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A cross-sectional study on tobacco advertising, promotion and sponsorship (TAPS) and violations of tobacco sale regulations in Myanmar: Do they affect on the current smoking and smokeless tobacco use among Myanmar high school students?

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ABSTRACT

Objectives: To examine associations of current smoking and smokeless tobacco use with TAPS and illicit tobacco sales exposures among Myanmar high school students.

Design: A quantitative, cross-sectional study.

Setting: Seven high schools from both urban and rural areas of four states and regions in Myanmar.

Participants: In total, 1,174 (482 males and 692 females) high school students were recruited using a self-administered questionnaire.

Main outcome measures: Current smoking and smokeless tobacco use, defined as using at least one time of any kind of smoking or smokeless tobacco products within the past 30 days.

Results: The prevalence of TAPS exposures was 90.9% among high school students in Myanmar. Current smoking and smokeless tobacco use was positively associated with > 14 years old age group (AOR 9.81; 95%CI 4.54–21.19), being male (AOR 28.06; 95%CI 13.29–59.25), exposure to any kind of TAPS (AOR 6.59; 95%CI 2.33–18.64), had seen selling cigars inside or within 100 feet of the school premises (AOR 4.17; 95%CI 1.65–10.58), had seen selling or giving cigars to minors (AOR 6.40; 95%CI 2.18–19.12), and had seen selling or distributing cigars by minors (AOR 2.42; 95% CI 1.42–4.10). Ever received health education about tobacco products (AOR 0.45; 95% CI 0.27–0.78), and higher perception score of smoking and smokeless tobacco products (AOR 0.17; 95% CI 0.10–0.30) were negatively associated with current smoking or smokeless tobacco use.

Conclusions: An alarming prevalence of TAPS exposure was found among Myanmar high school students. TAPS exposure and violations of tobacco sale regulations were strong risk factors for current smoking or smokeless tobacco use among Myanmar high school students while ever received health education about tobacco products was found as one of the protective factors. Specific smokeless tobacco sale regulations for minors are immediately needed in Myanmar.

Key words: Tobacco advertising, tobacco sale, current smoking and smokeless tobacco use, high school students, Myanmar

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This study is the first in Myanmar to report the associations of current smoking and smokeless tobacco use with TAPS and illicit tobacco sales exposures among high school students.
- The findings of this study cannot be generalized for the whole nation though it was conducted among 1,174 students from two states and two regions out of a total of seven states, seven regions, and one territory in Myanmar.
- This study could not confirmed the causal relationships of the current smoking and smokeless tobacco use among high school students because of the cross-sectional nature of our study.
- Due to the limitations of the cross-sectional study design, this study calls for further TAPS-related interventional and longitudinal studies to explore Myanmar adolescents' smoking and smokeless tobacco use behaviors.

INTRODUCTION

"Tobacco use," defined as the use of any type of smoking or smokeless tobacco, [1)] is regarded as an important public health concern worldwide. Globally, it was estimated that 24 million (7%) adolescents aged between 13 and 15 years smoked cigarettes and 13.4 million (3.6%) used smokeless tobacco products in 2017.[1)] In the United States, it was reported that 4 million high school students were current tobacco users in 2018.[2)] In Southeast Asia region, tobacco use prevalence was 5.7% and smokeless tobacco use prevalence was 7.2% among adolescents.[1)] A recent multicounty study reported that the prevalence of adolescent smokeless tobacco use in the World Health Organization (WHO) South-East Asia Region was highest in Bhutan (23.2%), followed by Nepal (16.2%), Timor-Leste (14.2%), Myanmar (9.8%), India (9.0%), Sri Lanka (8.5%), the Maldives (6.2%), Bangladesh (5.9%), and Thailand (5.7%).[3)] Thus, Myanmar ranked the fourth-highest adolescent smokeless tobacco use among these nine countries.

Tobacco use is responsible for five million deaths every year globally, a figure that is expected to rise to 10 million per year by 2030.[4)] Moreover, it is estimated that 600,000 people die from the effects of second-hand smoke, accounting for roughly 1% of global mortality.[5)] Adolescents are highly vulnerable to addiction to the nicotine in tobacco. A recent study has shown that the earlier people begin nicotine dependence, the more likely they are to

become addicted to smoking in adulthood.[6] Moreover, nicotine may harm brain development in adolescence.[7] Studies have shown adolescent smoking is associated with poor academic performance [8] and attention and cognitive deficits.[9]

Since 2001, the Global Youth Tobacco Survey (GYTS) has been implemented every three to five years in Myanmar to monitor school-going students' tobacco use. The 2016 GYTS reported that 10.6% of students used tobacco (21.1% for boys and 2.4% for girls). The prevalence of smokeless tobacco use was 11.0% for boys and 1.5% for girls.[10] In parallel with the GYTS, Myanmar has been conducting the nationwide Global School-based Student Health Survey (GSHS) to monitor the understanding of health risk behaviours among students aged between 13 and 17 years, including students' tobacco use. The GSHS survey reported that the prevalence of current tobacco smoking and current smokeless tobacco use in Myanmar students were 7.2% and 8.5%, respectively, in 2016.[11]

More than a decade ago, Myanmar signed the WHO Framework Convention on Tobacco Control (FCTC) and enacted the first Tobacco Control Law in 2006, regulating tobacco advertising, promotion, and sponsorship (TAPS) and tobacco sales among minors.[10] Subsequently, the restrictions on smoking in all indoor public places, the introduction of graphic health warnings on tobacco product packaging, and the raising of tobacco product taxes were also promulgated. However, the prevalence of current tobacco use among Myanmar youths had not changed significantly over the past 15 years.[10]

A comparison of the 2007 and the 2016 GSHS rounds also revealed that the prevalence of cigarette smoking had increased significantly, from 2.0% to 6.7%.[11] Although the Tobacco Control Law has already banned tobacco sales to minors under 18, adolescent smokers can still buy cigarettes from large stores, retail shops, or street vendors very easily without being denied by tobacco sellers.[10] These alarming findings indicate the failure of tobacco control efforts for young people in Myanmar.

Although the Tobacco Control Law in Myanmar prohibits TAPS activities by the tobacco industry, TAPS activities are still common in Myanmar. Most tobacco companies distribute tobacco products and personal goods with tobacco product labels free of charge or as gifts. According to the 2016 Myanmar GYTS report, 8.7% of boys and 3.6% of girls reported that tobacco companies had offered free tobacco products, and 7.3% of boys and 4.2% of girls reported owning something with a tobacco brand logo.[10] Furthermore, 83.4% of the students reported noticing someone using tobacco products on television or in videos or movies.[10]

Researchers from other parts of the world have reported that TAPS exposure can affect adolescent smoking behaviours.[12-15] At present, research in Myanmar is limited on the patterns of young people's smoking and smokeless tobacco use and their connection to TAPS exposure. Our previous study,[21] among the same study participants, revealed the low

awareness of the Tobacco Control Law among Myanmar high school students, but we did not examine how TAPS exposure and violations of tobacco sales regulations might affect Myanmar high school students' smoking and smokeless tobacco use. The present study aims to investigate (1) the prevalence of TAPS and illicit tobacco sale exposures and (2) their associations with current smoking and smokeless tobacco use among Myanmar high school students.

MATERIALS AND METHODS

Study population

A cross-sectional study was conducted among grade 10 and 11 high school students from seven high schools in Shan State, Mon State, Bago region, and Magway region in Myanmar. A simple random sampling using a drawing method was applied to select the study areas and schools. The details of the sampling procedure have been described elsewhere.[21)] In total, 1,339 high school students answered the self-administrated questionnaire. Of these, 165 were excluded due to missing or uncompleted response on TAPS exposure questions. Therefore, the total number of participants was 1,174 (482 males and 692 females).

Data collection

Data were collected by using a pre-tested, anonymous, self-administered questionnaire. The questionnaire in the Myanmar language contained 40 questions, covering nine components:1)

background information, 2) experience with tobacco products, 3) exposure to second-hand smoking, 4) perception of smoking and smokeless tobacco products, 5) sale of tobacco, 6) health warnings and information, 7) tobacco advertisement, promotion, and sponsorship, 8) smoke-free areas, and 9) the Tobacco Control Law and its enforcement. Permissions were obtained from local educational steering committees and authorities, schools' authorities, and teachers after a thorough explanation of the study's objectives and the contents of the questionnaire. Before taking part in the study, researchers explained clearly the nature and aims of this study, and the questionnaire's contents to all participants.

Study measures

Dependent variable

The outcome variable was "current smoking and smokeless tobacco use" among high school students. It was defined as using any kind of smoking or smokeless tobacco product at least one occasion within the 30 days preceding the survey.

Independent variables

The independent variables were socio-demographic characteristics, smoking exposure at home and school, perception and receiving health education about tobacco products, illicit sale exposure, and exposure to any kind of TAPS. The "exposure to any kind of TAPS" was

created using the following variables: 1) having seen or heard tobacco advertisings and sponsorship in any form, 2) having seen any goods displaying the label of a cigar or tobacco products being used in promotion, and 3) having seen any toy, comestible, or wares made in the form of a cigar. If a student had had at least one TAPS exposure, the response was counted as a "Yes," and if they had never experienced exposure, their response was counted as a "No."

