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Predictors of cigarette smoking across five countries: A cross-sectional study

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ABSTRACT

Background: Tobacco use continues to be the leading cause of death and disability in both developed and developing countries and is expected to remain so in 2020. Our research team has collected and analyzed survey-based data on smoking habits from several countries around the world including China, India, Jordan, Saudi Arabia, and Taiwan. Our objectives here are to identify correlates of cigarette smoking that are common across these countries. **Methods:** A cross-sectional study conducted among 3,658 participants from a convenience sample of adults from each country collected between 2008 and 2011. The survey included questions on socio-demographic characteristics, current and history of cigarette smoking, family and peer smoking, and perceived harm. Multivariate logistic regression was used to determine predictors of cigarette smoking in the past 24 h as well as in the past month. **Results:** Approximately, 40% of the sample had smoked a cigarette in the past day and 44% in the past month. Significant predictors included male gender, aged 25 years or more, lower education level and school performance, medical profession, dyspepsia, feeling lonely and bothered by events, using other tobacco products, alcohol use and family and friend smoking. Those who received anti-smoking messages from teachers in schools were less likely to be smokers. **Conclusions:** Results underscore the importance of teachers and school based anti-smoking programs in smoking prevention across cultures and highlight the prominence of social peer pressure and smoking family members as major predictors of smoking that must be incorporated in any tobacco prevention or cessation program.

KEY WORDS: Convenience sample, five nations, predictors, smoking, tobacco use

INTRODUCTION

Smoking is considered a chemical toxicant that can acutely or chronically cause detrimental effects on several body structures, including those in the cardiovascular and respiratory systems [1]. Cigarette smoking is a risk factor of several cancers [2-4] as well as heart attacks [5] and chronic obstructive pulmonary disease [6]. Tobacco use continues to be the leading cause of death and disability in both developed and developing countries and is expected to remain so in 2020 [7]. It is responsible for approximately 5.4 million deaths annually across the globe [8]. In the United sates, 443,000 deaths annually are attributed to smoking with a significant economic burden estimated at $193 billion and $96 billion in direct medical costs. Our research team has collected and analyzed survey based data on smoking habits from several countries around the world including China, India, Jordan, Saudi Arabia, and Taiwan. The predictors of cigarette smoking in these countries have been identified, and findings were published in several manuscripts [9-13]. The future goals are to develop culturally appropriate smoking cessation interventions tailored to each country based on the identified predictors. We recently combined the data from these countries into one dataset for a more generalizable population. Our objectives here are to identify correlates of cigarette smoking that are common across these countries. Implementing interventions that recognize predictors of use across different cultures can result in effective strategies that can be successful in reducing global cigarette smoking and prevent further infiltration worldwide.

STUDY POPULATION AND METHODS

Data Collection

A cross-sectional study was conducted in a convenience sample of willing adults 18 years or older from five countries: China, India, Jordan, Saudi Arabia, and Taiwan. Data were collected between 2008 and 2011. The study was institutional review board exempt and the survey was adapted from a previously used self-report survey [14,15]. Questions covered socio-demographic characteristics, current and history of cigarette smoking, environmental and behavioral determinants of smoking such as peer influence, and perceived harm. Distribution sites included physician clinics, academic institutions, shopping centers and marketing companies. Adults coming into the sites were randomly asked if they were willing to participate in a survey regarding smoking habits and attitudes that would need 5-10 min to fill out. If they agreed, they were given a survey and asked to drop the completed survey in a sealed box that was designated for this purpose at each site. Details of sampling procedures in each country have been previously described [9-13].

