was done to assess the association of gender with tobacco and arecanut consumption. Data was analysed by using SPSS version 19.

Results

According to the research, 10.3% of the people in the study smoked cigarettes. Many more males (8.2%) smoked than did females (2.2%). The reported ages of starting smoking were diverse: 7.1% did so between 14 and 15 years, 1.4% started after age 16, 1.3% between 11 and 13 and 2% before the age of 10.During the past 30 days, 0.7% reported using cigarettes daily and 1.6% only used them on less than 3 days. When it comes to how frequently people smoke, around 1% said they smoked more than 20 cigarettes a day and about 1 out of 30 (3.4%) said they smoked less than once each day. Paying attention to other types of smoking, 11.4% of the participants in this study used bidi or hookah. Smokeless tobacco was used by 7.2% of the population and among that percentage, 5.5% were male and 1.7% were female. Around 4.1% of the respondents began using smokeless tobacco at ages 11–13 and another 2.6% began at ages 14–15. Only a small number of respondents said they used smokeless tobacco: 0.1% used it every day, 1.5% used it between once and twice a week, 0.2% consumed it 20 or more times a day and 3% used it just less than once per ay. The study showed that 18.7% of the participants used areca nut and this number was higher for males (12.2%) than for females (6.5%). Out of all study participants, 0.7% used areca nut daily for 30 days, 13.9% used it on average 1–2 days and 6.3% used it less than once a day.

All the participants in the study had oral mucosa free of changes seen in smoking, smokeless tobacco or areca nut use.

Discussion

In this school-based sample (N=1,017), most respondents were 14–15 years old (72.6%) and 56.3%

were male (Table 1).

	Male	Female	P-vlaue
Have you ever tried or experimented with cigarette smoking, even one or two puffs?			
Yes	83 (14.5)	22 (5.0)	P<0.001
No	490 (85.4)	422 (95)	
How old were you when you first tried a cigarette?			
I have never tried smoking cigarette	498 (86.9)	414 (93.2)	P=.015
10 or Younger	13 (2.3%)	7 (1.6%)	
11 to 13 yrs old	9 (1.6%)	4 (0.9%)	
14 to 15 yrs old	41 (7.6%)	17 (3.8%)	
16 yrs or older	12 (2.1%)	2 (0.5%)	
During the past 30 days, on how many days did you smoke cigarettes			
0 days	530 (92.5%)	420 (94.6%)	
1 or 2 day	12 (2.1%)	4 (0.9%)	
3 to 5 days	12 (2.1%)	7 (1.6%)	
6 to 9 days	11 (1.9%)	9 (2.0%)	P=.644
10 to 19 day	2 (0.3%)	2 (0.5%)	
20 to 29 days	1 (0.2%)	0 (0.0%)	
30 days	5 (0.9%)	2 (0.5%)	
Please think about the days you smoked cigarettes during the past 30 days. How many cigarettes did you usually smoke per day?			
Ididnotsmokecigarettesduring thepast30days	534 (93.2%)	416 (93.7%)	
Lessthan1cigaretteperday	15 (2.6%)	20 (4.5%)	P=0.153
1cigaretteperday	3 (0.5%)	1 (0.2%)	
2 to 5cigarettes perday	14 (2.4%)	3 (0.7%)	
6 to 10 cigarettesperday	1 (0.2%)	0	
11 to 20 cigarettesperday	1 (0.2%))	0	
Morethan 20 cigarettesperday	5 (0.9%)	4 (0.9%)	
Have you ever tried or experimented with any form of smoked tobacco products other than cigarettes (such as Bidi, Hookka)?			
YES	53 (9.2%)	21 (2.1%)	
NO	487 (85%)	415 (40.8%)	P<0.001
OTHER	33 (5.8%)	8 (0.8%)	
Have you ever tried or experimented with any form of smokeless tobacco /chewing tobacco products (such as Raw tobacco ,snuff, Gutka, Pan with tobacco, any other)?			
YES	26 (4.5%)	11 (2.5%)	
NO	518 (90.4%)	425 (95.7%)	P=0.004
OTHER	29 (5.1%)	8 (1.8%)	