Exposure to the illicit sales of tobacco was measured by using the following variables: 1) having seen selling cigars inside or within 100 feet of the school premises within the last 12 months, 2) having seen selling or giving cigars to minors within the last 12 months, 3) having seen selling or distributing cigars by minors within the last 12 months, and 4) having seen selling cigarettes singly or in packs containing less than 20 within the last 12 months. The word "cigar" used in our variables meant "any cigarette, cheroot, cigar, or smoking pipe or any other similar material prepared by any means for inhalation of smoke emitted from the burning of a tobacco product," as described in Myanmar's Tobacco Control Law.[16)]

Study analysis

The data were coded, entered, and analysed using the Statistical Package for Social Science (SPSS) software program version 24.0 (IBM SPSS Inc.). Categorical data were analysed by

chi-square tests for hypothesis testing. For multiple logistic regression analysis, all the variables were re-coded on a dichotomous scale. All analyses were two tailed, setting $p<0.05$ as significance.

RESULTS

Table 1 shows the characteristics of the study participants by gender. Most of the participants (84.7%) were younger than or equal to 15 years of age. More than two thirds of the students (68.5% of males and 67.1% of females) were grade 10 students. Of those who took part, 25.3% of male and 1.3% of female students were current users of smoking and smokeless tobacco at the time of survey. Male students had more exposure to parents smoking (6.0%), siblings smoking (11.4%), and peers smoking (9.3%) than did female students. Nearly two thirds of females (66.0%) reported receiving health education on smoking and smokeless tobacco, compared to 52.7% of males. With regard to the perception of smoking and smokeless tobacco products, out of eight items, we set the mean score of seven as the cut-off point. Overall, 68.7% of males and 83.2% females scored more than seven.

Table 2 presents different kinds of TAPS exposures and its associations with current smoking and smokeless tobacco use among the study participants. In total, 90.9% had TAPS exposure in any form. The findings indicate that 71.7% had seen or heard of tobacco advertisement and sponsorship in any form, and 68.1% had seen goods displaying the label of

a cigar or other tobacco products being used in promotions. One out of three students had seen any toys, comestible or wares made in the form of a cigar. More than one third of the participants (35.3%) had seen or heard tobacco advertisements in sponsorship or support of sports, fun fairs, exhibitions, or other social activities.

Table 3 describes illicit tobacco sale exposures and their associations with current smoking and smokeless tobacco use among the study participants. Within the last 12 months, more than 80.0% had exposed to selling cigars inside or within 100 feet of the school premises, selling or giving cigars to minors, and selling cigarettes singly or in packs less than 20. Nearly 56.0% had seen selling or distributing cigars by minors.

Table 4 presents the unadjusted odds ratio (UOR), adjusted odds ratio (AOR), and 95% confidence intervals (CI) of current smokers and smokeless tobacco users among Myanmar high school students. In the binary logistic regression, being a grade 11 student (UOR 3.24; 95% CI 2.24-4.70) and seeing someone selling cigarettes, either singly or in packs of less than 20 (UOR 7.45; 95% CI 2.34–23.70), were associated with current smoking and smokeless tobacco use.

From the multiple logistic regression, current smoking and smokeless tobacco use was found to be positively associated with age >14 years old (AOR 9.81; 95% CI 4.54–21.19); being male (AOR 28.06; 95% CI 13.29–59.25); exposure to any kind of TAPS (AOR

6.59; 95% CI 2.33–18.64); had seen selling cigars inside or within 100 feet of the school premises within the last 12 months (AOR 4.17; 95% CI 1.65–10.58); had seen selling or giving cigars to minors within the last 12 months (AOR 6.40; 95% CI 2.18–19.12); and had seen selling or distributing cigars by minors within the last 12 months (AOR 2.42; 95% CI 1.42–4.10). Ever received health education about tobacco (AOR 0.45; 95% CI 0.27–0.78) and higher perception score of smoking and smokeless tobacco products (AOR 0.17; 95% CI 0.10–0.30) were negatively associated with current smoking and smokeless tobacco use (Table 3).

DISCUSSION

To the best of our knowledge, this is the first study to report the associations of current smoking and smokeless tobacco use with TAPS and illicit tobacco sale exposures among high school students in Myanmar. Majority of the study participants reported having exposures to TAPS and illicit tobacco sales. TAPS exposure increases the odds of current smoking and smokeless tobacco use among high school students. Similarly, being aged above 14 years, being male, and having been exposed to illicit tobacco sales were risk factors for current smoking and smokeless tobacco use among high school students. However, having received health education and having a higher perception score of smoking and smokeless tobacco use were negatively associated with current smoking and smokeless tobacco use.

In this study, a high prevalence of TAPS exposure (91%) was found among high school students in Myanmar, a country that has completely banned all forms of direct or indirect TAPS, including Corporate Social Responsibility (CSR) activities by tobacco industry. [16] Myanmar has a well-established Tobacco Control Law, the "Control of Smoking and Consumption of Tobacco Product Law," which has been enacted since 2006.[16] Nevertheless, the lack of enforcement of this law in Myanmar creates opportunities for tobacco companies and retailers to violate it. Our findings highlighted the urgent need to enforce this law in Myanmar to reduce TAPS exposure among adolescents in order to decrease tobacco use.

The global tobacco industry has been focusing on expanding its market in developing countries that have low tobacco taxes, partial TAPS bans, and weak law enforcement of TAPS regulations, rather than developed countries with high tobacco taxes, comprehensive complete TAPS bans, and strict implementation of TAPS regulations.[17-20] Moreover, it is not rare to see sponsored events and CSR activities by tobacco companies, violating the TAPS regulations and reframing tobacco products' image among Myanmar youths.[21, 22] Nigerian researchers have reported that exposure to events sponsored by the tobacco industry was associated with current cigarette use and increased susceptibility to cigarette use.[13] This study encourages Myanmar policy makers to formulate specific TAPS regulations addressing newly developed smoking and smokeless tobacco products and complete comprehensive TAPS

bans, including cross-border TAPS. Local authorities need to monitor TAPS among Myanmar youths strictly and to punish the tobacco companies, stores, and retailers violating TAPS regulations.

High school students having TAPS exposure in any form were six times more likely to smoke or use smokeless tobacco products than those without any TAPS exposure. Adolescent students, in a phase of life full of curiosity, are vulnerable to adopting risky life-style behaviours such as smoking or smokeless tobacco use.[23, 24)] A positive association between exposure to cigarette advertisements and initiating smoking has been reported among Indonesian students. [25)] A longitudinal study conducted in Germany also pointed out that the adjusted relative risk for established smoking and daily smoking were raised by 38% and 30%, respectively, with each additional 10 tobacco advertisements.[26)]

In addition, a recent study from Myanmar has reported that only half of high school students had heard about the Tobacco Control Law, and none of the study participants had ever heard of any reporting or punishing for any violation of the Tobacco Control Law banning TAPS activities and tobacco sales among minors.[21)] Our study suggests that Myanmar high school students should be properly informed not only about the dangers of TAPS exposure but also about the country's Tobacco Control Law and its punishments.

In this study, the prevalence of current smoking and smokeless tobacco use among

Myanmar high school students was 11.2%, higher than the national figure of 9.8% reported in the 2016 WHO GSHS for 13- to17-year-old students in Myanmar.[11] Our study also reported that male high school students were more likely to be current smoking and smokeless tobacco users than their peers were. A sub-national-level study also reported a considerably high prevalence of smoking (34.7%) and smokeless tobacco use (28.3%) among high school students.[22] The findings recommend Myanmar policy makers to consider smoking and smokeless tobacco use among adolescents as a priority public health concern and to put more effort into smoking and smokeless tobacco control measures.

In Myanmar, it has been reported that there were only three full-time staff assigned to national tobacco control, covering 2,080,000 smokers per each.[31] The country also has insufficient government budget for tobacco control and no innovative health promotion funding mechanism using tobacco taxes.[31] To tackle the current situation in Myanmar, effective implementation of tobacco control measures is needed to reduce current smoking and smokeless tobacco use, and human and financial resources for national tobacco control should be improved.

For the implementation of Article 6 of the WHO FCTC, increasing tobacco tax, is a cost-effective demand-reducing measure in global tobacco control.[31] However, cigarettes in Myanmar are relatively cheap, indicating that the country's tobacco tax policies need to be reevaluated. In the Association of Southeast Asian Nations (ASEAN), the price of the most

popular local cigarette brand in Myanmar is the second lowest (0.6 USD/20-stick pack), and that of the most popular foreign brand in Myanmar is the fourth highest (2.11 USD/20-stick pack).[31] This indicates a gap in tax differences between local and foreign brands. The price that stops youth from smoking in Myanmar was reported as being above 11 USD/20-stick pack, the lowest among ASEAN.[31] Therefore, the Myanmar government should revaluate tobacco tax levels and adjust tax policies to decrease smoking and smokeless tobacco use and TAPS exposures.