Statistical Analysis

Descriptive statistics and Chi-square analyses were performed to determine the frequencies and associations of sample characteristics with two outcomes: Past day use of cigarettes smoking versus no use, based on a survey question (Did you smoke cigarettes in the past day?) and past month use of cigarettes smoking versus no use, based on the survey question (Did you smoke cigarettes in the past 30 days?). The two outcomes were used to investigate if there were differences in smoking predictors among smokers who smoke daily compared with those who smoke less frequently. Bivariate analyses of participant characteristics were carried out with the two outcome variables, and results were presented as unadjusted odds ratios (OR) with 95% confidence intervals (CI). Two multivariate logistic regression models were carried out to determine predictors of cigarettes smoking with the two outcomes previously defined after assessing co-linearity between the independent variables. Significant variables ($P < 0.05$) in the bivariate analyses were included, and backward elimination was used to arrive at the final models. Interaction assessment was also carried out using the chunk test and no significant interactions were identified. Gender and age were kept as covariates in all multivariate models. Results were presented as adjusted ORs with 95% CIs. All statistical analyses were carried out using SAS statistical package version 9.3 and Excel 2007.

RESULTS

Among the 5,719 surveys distributed, a total of 3,658 completed the survey with the response rate 63.96%. The overall rates and the country specific rates of cigarette smoking are presented in Figure 1. Participants characteristics are described in Table 1. More than half of the participants were male (61.62%) and were older than 25 years of age (53.18%). The proportion of the total sample from each country was as follows: 18.91% from China, approximately 23% from India, 17.56% from Jordan, 16.73% from Saudi Arabia, and 23.79% from Taiwan. About 39.98% of the sample smoked cigarettes in the past day and 44.46% in the past month. Table 1 also summarizes the results of the Chi-square analyses of various participants' characteristics with the two outcome variables. Outcome 1: Past day cigarettes smoking versus not; outcome 2: Past month cigarettes smoking versus not.

Logistic Regression Analyses

Bivariate and multivariate logistic regression results with the two outcome variables are presented in Table 2. In the multivariate models (adjusted rates), females were less likely to smoke cigarettes in both models compared to males (OR = 0.32, 95% CI = 0.24-0.44 model 1, OR = 0.31, 95% CI = 0.23-0.43 model 2). Participants who were older than 25 were more likely to smoke cigarettes compared to younger participants (OR = 2.26, 95% CI = 1.70-3.01 model 1, OR = 1.63, 95% CI = 1.16-2.28 model 2).

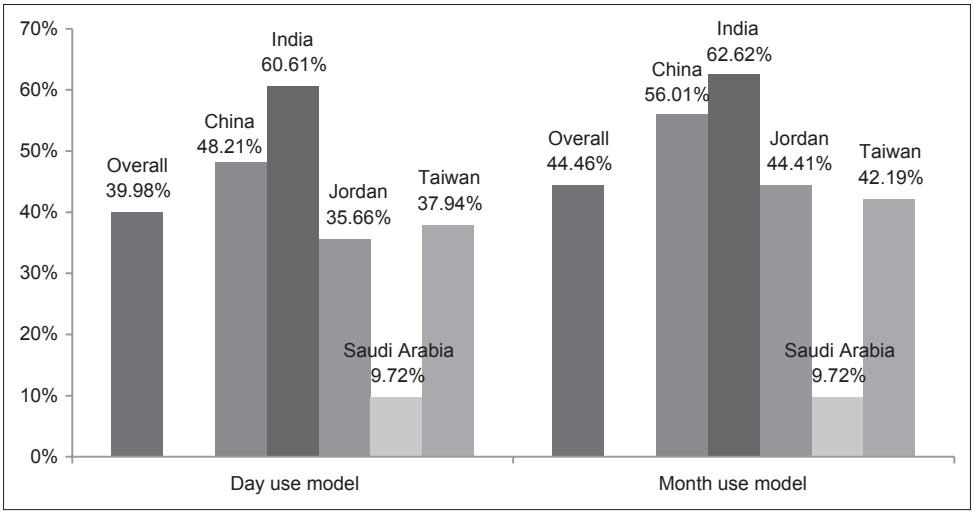

Figure 1: Proportion of smokers by country as defined by the two outcomes

Table 1: Characteristics of past smoking behavior among a sample of adults in China, India, Jordan, Saudi Arabia and Taiwan