How old were you when you first tried using smokeless tobacco			
I have never tried smokeless tobacco	512 (89.4%)	411 (92.8%)	P=0.032
10 or Younger	10 (1.7%)	1 (0.2%)	
11 to 13 yrs old	30 (5.2%)	12 (2.7%)	
14 to 15 yrs old	15 (2.6%)	11 (2.5%)	
16 yrs or older	6 (1%)	8 (1.8%)	
During the past 30 days, on how many days did you use smokeless tobacco /chewing tobacco			
0 days	549 (95.8%)	428 (96.4%)	
1 or 2 day	10 (1.7%)	5 (1.1%)	P=0.871
3 to 5 days	1 (0.2%)	1 (0.2%)	
6 to 9 days	4 (0.7%)	4 (0.9%)	
10 to 19 day	7 (1.2%)	4 (0.9%)	
20 to 29 days	1 (0.2%)	2 (0.5%)	
30 days	1 (0.2%)	0	
How old were you when you first tried using arecanut/supari			
I have never tried Arecanut	449 (78.4%)	378 (85.1%)	P=0.006
10 or Younger	29 (5.1%)	6 (1.4%)	
11 to 13yrs old	45 (7.9%)	24 (5.4%)	
14 to 15 yrs old	20 (3.5%)	18 (4.1%)	
16 yrs or older	30 (5.2%)	18 (4.1%)	
During the past 30 days ,on how many days did you use Arecanut/supari			
0 days	425 (74.2%)	382 (86%)	
1 or 2 day	92 (16.1%)	49 (11%)	
3 to 5 days	7 (1.2%)	1 (0.2%)	P<0.001
6 to 9 days	37 (6.5%)	5 (1.1%)	
10 to 19 day	3 (0.5%)	3 (0.7%)	
20 to 29 days	3 (0.5%)	3 (0.7%)	
30 days	6 (1%)	1 (0.2%)	

Table 1. *gggg*

Males and females were similarly distributed by age, but males constituted a larger share of the overall sample. These distributions are typical of Indian secondary-school surveys and provide useful context for interpreting sex differences in tobacco and areca-nut behaviors.

Cigarette experimentation and current smoking. Overall, 10.3% reported ever trying cigarettes (≥1–2 puffs), with a markedly higher prevalence among males (14.5%) than females (5.0%), and a highly significant association by sex ($p<0.001$). This male excess mirrors other Indian adolescent data. For instance, a Northern India adolescent survey reported that 24.1% had tried tobacco products, with two-thirds of experimenters being boys (small, mixed-mode sample) [10]. In contrast, among early adolescents (10–13 years) from urban slums in Western India, 19.1% were ever tobacco users and 6.2% current users, reflecting both higher experimentation and non-trivial current use in a socioeconomically vulnerable setting [11]. Our lower ever-smoking estimate compared with [10] and [11] likely reflects differences in age structure (more 14–15-year-olds vs. mid- to late-adolescents in [10]) and setting (general schools vs. urban slums in [11]).

Age at first cigarette in our cohort clustered in mid- adolescence: 5.7% of all students initiated at 14–15 years and 3.3% before age 14, with significant sex differences (p=0.015). The mid-teen onset aligns with clinic- and community-based observations that initiation accelerates after early adolescence; however, slum-dwelling early adolescents in Gujarat showed very early onset, with ~43% of users starting at ≤10 years [11], underscoring context- specific vulnerability. These contrasts reinforce the need to tailor prevention earlier in disadvantaged settings while sustaining mid-teen prevention in general schools.

Despite notable experimentation, past-30-day smoking was rare in our data (6.6% any days) and intensity was low (most smokers reported ≤5 cigarettes/day). Frequency distributions did not differ significantly by sex (p=0.644) nor did typical daily consumption (p=0.153). This pattern high experimentation but low current intensity echoes school-based observations that many Indian adolescents experiment without quickly transitioning to daily smoking, particularly outside high-deprivation contexts [10, 11]. Even so, experimentation is a strong predictor of subsequent escalation, warranting early, universal prevention.

Other smoked products. Ever-use of bidi/hookah/ other smoked tobacco was 7.3%, higher among males (9.2%) than females (4.7%) with a significant association (p<0.001). This aligns with reports that non-cigarette smoked products remain salient among male adolescents, especially where peer models and availability persist [10]. Given the strong cultural and price appeal of bidis, monitoring should include these products rather than focusing on cigarettes alone.