In this study, students who had seen someone selling cigars inside or within 100 feet of the school premises during the last 12 months were four times more likely to be current users of smoking and smokeless tobacco products than their peers were. It is illegal to sell cigars inside or within 100 feet of a school premises in Myanmar.[16] This finding implies that the lack of monitoring and reporting of illicit tobacco sales inside or near school premises exerts an influence on current tobacco use among Myanmar high school students. In addition, these illicit tobacco sales provide easy access to tobacco for students as well as for school personnel, triggering second-hand smoking exposure and student curiosity about tobacco use. Therefore, school personnel, students, and parents should monitor and report such illicit tobacco sales to local authorities and actions should be taken according to rules and regulations.

Yet there is no specific regulation on smokeless tobacco sales and distributions to and by minors in Myanmar, the selling or giving of cigars to minors under 18 and the selling or distributing of cigars by minors under 18 are illegal.[16] Nonetheless, 82.5% of participants in this study reported that they had seen someone selling or giving cigars to minors within the last 12 months, and 55.6% of the participants reported having seen selling or distributing cigars by minors within the last 12 months. The study also revealed that seeing these two illicit tobacco activities within the last 12 months were significantly associated with current tobacco use among the study participants. A study of adolescents in the United States has also reported an association between smokeless tobacco use and smoking.[28] In order to reduce current tobacco use among Myanmar high school students, this study recommends the urgent need of specific smokeless tobacco sale regulations to and by minors in Myanmar, and the strict law enforcement on all smoking and smokeless tobacco sales or distributions to and by minors in the country.

Another common violation of the Tobacco Control Law in Myanmar is the sale of cigarettes singly or in packs of less than 20. Despite the significant price difference[31] both foreign and local brands become affordable for smokers when they are sold singly or in packs of less than 20. Such sales are contrary to the demand-reducing tobacco control measures of the national policy and negatively affect the tobacco use of all age groups, especially adolescents.

In addition, other smoking and smokeless tobacco products, such as cheroots, cigars, pipes, betel quids, etc., can be purchased singly or in small quantities in Myanmar. To reduce current smoking and smokeless tobacco use in all age groups, our study recommends that the 2006 Tobacco Control Law be updated to address the sale and purchase of all forms of smoking and smokeless tobacco products in small quantities, along with strict law enforcement, especially among minors.

The findings of this study imply that effective health education and high perception of smoking and smokeless tobacco use can be protective factors against current tobacco use among Myanmar high school students. In this study, students who had ever received health education about smoking and smokeless tobacco use and those with the higher perception score of smoking and smokeless tobacco products were less likely to be current smoking and smokeless tobacco users than their counterparts were. Nearly two thirds of the participants had ever received health education about smoking and smokeless tobacco use, and nearly 80% had the higher perception score of smoking and smokeless tobacco use. Health education programs and tobacco control measures targeting the young should address the newly developed and popular tobacco products like electronic cigarettes, shisha, pipes, menthol and fruit-flavored cigarettes etc. Youths' awareness on not only the harms of tobacco products but also the country’s Tobacco Control Law should be promoted.

The study findings also revealed that 10.7% of the current tobacco users were 14 years old or less. Another Myanmar researcher has reported that the average age of first tobacco use is 14 years.[22] Therefore, tobacco control intervention measures should be introduced to Myanmar high school students before the age of 14. Awareness of the Tobacco Control Law remains quite low in Myanmar.[21, 22] Furthermore, the provision of health education via youth-friendly media, such as the internet, mobile applications, and social networking services, may receive more attention from high school students.

In contrast to other studies,[21, 22] parental smoking, sibling smoking, and peer smoking were not found to be associated with current smoking and smokeless tobacco use in this study. This may be because most of the study participants did not have exposure to parents, siblings, or peers who smoked. Having high knowledge and perception about tobacco use may also have prevented them from using tobacco.[22]

Despite being the very first study in Myanmar reporting the associations of current smoking and smokeless tobacco use, with TAPS and illicit tobacco sale exposures among Myanmar high school students, the present study did not explored the associations between initiation or daily tobacco use , and TAPS and illicit tobacco sales among Myanmar high school students. Yet this study was conducted among 1,174 high school students from two states and two regions out of a total of seven states, seven regions and one territory of Myanmar, its findings cannot be generalized for the whole nation. Due to the limitations of

cross-sectional nature of our study, we recommend further interventional or longitudinal studies of TAPS and sales exposure for a better understanding of adolescent tobacco use in Myanmar,

CONCLUSIONS

This study reported a high prevalence of TAPS and illicit tobacco sales exposures among Myanmar high school students. Current smoking and smokeless tobacco use among Myanmar high school students was statistically associated with overall TAPS exposure. Violations of tobacco sales regulations were reported to be strong risk factors for current smoking and smokeless tobacco use among Myanmar high school students. Our findings highlight that the need for Myanmar's Tobacco Control Law enforcement is at an alarming stage. Sales and purchase of not only cigarettes but also all forms of smoking and smokeless tobacco products in small quantities should be regulated. Specific smokeless tobacco sale regulations for minors are immediately needed in the country.

ABBREVIATIONS

TAPS	Tobacco Advertising, Promotion, and Sponsorship
AOR	Adjusted Odds Ratios
UOR	Unadjusted Odds Ratios
CI	Confidence Intervals

WHO	World Health Organization
GYTS	Global Youth Tobacco Survey
GSHS	Global School-based Student Health Survey
FCTC	Framework Convention on Tobacco Control
SPSS	Statistical Package for Social Science
IBM	International Business Machines
CSR	Corporate Social Responsibility
ASEAN	Association of South-East Asian Nations
USD	The United States Dollar

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Data sharing statement

No additional data are available.

Author contributions

YMS and NNL conceptualised the study and designed the study. NNL, and TNS contributed to data collection and data acquisition. YMS,TNS, HH, and SMC performed data analyses and data interpretations. YMS, HH, and SMC wrote the first draft of the manuscript. MK, TMT, EMW, and ZZA contributed to data acquisition. NH contributed to the study design, data interpretation, and revising the manuscript. TK and EY revised the manuscript. All authors had full access to the data, and take responsibility to the accuracy of data analysis. All authors approved the final manuscript and agreed to submit it for publication and take accountability.

Ethical approval and consent to participate

This study was approved by the Department of Medical Services, Ministry of Health, Myanmar (Letter No. 617 of Planning/Research issued on August 26, 2015), and the Ministry of Education, Myanmar (Letter No. 12125 of Information/Research issued on October 19, 2015), as well as the ethical review committee of Nagoya University School of Medicine (No. 6518 issued on August 31, 2015). All data collection and analytical processes retained anonymity for privacy and confidentiality. The locations, names, and numbers of the eligible participants of the schools involved were not documented.

Competing interests

All authors declared no conflicts of interest for this study.

Additional file

There is no additional files.

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Table List

TABLES

Table 1 Characteristics of study participants (N=1,174)

Characteristics	Male (N=482)		Female (N=692)		Total (N=1,174)	
	N	%	N	%	N	%
Age						
≤14 years	195	40.5	307	44.4	502	42.8
15 years	199	41.3	293	42.3	492	41.9
16 years	61	12.7	91	13.2	152	12.9
17 years	21	4.4	1	0.1	22	1.9
≥18 years	6	1.2	0	0.0	6	0.5
Grade						
10	330	68.5	464	67.1	794	67.6
11	152	31.5	228	32.9	380	32.4
Current smoking and smokeless tobacco use						
No	360	74.7	683	98.7	1,043	88.8
Yes	122	25.3	9	1.3	131	11.2
Parent smoking						
No	453	94.0	662	95.7	1,115	95.0
Yes	29	6.0	30	4.3	59	5.0
Sibling smoking						
No	427	88.6	652	94.2	1,079	91.9
Yes	55	11.4	40	5.8	95	8.1
Peer smoking						
No	437	90.7	641	92.6	1,078	91.8
Yes	45	9.3	51	7.4	96	8.2
Ever received health education about smoking and smokeless tobacco use						
No	228	47.3	235	34.0	463	39.4
Yes	254	52.7	457	66.0	711	60.6
Perception of smoking and smokeless tobacco products						
≤ 7	151	31.3	116	16.8	267	22.7
>7	331	68.7	576	83.2	907	77.3

Table 2 Different kinds of TAPS [a)] exposures among study participants (N=1,174)