Characteristic	Total frequency (percentage)	Day use model (39.98%)		Month use model (44.46%)	
		Percentage	*P* value	Percentage	*P* value
Demographics and other information					
Gender			<0.0001*		<0.0001*
Male	2007 (61.62)	47.48		52.17	
Female	1204 (36.97)	26.91		31.15	
Age (years)			<0.0001*		<0.0001*
<25 years old	1525 (46.82)	22.89		27.80	
25 years old or older	1732 (53.18)	55.02		59.12	
Country			<0.0001*		<0.0001*
China	616 (18.91)	48.21		56.01	
India	749 (23.00)	60.61		62.62	
Jordan	572 (17.56)	35.66		44.41	
Saudi Arabia	545 (16.73)	9.72		9.72	
Taiwan	775 (23.79)	37.94		42.19	
Marriage status			<0.0001*		<0.0001*
Single	653 (20.05)	15.93		18.38	
Married	479 (14.71)	48.85		55.32	
Occupation			0.0007*		0.006*
Nonmedical field	252 (8.66)	42.06		46.83	
Medical field	259 (8.90)	29.73		35.91	
Education			0.52		0.15*
High school degree or less	1181 (36.27)	38.78		42.25	
College degree or more	2041 (62.68)	40.62		45.76	
Grades			<0.0001*		<0.0001*
Mostly As and Bs	838 (25.73)	18.14		22.79	
Mostly Bs, Cs, Ds and Fs	1038 (31.87)	38.05		42.29	
School type			<0.0001*		<0.0001*
Public school	1586 (48.70)	31.40		36.44	
Private school	812 (24.93)	36.21		42.12	
Health condition and other information					
Had Shortness of breath before			<0.0001*		<0.0001*
No	1552 (51.68)	36.66		41.75	
Yes	1405 (46.79)	50.32		55.09	
Had heart disease before			0.26*		0.10*
No	3093 (94.99)	40.06		44.58	
Yes	129 (3.96)	41.09		45.74	
Dyspepsia			<0.0001*		<0.0001*
Rarely	1486 (52.14)	46.37		51.62	
Sometimes or frequently	571 (20.04)	30.47		36.08	
General health status			<0.0001*		<0.0001*
Good	1157 (35.52)	35.61		36.73	
Fair or bad	116 (3.56)	81.90		83.62	
Felling bothered			<0.0001*		0.0003*
Was bothered by many things	1243 (38.16)	45.05		48.91	
Nothing really bothered me	1925 (59.10)	37.04		41.61	
Feeling lonely			0.0003*		<0.0001*
I felt lonely	893 (27.42)	45.13		50.73	
I did not feel lonely	2164 (66.44)	38.54		42.70	
Exposure to medias/teachers smoking message					
TV			<0.0001*		<0.0001*
For smoking	211 (6.48)	49.76		53.55	
Against smoking	1587 (48.74)	36.67		41.02	
Internet			<0.0001*		<0.0001*
For smoking	207 (6.36)	53.14		56.52	
Against smoking	1078 (33.10)	35.62		39.61	
Teachers			<0.0001*		<0.0001*
For smoking	70 (2.15)	41.43		47.14	
Against smoking	1524 (46.81)	26.05		30.45	
Tobacco and other substances use experience					
Alcohol use			<0.0001*		<0.0001*
Never	996 (30.59)	26.71		33.94	
Tried alcohol before	1616 (49.63)	57.92		61.94	
Alcohol use in last 30 days			<0.0001*		<0.0001*
No	1468 (45.09)	27.93		33.65	
Yes	1137 (34.92)	69.22		73.97	

(*Contd...*)

Table 1: (***Continued***...)