Smokeless tobacco (SLT). SLT experimentation was low in our cohort (3.6% overall; p=0.004 by sex), and past-30-day SLT use was rare (3.9% any days; p=0.871). Age at first SLT use was significantly associated with sex (p=0.032), with most initiations in mid-adolescence. While our SLT prevalence is modest, other Indian settings report heavier SLT involvement among adolescent users e.g., community-based samples of adolescent tobacco users show SLT predominance and initiation around 15–16 years [11]. Socioeconomic context, social modeling, and product affordability likely explain these discrepancies.

Areca nut (supari/betel-nut). Areca-nut initiation was substantially more common than SLT in our data: 18.7% had ever used (by complement of 81.3% “never”), with significant sex differences in age at first use (p=0.006), and 20.6% reported any past-30-day use. Frequency of daily areca-nut use also differed significantly by sex (p<0.001). These findings closely parallel recent school-based data from Mumbai, where areca-only use (without tobacco) among grades 7–9 reached 24.3%, exceeding tobacco- only (3.9%) and dual use (1.5%) [12]. Taken together, areca-nut appears to be the predominant psychoactive oral behavior among Indian early-to-mid adolescents, often preceding or existing independently of tobacco. Given its established carcinogenicity (IARC Group 1), routine school surveillance and targeted messaging on areca-nut are imperative not just tobacco.

Sex differences and effect sizes. Across domains, males consistently exhibited higher experimentation for smoked products (cigarettes and other smoked forms), whereas areca-nut and SLT sex gaps were narrower and, in some settings, may favor females [12, 13]. In our study, the unadjusted sex odds ratio for any past-30-day smoking was ~3.25 (95% CI: 2.00–5.29), though category-wise differences in frequency were not statistically significant, suggesting limited power to detect differences at low prevalence. The convergence of our sex-stratified patterns with those reported in diverse Indian settings strengthens xternal validity.

Public health implications. First, prevention should start before mid-adolescence, with particular attention to areca-nut as a culturally accepted gateway behavior. Second, context-sensitive strategies are required: earlier, more intensive interventions in urban-slum schools (where very early initiation is documented) [11], and sustained universal programs in general schools. Third, routine school health programs should track all products (cigarettes, bidis, hookah, SLT, and areca-nut) and incorporate sex-responsive messaging, given consistent male excess in smoked products

and high areca-nut uptake across sexes.

Strengths and limitations. The present survey's large sample and granular product-specific measures (initiation age, 30-day frequency, typical daily use) support nuanced inferences. However, school-based, cross-sectional self-report may underestimate sensitive behaviors; comparisons with smaller or differently sampled studies (online surveys, community/slum-based samples) [10-12] should be interpreted with sampling frames in mind.

Conclusion. In this large school-based cohort, cigarette experimentation is non-trivial but current smoking is infrequent and low-intensity; areca-nut use is both more common and more frequent than tobacco. These patterns are consistent with recent Indian adolescent literature and highlight the need to elevate areca-nut within adolescent oral-health and substance-use prevention, while maintaining comprehensive tobacco control tailored to local risk environments.

In conclusion, the data derived from our study can be utilized by the fellow healthcare investigators to add up to the existing data so that the tangible prevalence rate of tobacco and areca nut users and OPMDs associated with them among children and adolescents can be determined. These data also help us in carrying out interventional measures to reduce the prevalence of tobacco and areca nut chewing habits thereby reducing the prevalence of OPMDs associated with them. The data derived from our study can be used by the policy makers and governmental agencies for the effective implementation of areca nut and tobacco control policies.

Implications

1. The results of our study will help in targeting the adolescent school children for the awareness and educational intervention aimed at reducing tobacco and areca nut use.

2. It will help in early detection of oral mucosal lesions and oral potentially malignant disorders.

3. It will also help in making policy decisions to reduce the burden of tobacco and areca nut use among adolescents.

Declaration of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

Authors Contribution

Srenwentu chakraborty was responsible for the conceptualization of the study, data collection, and writing of the manuscript.

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