TAPS [a)]	Use [b)] (N=131)		No use [c)] (N=1,043)		Total (N=1,174)	
	N	%	N	%	N	%
Ever seen or heard tobacco advertising and sponsorship in any form **						
No	25	19.1	307	29.4	332	28.3
Yes	106	80.9	736	70.6	842	71.7
Ever seen tobacco advertising signboards (vinyl, LED, stickers, etc.)						
No	128	97.7	994	95.3	1,122	52.0
Yes	3	2.3	49	4.7	52	4.4
Ever seen tobacco advertising drawing or painting (on vehicles, on walls, on boards, etc.)						
No	118	90.1	925	88.7	1,043	88.8
Yes	13	9.9	118	11.3	131	11.2
Ever seen tobacco advertising in journals, magazines, newspapers, and pamphlets						
No	125	95.4	998	95.7	1,123	95.7
Yes	6	4.6	45	4.3	51	4.3
Ever seen broadcasting of tobacco advertisements (TV, radio, internet, social network like Facebook, etc.)						
No	120	91.6	982	94.2	1,102	93.9
Yes	11	8.4	61	5.8	72	6.1
Ever seen or heard about the distribution of tobacco products free of charge or as gifts						
No	124	94.7	953	91.4	1,077	91.7
Yes	7	5.3	90	8.6	97	8.3
Ever seen or heard distributions of personal goods with tobacco product labels free of charge or as gifts ***						
No	64	48.9	702	67.3	766	65.2
Yes	67	51.1	341	32.7	408	34.8
Ever seen or heard about tobacco advertising with lucky draw, exchange of old cigarette pack with new ones, bonus to sellers, car stickers, etc. *						
No	125	95.4	1,025	98.3	1,150	98.0
Yes	6	4.6	18	1.7	24	2.0
Ever seen any goods with the label of a cigar or tobacco products being used in promotions (clothes, hats, lighters, key chains, tissue boxes, stationeries, kitchen utensils, etc.)						
No	34	26.0	340	32.6	703	67.4

Yes	374	31.9	97	74.0	800	68.1
Ever seen any toy, comestible or wares made in the form of a cigar (toys, chewing gums, sweet sticks, key chains, lighters, balloons, etc.)						
No	88	67.2	702	67.3	790	67.3
Yes	43	32.8	341	32.7	384	32.7
Ever heard about the announcements of tobacco advertisement at fairs and festivals *						
No	128	97.7	1,040	99.7	1,168	99.5
Yes	3	2.3	3	0.3	6	0.5
Ever seen or heard about the tobacco advertising as sponsorship or support to sports, funfairs, exhibitions, or any social activities **						
No	70	53.4	689	66.1	759	64.7
Yes	61	46.6	354	33.9	415	35.3
Exposure to any kind of TAPS [a)]						
No	8	6.1	99	9.5	107	9.1
Yes	123	93.9	944	90.5	1,067	90.9

*p<0.05, **p<0.01, ***p<0.001; [a)]Tobacco advertisement, promotion, and sponsorship, [b)]Current smoking and smokeless tobacco use, [c)]No current smoking and smokeless

Table 3 Illicit tobacco sale exposures among study participants (N=1,174)

Illicit tobacco sale	Use [b] (N=131)		No use [c] (N=1,043)		Total (N=1,174)	
	N	%	N	%	N	%
Had seen selling cigars inside or within 100 feet of the school premises within the last 12 months **						
No	92	19.1	93	13.4	185	15.8
Yes	390	80.9	599	86.6	989	84.2
Had seen selling or giving cigars to minors [a] within the last 12 months ***						
No	86	17.8	120	17.3	206	17.5
Yes	396	82.2	572	82.7	968	82.5
Had seen selling or distributing cigars by minors [a] within the last 12 months **						
No	209	43.4	312	45.1	521	44.4
Yes	273	56.6	380	54.9	653	55.6
Had seen selling cigarettes singly or in packs less than 20 cigarettes within the last 12 months ***						
No	50	10..4	108	15.6	158	13.5
Yes	432	89.6	584	84.4	1,016	86.5

*p<0.05, **p<0.01, ***p<0.001; [a]Under 18 years old

Table 4 Odds ratio (OR) and 95% confidence interval (CI) of current smoking and smokeless tobacco use among study participants (N=1,174)

Characteristics	Use [a] (N=131)	No use [b] (N=1043)	Unadjusted		Adjusted [c]	
	N (%)	N (%)	OR	95% CI	OR	95% CI
Age						
≤ 14 years	14 (10.7)	488 (46.8)	1	Reference	1	Reference
> 14 years	117 (89.3)	555 (53.2)	7.35	(4.17-12.96)***	9.81	(4.54-21.19)***
Gender						
Female	9 (6.9)	683 (65.5)	1	Reference	1	Reference
Male	122 (93.1)	360 (34.5)	25.72	(12.91-51.22)***	28.06	(13.29-59.25)***
Grade						
10	56 (42.7)	738 (70.8)	1	Reference	1	Reference
11	75 (57.3)	305 (29.2)	3.24	(2.24-4.70)***	1.52	(0.85-2.73)
Parent smoking						
No	128 (97.7)	987 (94.6)	1	Reference	1	Reference
Yes	3 (2.3)	56 (5.4)	0.41	(0.13-1.34)	0.31	(0.08-1.29)
Sibling smoking						
No	118 (90.1)	961 (92.1)	1	Reference	1	Reference
Yes	13 (9.9)	82 (7.9)	1.29	(0.70-2.39)	1.06	(0.47-2.37)
Peer smoking						
No	119 (90.8)	959 (91.9)	1	Reference	1	Reference
Yes	12 (9.2)	84 (8.1)	1.15	(0.61-2.17)	0.41	(0.17-0.95)
Exposure to any kind of TAPS [a]						

No	89 (6.1)	99 (9.5)	1	Reference	1	Reference
Yes	123 (93.9)	944 (90.5)	1.61	(0.77-3.40)	6.59	(2.33-18.64)***
Had seen selling cigars inside or within 100 feet of the school premise within the last 12 months						
No	9 (6.9)	176 (16.9)	1	Reference	1	Reference
Yes	122 (93.1)	867 (83.1)	2.75	(1.37-5.52)**	4.17	(1.65-10.58)**
Had seen selling or giving cigars to minors [a)] within the last 12 months						
No	4 (3.1)	202 (19.4)	1	Reference	1	Reference
Yes	127 (96.9)	841 (80.6)	7.63	(2.79-20.88)***	6.46	(2.18-19.12)***
Had seen selling or distributing cigars by minors [a)] more than once within the last 12 months						
No	44 (33.6)	477 (45.7)	1	Reference	1	Reference
Yes	87 (66.4)	566 (54.3)	1.67	(1.14-2.44)**	2.42	(1.42-4.10)***
Had seen selling cigarettes singly or in packs less than 20 cigarettes within the last 12 months						
No	3 (2.3)	155 (14.9)	1	Reference	1	Reference
Yes	128 (97.7)	888 (85.1)	7.45	(2.34-23.70)***	3.32	(0.93-11.85)
Ever received health education about smoking and smokeless tobacco use						
No	70 (53.4)	393 (37.7)	1	Reference	1	Reference
Yes	61 (46.6)	650 (62.3)	0.53	(0.37-0.76)***	0.45	(0.27-0.78)**
Perception of smoking and smokeless tobacco products						
≤ 7	80 (61.1)	187 (17.9)	1	Reference	1	Reference
>7	51 (38.9)	856 (82.1)	0.14	0.10-0.21)***	0.17	(0.10-0.30)***

*p<0.05, **p<0.01, ***p<0.001; [a)]Current smoking and smokeless tobacco use, [b)]No current smoking and smokeless tobacco use, [c)]Adjusted for the variables listed in the table, [d)]Under 18 years old

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7-8
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8-9
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	8-9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-10

Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	-
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9-11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	-
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	-

		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11 Table 1
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	11-13 Table 2 Table 3
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-13 Table 4
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	13

Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

A cross-sectional study on tobacco advertising, promotion and sponsorship (TAPS) and violations of tobacco sale regulations in Myanmar: Do these factors affect current tobacco use among Myanmar high school students?

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A cross-sectional study on tobacco advertising, promotion and sponsorship (TAPS) and violations of tobacco sale regulations in Myanmar: Do these factors affect current tobacco use among Myanmar high school students?

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ABSTRACT

Objectives: To examine the associations of current tobacco use with tobacco advertising, promotion and sponsorship (TAPS), and illicit tobacco sales exposures among Myanmar high school students.

Design: A quantitative, cross-sectional study.

Setting: Seven high schools from both urban and rural areas of four states and regions in Myanmar.

Participants: In total, 1,174 high school students (482 males and 692 females) were interviewed using a self-administered questionnaire.

Main outcome measure: Current tobacco use of participants, defined as using any kind of smoked or smokeless tobacco product at least one occasion within the past 30 days.

Results: The prevalence of TAPS exposure was 90.9% among high school students in Myanmar. Current tobacco use was positively associated with being over 14 years old (AOR 9.81; 95%CI 4.54–21.19), being male (AOR 28.06; 95%CI 13.29–59.25), exposure to any kind of TAPS (AOR 6.59; 95%CI 2.33–18.64), having seen any smoked tobacco product for sale inside or within 100 feet of the school premises (AOR 4.17; 95%CI 1.65–10.58), having seen the sale or gifting of any smoked tobacco product to minors (AOR 6.40; 95%CI 2.18–19.12), and having seen the sale or distribution of any smoked tobacco product by minors (AOR 2.42; 95% CI 1.42–4.10). Having ever received health education about tobacco use (AOR 0.45; 95% CI 0.27–0.78), or having a higher perception score of tobacco use (AOR 0.17; 95% CI 0.10–0.30) were negatively associated with current tobacco use.