Characteristic	Total frequency (percentage)	Day use model (39.98%)		Month use model (44.46%)	
		Percentage	*P* value	Percentage	*P* value
Have used cigar before			<0.0001*		<0.0001*
No	1975 (60.69)	18.68		22.53	
Yes	1098 (33.74)	80.05		85.52	
Cigar use in the last 30 days			<0.0001*		<0.0001*
No	2756 (87.85)	38.03		42.53	
Yes	211 (6.73)	87.68%		93.84	
Tried chewing tobacco before			<0.0001*		<0.0001*
No	1828 (56.16)	30.09		35.34	
Yes	463 (14.22)	84.88		86.39	
Relatives' and friends' smoking status					
Father is a smoker			<0.0001*		<0.0001*
No	2012 (61.77)	39.56		43.84	
Yes	1045 (32.08)	43.35		48.23	
Mother is a smoker			<0.0001*		<0.0001*
No	2094 (64.29)	32.86		38.06	
Yes	214 (6.57)	47.20		53.74	
Siblings are smokers			<0.0001*		<0.0001*
No	1864 (57.23)	32.30		36.37	
Yes	1176 (36.11)	54.00		59.44	
Close friends are smokers			<0.0001*		<0.0001*
No	875 (26.95)	28.69		31.89	
Yes	1428 (43.98)	50.28		55.67	
Smoke if best friends offer cigarettes			<0.0001*		<0.0001*
No	1726 (52.99)	7.94		11.12	
Yes	884 (27.14)	77.04		86.65	

*$P \leq 0.2$, Total numbers do not add up to 3,658 because of missing value

Participants from India and Saudi Arabia were less likely to smoke as compared to China (OR = 0.13, 95% CI = 0.06-0.26 model 1 and OR = 0.15, 95% CI = 0.08-0.31 model 2 for India, and OR = 0.03, 95% CI = 0.003-0.50 model 1, OR = 0.005, 95% CI = <0.001-0.09 model 2 for Saudi Arabia). There were no significant differences in smoking rates in Jordan and Taiwan in comparison to China after controlling for potential confounders. Participants who had dyspepsia frequently or occasionally were less likely to smoke compared to those who rarely had the symptoms (OR = 0.69, 95% CI = 0.49-0.99 model 1). Those who worked or studied in medically related field were more likely to smoke compared to those who were not in a medically related field (OR = 2.09, 95% CI = 1.10-3.96 model 2). Participants with a college degree or more were less likely to smoke in the past month compared to those with a lower education level (OR = 0.42, 95% CI = 0.29-0.60). Similarly, those who usually got low grade point averages at school were more likely to smoke compared to participants who usually got higher grades (OR = 1.92, 95% CI = 1.36-2.71 model 1, OR = 1.60, 95% CI = 1.08-2.37 model 2). Among the anti-smoking messages that were presented to respondents were from teachers, radio, newspaper, billboards, TV, and the internet. The study revealed that only the teacher's message was significantly effective in the multivariate model. Participants, who had been exposed to anti-smoking messages from their teachers, were less likely to be smokers (OR = 0.35, 95% CI = 0.14-0.91 model 2). Some personal emotions were predictors as well. Participants who didn't get bothered by many things the week prior to filling out the survey (OR = 0.75, 95% CI = 0.57-0.98 model 1), and who didn't feel lonely the week prior to filling out the survey (OR = 0.69, 95% CI = 0.50-0.95 model 2) were less likely to smoke cigarettes. Other substance use was also a strong predictor of cigarettes smoking. For example, those who drank alcohol at any time point during the last month (OR = 2.69, 95% CI = 1.91-3.80 model 1, OR = 4.35, 95% CI = 2.86-6.61 model 2), who tried smoking tobacco in the form of cigars previously (OR = 3.82, 95% CI = 2.86-5.09 model 1, OR = 5.34, 95% CI = 3.80-7.50 model 2), or those who had tried chewing tobacco before (OR = 2.66, 95% CI = 1.56-4.55 model 1) were also more likely to smoke. Social network of smoking peers was another strong predictor, especially among family and close friends. Participants who had siblings (OR = 1.52, 95% CI = 1.16-2.00 model 1, OR = 1.69, 95% CI = 1.25-2.30 model 2) and close friends (OR = 1.98, 95% CI = 1.36-2.88 model 1, OR = 1.97, 95% CI = 1.35-2.88 model 2) that smoke were more likely to be smokers as well. Participants who thought they would smoke if their best friends were to offer them a cigarette were more likely to smoke (OR = 20.32, 95% CI = 15.11-27.34 model 1, OR = 31.85, 95% CI = 22.31-45.47 model 2). Variables that were significant in the bivariate models but not in the multivariate model following adjustments, include marital status, school type (public/private), experiencing shortness of breath (sometimes/rarely), perceived overall health status (good/fair or bad), and parents' smoking status.