Conclusions: There was an alarming prevalence of TAPS exposure among Myanmar high school students. TAPS exposure and violations of tobacco sale regulations were strong risk factors for current tobacco use among Myanmar high school students, while health education about tobacco products was reported as an effective protective factor. Specific smokeless tobacco sale regulations for minors are needed immediately in Myanmar.

Key words: Tobacco advertising, tobacco sale, current tobacco use, high school students, Myanmar

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This study is the first in Myanmar to report the associations of current tobacco use with TAPS, and illicit tobacco sales exposures among high school students.
- The findings of this study cannot be generalized for the whole nation. It was conducted among 1,174 students from two states and two regions out of a total of seven states, seven regions, and one territory in Myanmar.
- This study could not confirm the causal relationships of current tobacco use among high school students because of the cross-sectional nature of our study.
- Due to the limitations of the cross-sectional study design, this study calls for further TAPS-related interventional and longitudinal studies to explore Myanmar adolescents' tobacco use behaviours.

INTRODUCTION

"Tobacco use," defined as the use of any type of smoked or smokeless tobacco,[1)] is regarded as an important public health concern worldwide. Globally, it was estimated that 24 million (7.0%) adolescents aged between 13 and 15 years had smoked cigarettes in the past 30 days and 13.4 million (3.6%) had used smokeless tobacco products in the past 30 days during 2017.[1)] In the United States, it was reported that 4 million high school students were current tobacco users in 2018.[2)] In Southeast Asia , the prevalence of adolescents' tobacco use in the past 30 days was 5.7% and that of smokeless tobacco use was 7.2% over the period of 2007 to 2017.[1)] A recent multi-national study reported that, between 2009 and 2013, adolescent smokeless tobacco use in the World Health Organization (WHO) South-East Asia Region (SEAR) was at its highest in Bhutan (23.2%), followed by Nepal (16.2%), Timor-Leste (14.2%), Myanmar (9.8%), India (9.0%), Sri Lanka (8.5%), the Maldives (6.2%), Bangladesh (5.9%), and Thailand (5.7%).[3)] Thus, Myanmar ranked the fourth-highest for adolescent smokeless tobacco use among these nine countries. Myanmar is one of the countries with high prevalence of tobacco use among young population in the WHO SEAR countries.[4)] Cigarette smoking among schoolchildren is much higher in Myanmar compared to other SEAR countries, i.e., Bangladesh, India, Maldives, Nepal, and Sri Lanka.[5)] The use of smokeless tobacco product is also highly prevalent in Myanmar as compared to other countries.[6)]

Tobacco use is responsible for five million deaths every year globally, a figure that is expected to rise to 10 million per year by 2030.[7] In 2004, it was estimated that 600,000 people had died from the effects of second-hand smoke, accounting for roughly 1% of global mortality.[8] Adolescents are highly vulnerable to addiction to the nicotine in tobacco. A recent study has shown that the earlier people become dependent on nicotine, the more likely they are to become addicted to smoking in adulthood.[9] Moreover, nicotine consumption may negatively impact brain development during adolescence.[10] Studies have shown that adolescent smoking is associated with poor academic performance[11] and attention and cognitive deficits.[12] Smokeless tobacco use is as dangerous as smoked forms of tobacco because it contains nicotine, carcinogens and other toxic chemicals.[13] Smokeless tobacco use has deleterious effects to oral health including the staining and discolouration of teeth, leukoplakia, erythroplakia and oral cancer.[14]A recent systematic review from India reported a positive association between smokeless tobacco use and various cancers (oral, oesophageal, pancreatic) in the South-East Asian Region and Eastern Mediterranean Region.[15] Moreover, another recent systematic review in the United States found an increased risk of heart disease and stroke among smokeless tobacco users.[16]

Studies have shown that tobacco and smokeless tobacco use is highly prevalent among Myanmar high school students. Since 2001, the Global Youth Tobacco Survey

(GYTS) has been conducted every 3 to 5 years in Myanmar to monitor tobacco use among high school students .The findings from the 2016 GYTS conducted among high school students pointed out that the prevalence of the current use of smoked tobacco products and the prevalence of the current use of smokeless tobacco products was 10.6% and 5.7 respectively.[17] In parallel with the GYTS, Myanmar has been conducting the nationwide Global School-based Student Health Survey (GSHS) to monitor the understanding of health risk behaviours among high school students. The 2016 survey also reported that the prevalence of current tobacco smoking and current smokeless tobacco use among high school students was 7.2% and 8.5%, respectively.[18] Another study conducted among high school students in 2015 in Nay Pyi Taw, Myanmar, reported that 34.7% were smokers and 28.3% were smokeless tobacco users.[19] Therefore, the use of smoked and smokeless tobacco among high school students in Myanmar is an important public health issue as well as a social one. Moreover, all these studies also pointed out that most high school students began using tobacco before the age of 14. However, in Myanmar, parents tend to show less concern about their children becoming smokeless tobacco users (especially chewing betel quid with tobacco) because there is a widespread misconception that the use of smokeless tobacco is not as harmful as the use of cigarettes.[13] It is important to monitor the initiation and pattern of tobacco use among adolescents and youths, especially among high school students.

More than a decade ago, Myanmar signed the WHO Framework Convention on Tobacco Control (FCTC) and enacted the first Tobacco Control Law in 2006, regulating tobacco advertising, promotion, and sponsorship (TAPS) and tobacco sales to minors.[17] Subsequently, the restrictions on smoking in all indoor public places, the introduction of graphic health warnings on tobacco product packaging, and the raising of tobacco product taxes were all promulgated. Despite this, the prevalence of current tobacco use among Myanmar high school students has not changed significantly over the past 15 years.[17]

A comparison of the 2007 and the 2016 GSHS also revealed that the prevalence of cigarette smoking among high school students had increased significantly, from 2.0% to 6.7%.[18] Although the Tobacco Control Law has banned tobacco sales to minors, adolescent smokers can still buy cigarettes from large stores, retail shops, or street vendors very easily.[17] These alarming findings indicate the failure of efforts to control tobacco consumption among young people in Myanmar.

Although the Tobacco Control Law in Myanmar prohibits TAPS activities by the tobacco industry, TAPS activities are still common. Most tobacco companies distribute tobacco products and personal goods with tobacco product labels either free of charge or as gifts. According to the 2016 Myanmar GYTS conducted among high school students, 8.7% of boys and 3.6% of girls reported that tobacco companies had offered free tobacco products,

and 7.3% of boys and 4.2% of girls reported owning something with tobacco branding or a tobacco logo.[17] Furthermore, 83.4% of the students reported noticing someone using tobacco products on television or in videos and movies.[17]

Researchers from other parts of the world have reported that TAPS exposure can affect adolescent smoking behaviours.[20-23] A positive association between exposure to cigarette advertisements and initiating smoking has been reported among Indonesian students.[20] A longitudinal study conducted in Germany also pointed out that, with every additional 10 tobacco advertisements, the adjusted relative risk for established smoking and daily smoking was raised by 38% and 30%, respectively.[24] Adolescent students, in a phase of life where curiosity is at its peak, are vulnerable to adopting smoked or smokeless tobacco use.[13, 25]

At present, research in Myanmar is limited where concerns the patterns of high school students' tobacco use and their connection to TAPS exposure. Our previous study,[26] conducted among the same participants, revealed the low awareness of the Tobacco Control Law among Myanmar high school students, but we did not examine how TAPS exposure and violations of tobacco sales regulations might affect Myanmar high school students' tobacco use. The present study aims to investigate (1) the prevalence of TAPS and illicit tobacco sale

exposures and (2) their associations with current tobacco use among Myanmar high school students.

MATERIALS AND METHODS

Study population

A cross-sectional study was conducted among grade 10 and 11 high school students from seven high schools in Shan State, Mon State, Bago region, and Magway region in Myanmar. A simple random sampling technique using a drawing method was applied to select the study areas and schools. The details of the sampling procedure have been described elsewhere.[26] In total, 1,339 high school students answered a self-administrated questionnaire. Of these, 165 were excluded due to missing or incomplete responses to TAPS exposure questions. In sum, the total number of participants was 1,174 (482 males and 692 females) and the response rate was 87.7%.

Data collection

Data were collected by using a pre-tested, anonymous, paper and pencil self-administered questionnaire. The questionnaire in the Myanmar language contained 40 questions, covering nine components:1) background information, 2) experience with tobacco products, 3) exposure to second-hand smoking, 4) perception of smoked and smokeless tobacco products,

5) sale of tobacco, 6) health warnings and information, 7) tobacco advertisement, promotion, and sponsorship, 8) smoke-free areas, and 9) the Tobacco Control Law and its enforcement.

Study measures

Dependent variable

The outcome variable was "current tobacco use" among high school students. It was defined as the use of any kind of smoked or smokeless tobacco product on at least one occasion within the 30 days preceding the survey.

Independent variables

After controlling socio-demographic characteristics, smoking exposure at home and school, receiving health education about tobacco use, and the perception of tobacco use as covariates, the independent variables in this study were participants' exposure to any kind of TAPS and illicit tobacco sale exposures. "Exposure to any kind of TAPS" was defined using the following variables: 1) having seen or heard tobacco advertisements or sponsorship in any form, 2) having seen any goods displaying the label of any tobacco product being used in promotion, and 3) having seen any toy, comestible, or wares made in the form of any tobacco product. If a student had had at least one TAPS exposure, the response was counted as a "Yes," and if they had never experienced exposure, their response was counted as a "No."

For illicit tobacco sale exposures, we measured four different types of tobacco sales to students contravening several of the tobacco sale regulations prohibited by Myanmar Tobacco Control Law. These four variables were: 1) having seen any smoked tobacco product for sale inside or within 100 feet of the school premises within the last 12 months, 2) having seen the sale or gifting of any smoked tobacco product to minors within the last 12 months, 3) having seen the sale or distribution of any smoked tobacco product by minors within the last 12 months, and 4) having seen the sale of cigarettes singly or in packs containing less than 20 within the last 12 months.

Study analysis

The data were coded, entered, and analysed using the Statistical Package for Social Science (SPSS) software program version 24.0 (IBM SPSS Inc.). Categorical data were analysed by chi-square tests for hypothesis testing. For multivariable logistic regression, all the variables were re-coded on a dichotomous scale. All analyses were two-tailed, setting $p<0.05$ as the significance value.

Public and patient involvement statement

Patients and members of the public were not involved in the design of this study. The study findings will be disseminated within Ministries.

RESULTS

Table 1 shows the characteristics of the study participants by gender. Most of the participants (84.7%) were younger than or equal to 15 years of age. More than two-thirds of the students (68.5% of males and 67.1% of females) were grade 10 students. Of those who took part, 25.3% of male and 1.3% of female students were current users of smoked or smokeless tobacco at the time of the survey. Male students had more exposure to parental smoking (6.0%), sibling smoking (11.4%), and peer smoking (9.3%) than did female students. Nearly two-thirds of females (66.0%) reported receiving health education about tobacco use, compared to 52.7% of males. Regarding the perception of tobacco use, out of eight items, we set the mean score of seven as the cut-off point. Overall, 68.7% of males and 83.2% of females scored more than seven.

Table 2 presents different kinds of TAPS exposures and its associations with current tobacco use among the study participants. In total, 90.9% had TAPS exposure in any form. The findings indicate that 71.7% had seen or heard of tobacco advertisement and sponsorship in any form, and 68.1% had seen goods displaying the label of any tobacco product being used in promotions. One out of three students had seen toys, comestibles or wares made in the form of any tobacco product. More than one-third of the participants (35.3%) had seen or heard tobacco advertisements in sponsorship or support of sports, funfairs, exhibitions, or other social activities.

Table 3 describes illicit tobacco sale exposures and their associations with current tobacco use among the study participants. Within the last 12 months, more than 80.0% had been exposed to the sale of any smoked tobacco product inside or within 100 feet of the school premises, the sale or gifting of any smoked tobacco product to minors, or the sale of cigarettes singly or in packs of less than 20. Nearly 56.0% had seen the sale or distribution of any smoked tobacco product by minors.

Table 4 presents the unadjusted odds ratio (UOR), adjusted odds ratio (AOR), and 95% confidence intervals (CI) of current tobacco use among Myanmar high school students. In the binary logistic regression, being a grade 11 student (UOR 3.24; 95% CI 2.24-4.70) and having seen the sale of cigarettes, either singly or in packs of less than 20 (UOR 7.45; 95%CI 2.34–23.70) were associated with current tobacco use.

From the multiple logistic regression, current tobacco use was found to be positively associated with being over 14 years old (AOR 9.81; 95%CI 4.54–21.19); being male (AOR 28.06; 95%CI 13.29–59.25); being exposed to any kind of TAPS (AOR 6.59; 95%CI 2.33–18.64); having seen any smoked tobacco product for sale inside or within 100 feet of the school premises within the last 12 months (AOR 4.17; 95%CI 1.65–10.58); having seen the sale or gifting of any smoked tobacco product to minors within the last 12 months (AOR 6.40; 95%CI 2.18–19.12); and having seen the sale or distribution of any smoked tobacco product

by minors within the last 12 months (AOR 2.42; 95% CI 1.42–4.10). Having ever received health education about tobacco use (AOR 0.45; 95% CI 0.27–0.78) and having a higher perception score with regards to tobacco use (AOR 0.17; 95% CI 0.10–0.30) were negatively associated with current tobacco use (Table 3).

DISCUSSION

To the best of our knowledge, this is the first study to report the associations of current tobacco use with TAPS and illicit tobacco sale exposures among high school students in Myanmar. The majority of the study participants reported having been exposed to TAPS and illicit tobacco sales. TAPS exposure and illicit tobacco sale exposures increase the odds of current tobacco use among high school students.

In this study, a high prevalence of TAPS exposure (91%) was reported among high school students in Myanmar, a country that has completely banned all forms of direct or indirect TAPS, including Corporate Social Responsibility (CSR) activities by the tobacco industry.[27] Myanmar has a well-established Tobacco Control Law named the "Control of Smoking and Consumption of Tobacco Product Law," which has been enacted since 2006.[27] However, the monitoring, reporting and punishment of TAPS activities prohibited by the law are not common in Myanmar. Other studies conducted in Myanmar also pointed out that the awareness of the tobacco control law among high school students was low and that the lack of

tobacco control law enforcement was in a critical state.[19,26] It is not rare to see sponsored events and CSR activities executed by tobacco companies, violating the TAPS regulations and reframing tobacco products' image among Myanmar youths.[19,26] The global tobacco industry has been focusing on expanding its market in developing countries that have low tobacco taxes, partial TAPS bans, and weak law enforcement of TAPS regulations, rather than in developed countries with high tobacco taxes, comprehensive and complete TAPS bans, and the strict implementation of TAPS regulations.[28-31]

The weakness of tobacco control law enforcement in Myanmar creates opportunities for tobacco companies and retailers to violate it. Nigerian researchers have reported that exposure to events sponsored by the tobacco industry was associated with current cigarette use and demonstrated the importance of the tobacco control law and its enforcement in reducing tobacco use. Our findings highlighted the urgent need to enforce this law in Myanmar to reduce TAPS exposure among adolescents in order to decrease tobacco use. It also encourages Myanmar policymakers to formulate specific TAPS regulations addressing newly developed smoking and smokeless tobacco products and complete comprehensive TAPS bans, including cross-border TAPS. Local authorities need to monitor TAPS among Myanmar youths strictly and to punish the tobacco companies, stores, and retailers violating TAPS regulations.

High school students exposed to TAPS in any form were six times more likely to be current tobacco users than those without any TAPS exposure. A recent study from Myanmar has reported that only half of the high school students had heard about the Tobacco Control Law, and none of the study participants had ever heard of any reporting of or punishment for any violation of the Tobacco Control Law that bans TAPS activities and tobacco sales among minors.[26] Our study suggests that Myanmar high school students should be properly informed not only about the dangers of TAPS exposure but also about the country's Tobacco Control Law and its punishments.

In this study, the prevalence of current tobacco use among Myanmar high school students was 11.2%, which is higher than the national figure of 9.8% reported in the 2016 WHO GSHS for students between 13 and 17 years old in Myanmar.[18] Our study also reported that male high school students were more likely to be current tobacco users than their female peers were. A sub-national-level study also reported a considerably high prevalence of smoked (34.7%) and smokeless tobacco use (28.3%) among high school students.[19] The findings suggest Myanmar policymakers to consider both smoked and smokeless tobacco use among adolescents as a public health priority and to put more effort into implementing control measures.

In Myanmar, it has been reported that there were only three full-time staff assigned

to national tobacco control, meaning they were each responsible for 2,080,000 smokers.[32] The country also has an insufficient government budget for tobacco control and there is no health promotion funding mechanism in place for the use of tobacco taxes.[32] To tackle the current situation in Myanmar, the effective implementation of tobacco control measures is needed to reduce current tobacco use, and human and financial resources for national tobacco control should be improved.

Increasing tobacco tax, as recommended for implementation of Article 6 of the WHO FCTC, functions as a cost-effective demand-reducing measure in global tobacco control.[32] However, cigarettes in Myanmar are relatively cheap, indicating that the country's tobacco tax policies need to be re-evaluated. Among the Association of Southeast Asian Nations (ASEAN), the price of the most popular local cigarette brand in Myanmar is the second lowest (0.6 USD/20-stick pack), and that of the most popular foreign brand in Myanmar is the fourth highest (2.11 USD/20-stick pack).[32] This indicates a gap in tax differences between local and foreign brands of cigarettes. The price at which youths in Myanmar are deterred from smoking is reportedly 11 USD/20-stick pack, the lowest among the ASEAN.[32] Therefore, the Myanmar government should revaluate tobacco tax levels and adjust tax policies to decrease tobacco use and TAPS exposures.

In this study, students who had seen any smoked tobacco product for sale inside or within 100 feet of the school premises during the last 12 months were four times more likely to be current tobacco users than their peers were. It is illegal to sell any kind of smoked tobacco products inside or within 100 feet of school premises in Myanmar.[27] This finding implies that the lack of monitoring and reporting of illicit tobacco sales inside or near school premises exerts an influence on current tobacco use among Myanmar high school students. In addition, these illicit tobacco sales provide easy access to tobacco for students as well as for school personnel, triggering second-hand smoking exposure and student curiosity about tobacco use. Therefore, school personnel, students, and parents should monitor and report any illicit tobacco sales to local authorities and actions should be taken according to the rules and regulations.

However, there is no specific regulation on smokeless tobacco sales and distributions to and by minors in Myanmar, the sale or gifting of any smoked tobacco product to minors and the sale or distribution of any smoked tobacco product by minors are illegal.[27] Nonetheless, 82.5% of participants in this study reported that they had seen someone selling or gifting of any smoked tobacco product to a minor within the last 12 months, and 55.6% of the participants reported having witnessed the sale or distribution of any smoked tobacco product by minors within the last 12 months. The study also revealed that having seen these

two illicit tobacco activities within the last 12 months was significantly associated with current tobacco use among the study participants. A study of adolescents in the United States has also reported an association between smokeless tobacco use and smoking.[33] In order to reduce current tobacco use among Myanmar high school students, this study recommends the urgent need of specific smokeless tobacco regulations concerning sales made to and by minors in Myanmar, and strict law enforcement on sales and distributions all smoked and smokeless tobacco to and by minors in the country.

Another common violation of the Tobacco Control Law in Myanmar is the sale of cigarettes singly or in packs of less than 20. Despite the significant price difference[32] both foreign and local brands become affordable for smokers when they are sold singly or in packs of less than 20. Such sales are contrary to the demand-reducing tobacco control measures of the national policy and negatively affect the tobacco use of all age groups, especially adolescents.

In addition, other smoked and smokeless tobacco products, such as cheroots, cigars, pipes, betel quids, etc., can be purchased singly or in small quantities in Myanmar. To reduce tobacco use in all age groups, our study recommends that the 2006 Tobacco Control Law be updated to address the sale and purchase of all forms of smoked and smokeless tobacco products in small quantities, along with strict law enforcement, especially among minors.

The findings of this study imply that effective health education and high perception of tobacco use can be effective factors in combating the current tobacco use among Myanmar high school students. In this study, students who had received health education about tobacco use and those with a higher perception score of tobacco use were less likely to be current tobacco users than their counterparts. Nearly two-thirds of the participants had received health education about tobacco use, and nearly 80% had a higher perception score. Health education programs and tobacco control measures targeting the young should address the newly developed and popular tobacco products like electronic cigarettes, shisha, pipes, menthol and fruit-flavoured cigarettes etc. Youths' awareness of not only the harms of tobacco products but also the country's Tobacco Control Law should be promoted.

The study findings also revealed that 10.7% of current tobacco users were 14 years old or less. Another Myanmar researcher has reported that the average age for first tobacco use is 14 years.[19] Therefore, tobacco control intervention measures should be introduced to Myanmar high school students before the age of 14. Awareness of the Tobacco Control Law remains quite low in Myanmar.[19,26] Furthermore, the provision of health education via youth-friendly media, such as the internet, mobile applications, and social networking services, may attract more attention from high school students.

In contrast to other studies,[19,26] parental smoking, sibling smoking, and peer smoking were not found to be associated with current tobacco use in this study. This may be because only the smoking status of parents, siblings and peers of the participants was assessed in this study and most of the study participants did not have exposure to parents, siblings, or peers who smoked. Having high knowledge and perception about tobacco use may also have prevented them from using tobacco.[19]

Despite being the very first study in Myanmar to report the associations between current tobacco use, TAPS and illicit tobacco sale exposure among Myanmar high school students, the present study did not explore the associations of first-time or daily tobacco use, and TAPS or illicit tobacco sales among Myanmar high school students. This study was conducted among 1,174 high school students from two states and two regions out of a total of seven states, seven regions and one territory of Myanmar, and its findings cannot be generalized for the whole nation. Due to the limitations of the cross-sectional nature of our study, we recommend further interventional or longitudinal studies of TAPS and sales exposure for a better understanding of adolescent tobacco use in Myanmar.

CONCLUSIONS

This study reported high prevalences of TAPS and illicit tobacco sales exposures among Myanmar high school students. Current tobacco use among Myanmar high school students

was statistically associated with overall TAPS exposure. Violations of tobacco sales regulations were reported to be strong risk factors for current smoked and smokeless tobacco use among Myanmar high school students. Our findings highlight that Myanmar's Tobacco Control Law enforcement is in an alarming state and requires urgent improvement. Sales and purchase of not only cigarettes but also all forms of smoked and smokeless tobacco products in small quantities should be regulated. Specific smokeless tobacco sale regulations for minors are urgently needed in the country.

ABBREVIATIONS

TAPS	Tobacco Advertising, Promotion, and Sponsorship
AOR	Adjusted Odds Ratios
UOR	Unadjusted Odds Ratios
CI	Confidence Intervals
WHO	World Health Organization
GYTS	Global Youth Tobacco Survey
GSHS	Global School-based Student Health Survey
FCTC	Framework Convention on Tobacco Control
SPSS	Statistical Package for Social Science
IBM	International Business Machines

CSR	Corporate Social Responsibility
ASEAN	Association of South-East Asian Nations
USD	The United States Dollar

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Data sharing statement

No additional data are available.

Author contributions

YMS and NNL conceptualised the study and designed the study. NNL, and TNS contributed to data collection and data acquisition. YMS, TNS, HH, and SMC performed data analyses and data interpretations. YMS, HH, and SMC wrote the first draft of the manuscript. MK, TMT, EMW, TK, EY, and ZZA contributed to data acquisition. NH contributed to the study design, data interpretation, and revising the manuscript. YMS, TNS, SMC, and NH revised and edited the manuscript. All authors had full access to the data, and take responsibility to

the accuracy of data analysis. All authors approved the final manuscript and agreed to submit it for publication and take accountability.

Ethical approval and consent to participate

This study was ethically approved by the Department of Medical Services, Ministry of Health and Sports, Myanmar (Letter No. 617 of Planning/Research issued on August 26, 2015), and the Ministry of Education, Myanmar (Letter No. 12125 of Information/Research issued on October 19, 2015), as well as the ethical review committee of Nagoya University School of Medicine (No. 6518 issued on August 31, 2015). To conduct this school- based survey, permissions from Ministry of Education, Regional Offices of Basic Education, Ministry of Health and Sports, local educational steering committees and authorities, the schools' authorities, the headmasters of participated schools and local Parents-Teacher Associations were obtained. The survey procedure was approved by Ministry of Education and Ministry of Health and Sports. After thoroughly explaining the study's objectives, contents of the survey questionnaire, and rights of the study participants, the written-informed consents from local educational steering committees and authorities, the schools' authorities, the headmasters of participated schools, local Parents-Teacher Associations, and parents were obtained. One week prior to the survey, the information sheet and the written-informed consents that stating the study's objectives, the survey's procedure and the contents of the questionnaires, and the rights of the study participants were sent to parents. Researchers also explained the study's objectives, contents of the survey questionnaire, the voluntary nature and procedure of the survey, and the rights of the participants to collaborators, students and teachers before conducting the survey. All data collection and analytical processes remain anonymous for privacy and confidentiality. The locations, names, and numbers of the eligible participants of the schools involved were not documented.

Competing interests

All authors declared no conflicts of interest for this study.

Additional file

There is no additional files.

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Table List

Table 1 Characteristics of study participants

Table 2 Different kinds of TAPS [a)] exposures among study participants

Table 3 Illicit tobacco sale exposures among study participants

Table 4 Odds ratio (OR) and 95% confidence interval (CI) of current tobacco use among study participants.

TABLES

Table 1 Characteristics of study participants (N=1,174)

Characteristics	Male (N=482)		Female (N=692)		Total (N=1,174)	
	N	%	N	%	N	%
Age						
≤14 years	195	40.5	307	44.4	502	42.8
15 years	199	41.3	293	42.3	492	41.9
16 years	61	12.7	91	13.2	152	12.9
17 years	21	4.4	1	0.1	22	1.9
≥18 years	6	1.2	0	0.0	6	0.5
Grade						
10	330	68.5	464	67.1	794	67.6
11	152	31.5	228	32.9	380	32.4
Current tobacco use						
No	360	74.7	683	98.7	1,043	88.8
Yes	122	25.3	9	1.3	131	11.2
Parent smoking						
No	453	94.0	662	95.7	1,115	95.0
Yes	29	6.0	30	4.3	59	5.0
Sibling smoking						
No	427	88.6	652	94.2	1,079	91.9
Yes	55	11.4	40	5.8	95	8.1
Peer smoking						
No	437	90.7	641	92.6	1,078	91.8
Yes	45	9.3	51	7.4	96	8.2
Ever received health education about tobacco use						
No	228	47.3	235	34.0	463	39.4
Yes	254	52.7	457	66.0	711	60.6
Perception of tobacco use						
≤ 7	151	31.3	116	16.8	267	22.7
>7	331	68.7	576	83.2	907	77.3

Table 2 Different kinds of TAPS [a)] exposures among study participants (N=1,174)

TAPS [a)]	Use [b)] (N=131)		No use [c)] (N=1,043)		Total (N=1,174)	
	N	%	N	%	N	%
Ever seen or heard tobacco advertising and sponsorship in any form **						
No	25	19.1	307	29.4	332	28.3
Yes	106	80.9	736	70.6	842	71.7
Ever seen tobacco advertising signboards (vinyl, LED, stickers, etc.)						
No	128	97.7	994	95.3	1,122	52.0
Yes	3	2.3	49	4.7	52	4.4
Ever seen tobacco advertising drawing or painting (on vehicles, on walls, on boards, etc.)						
No	118	90.1	925	88.7	1,043	88.8
Yes	13	9.9	118	11.3	131	11.2
Ever seen tobacco advertising in journals, magazines, newspapers, and pamphlets						
No	125	95.4	998	95.7	1,123	95.7
Yes	6	4.6	45	4.3	51	4.3
Ever seen broadcasting of tobacco advertisements (TV, radio, internet, social network like Facebook, etc.)						
No	120	91.6	982	94.2	1,102	93.9
Yes	11	8.4	61	5.8	72	6.1
Ever seen or heard about the distribution of tobacco products free of charge or as gifts						
No	124	94.7	953	91.4	1,077	91.7
Yes	7	5.3	90	8.6	97	8.3
Ever seen or heard distributions of personal goods with tobacco product labels free of charge or as gifts ***						
No	64	48.9	702	67.3	766	65.2
Yes	67	51.1	341	32.7	408	34.8
Ever seen or heard about tobacco advertising with lucky draw, exchange of old cigarette pack with new ones, bonus to sellers, car stickers, etc. *						
No	125	95.4	1,025	98.3	1,150	98.0
Yes	6	4.6	18	1.7	24	2.0
Ever seen any goods with the label of any tobacco product being used in promotions (clothes, hats, lighters, key chains, tissue boxes, stationeries, kitchen utensils, etc.)						
No	34	26.0	340	32.6	703	67.4

Yes	374	31.9	97	74.0	800	68.1
Ever seen any toy, comestible or wares made in the form of any tobacco product (toys, chewing gums, sweet sticks, key chains, lighters, balloons, etc.)						
No	88	67.2	702	67.3	790	67.3
Yes	43	32.8	341	32.7	384	32.7
Ever heard about the announcements of tobacco advertisement at fairs and festivals *						
No	128	97.7	1,040	99.7	1,168	99.5
Yes	3	2.3	3	0.3	6	0.5
Ever seen or heard about the tobacco advertising as sponsorship or support to sports, funfairs, exhibitions, or any social activities **						
No	70	53.4	689	66.1	759	64.7
Yes	61	46.6	354	33.9	415	35.3
Exposure to any kind of TAPS [a)]						
No	8	6.1	99	9.5	107	9.1
Yes	123	93.9	944	90.5	1,067	90.9

*p<0.05, **p<0.01, ***p<0.001; [a)]Tobacco advertisement, promotion, and sponsorship, [b)]Current tobacco use, [c)]No current tobacco use

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Table 3 Illicit tobacco sale exposures among study participants (N=1,174)

Illicit tobacco sale	Use [b] (N=131)		No use [c] (N=1,043)		(N
	N	%	N	%	N
Had seen any smoked tobacco product for sale inside or within 100 feet of the school premises within th					
No	92	19.1	93	13.4	
Yes	390	80.9	599	86.6	
Had seen the sale or gifting of any smoked tobacco product to minors [a] within the last 12 months ***					
No	86	17.8	120	17.3	
Yes	396	82.2	572	82.7	
Had seen the sale or distribution of any smoked tobacco product by minors [a] within the last 12 months					
No	209	43.4	312	45.1	
Yes	273	56.6	380	54.9	
Had seen the sale of cigarettes singly or in packs less than 20 cigarettes within the last 12 months ***					
No	50	10..4	108	15.6	
Yes	432	89.6	584	84.4	

*p<0.05, **p<0.01, ***p<0.001; [a]Under 18 years old, [b]Current tobacco use, [c]No current tobacco use

Table 4 Odds ratio (OR) and 95% confidence interval (CI) of current tobacco use among study participants (N=1,174)

Characteristics	Use [a] (N=131)	No use [b] (N=1043)	Unadjusted		Adjusted [c]	
	N (%)	N (%)	OR	95% CI	OR	95% CI
Age						
≤ 14 years	14 (10.7)	488 (46.8)	1	Reference	1	Reference
> 14 years	117 (89.3)	555 (53.2)	7.35	(4.17-12.96)***	9.81	(4.54-21.19)***
Gender						
Female	9 (6.9)	683 (65.5)	1	Reference	1	Reference
Male	122 (93.1)	360 (34.5)	25.72	(12.91-51.22)***	28.06	(13.29-59.25)***
Grade						
10	56 (42.7)	738 (70.8)	1	Reference	1	Reference
11	75 (57.3)	305 (29.2)	3.24	(2.24-4.70)***	1.52	(0.85-2.73)
Parent smoking						
No	128 (97.7)	987 (94.6)	1	Reference	1	Reference
Yes	3 (2.3)	56 (5.4)	0.41	(0.13-1.34)	0.31	(0.08-1.29)
Sibling smoking						
No	118 (90.1)	961 (92.1)	1	Reference	1	Reference
Yes	13 (9.9)	82 (7.9)	1.29	(0.70-2.39)	1.06	(0.47-2.37)
Peer smoking						
No	119 (90.8)	959 (91.9)	1	Reference	1	Reference
Yes	12 (9.2)	84 (8.1)	1.15	(0.61-2.17)	0.41	(0.17-0.95)

Exposure to any kind of TAPS [a)]						
No	89 (6.1)	99 (9.5)	1	Reference	1	Reference
Yes	123 (93.9)	944 (90.5)	1.61	(0.77-3.40)	6.59	(2.33-18.64)***
Had seen any smoked tobacco product for sale inside or within 100 feet of the school premises within the last 12 months						
No	9 (6.9)	176 (16.9)	1	Reference	1	Reference
Yes	122 (93.1)	867 (83.1)	2.75	(1.37-5.52)**	4.17	(1.65-10.58)**
Had seen the sale or gifting of any smoked tobacco product to minors [a)] within the last 12 months						
No	4 (3.1)	202 (19.4)	1	Reference	1	Reference
Yes	127 (96.9)	841 (80.6)	7.63	(2.79-20.88)***	6.46	(2.18-19.12)***
Had seen the sale or distribution of any smoked tobacco product by minors [a)] within the last 12 months						
No	44 (33.6)	477 (45.7)	1	Reference	1	Reference
Yes	87 (66.4)	566 (54.3)	1.67	(1.14-2.44)**	2.42	(1.42-4.10)***
Had seen the sale of cigarettes singly or in packs less than 20 cigarettes within the last 12 months						
No	3 (2.3)	155 (14.9)	1	Reference	1	Reference
Yes	128 (97.7)	888 (85.1)	7.45	(2.34-23.70)***	3.32	(0.93-11.85)
Ever received health education about tobacco use						
No	70 (53.4)	393 (37.7)	1	Reference	1	Reference
Yes	61 (46.6)	650 (62.3)	0.53	(0.37-0.76)***	0.45	(0.27-0.78)**
Perception of tobacco use						
≤ 7	80 (61.1)	187 (17.9)	1	Reference	1	Reference
>7	51 (38.9)	856 (82.1)	0.14	(0.10-0.21)***	0.17	(0.10-0.30)***

*p<0.05, **p<0.01, ***p<0.001; [a)]Current tobacco use, [b)]No current tobacco use, [c)]Adjusted for age, gender, grade, parent smoking, sibling smoking, peer smoking, ever received health education about tobacco use, and perception of tobacco use, [d)]Under 18 years old

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-9
Objectives	3	State specific objectives, including any prespecified hypotheses	8-9
Methods			
Study design	4	Present key elements of study design early in the paper	9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	9-10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10-11

Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-11
Bias	9	Describe any efforts to address potential sources of bias	21
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10-11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9,11-12

		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11-13 Table 1 to 3
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	11-14 Table 1 Table 2 Table 3
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-14 Table 4
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-

Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	23

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.