DISCUSSION

The results of this study demonstrate high rates of cigarette smoking across five countries with approximately 40% of the sample smoking in the past day and 44% smoking in the past month. The highest smoking rate was reported in the Indian sample with over 60% smokers. From our multivariate analysis, after controlling for confounders and covariates, participants

Table 2: Univariate and multivariate logistic regressions with the two smoking outcomes among a sample of adults in China, India, Jordan, Saudi Arabia and Taiwan

	Day use model		Month use model	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Demographics and other information				
Gender				
Male	Reference	Reference	Reference	Reference
Female	0.40 (0.34-0.47)*	0.32 (0.24-0.44)*	0.41 (0.35-0.48)*	0.31 (0.23-0.43)*
Age (years)				
<25 years old	Reference	Reference	Reference	Reference
25 years old or older	4.12 (3.53-4.80)*	2.26 (1.70-3.01)*	3.8 (3.27-4.39)*	1.63 (1.16-2.28) *
Country				
China	Reference	Reference	Reference	Reference
India	1.65 (1.33-2.05)*	0.13 (0.06-0.26)*	1.32 (1.06-1.64)*	0.15 (0.08-0.31)*
Jordan	0.59 (0.47-0.75)*	1.19 (0.11-12.65)	0.63 (0.50-0.79)*	0.28 (0.03-3.03)
Saudi Arabia	0.11 (0.08-0.16)*	0.03 (0.003-0.50)*	0.08 (0.06-0.11)*	0.005 (<.001-0.09)*
Taiwan	0.65 (0.53-0.81)*	0.39 (0.01-8.88)	0.58 (0.47-0.71)*	0.05 (0.01-1.04)
Occupation				
Nonmedical field	Reference		Reference	Reference
Medical field	0.58 (0.40-0.84)*		0.63 (0.44-0.90)*	2.09 (1.10-3.96)*
Education				
High school degree or less	Reference		Reference	Reference
College degree or more	1.08 (0.93-1.25)		1.16 (1.01-1.34)*	0.42 (0.29-0.60)*
Grades				
Mostly As and Bs	Reference	Reference	Reference	Reference
Mostly Bs, Cs, Ds and Fs	2.77 (2.23-3.44)*	1.92 (1.36-2.71)*	2.48 (2.02-3.03)*	1.60 (1.08-2.37)*
Health condition and other information				
Dyspepsia				
Rarely suffer from dyspepsia	Reference	Reference	Reference	Reference
Have dyspepsia sometimes	0.50 (0.41-0.62)*	0.69 (0.49-0.99)*	0.52 (0.43-0.64)*	0.72 (0.51-1.04)
Feeling bothered				
Was bothered by many things	Reference	Reference	Reference	
Nothing really bothered me	0.71 (0.62-0.83)*	0.75 (0.57-0.98)*	0.75 (0.65-0.86)*	
Feeling lonely				
I felt lonely	Reference		Reference	Reference
I did not feel lonely	0.76 (0.65-0.89)*		0.73 (0.62-0.85)*	0.69 (0.50-0.95)*
Exposure to medias/teachers smoking message				
Teachers				
For smoking	Reference		Reference	Reference
Against smoking	0.49 (0.30-0.81)*		0.48 (0.30-0.79)*	0.35 (0.14-0.91)*
Tobacco and other substances use experience				
Alcohol use in last 30 days				
No	Reference	Reference	Reference	Reference
Yes	5.80 (4.89-6.87)*	2.69 (1.91-3.80)*	5.60 (4.72-6.64)*	4.35 (2.86-6.61)*
Have used cigar before				
No	Reference	Reference	Reference	Reference
Yes	17.46 (14.49-21.04)*	3.82 (2.86-5.09)*	20.27 (16.62-24.71)*	5.34 (3.80-7.50)*
Tried chewing tobacco before				
No	Reference	Reference	Reference	
Yes	13.04 (9.92-17.14)*	2.66 (1.56-4.55)*	11.70 (8.82-15.52)*	
Relatives' and friends' smoking status				
Siblings are smokers				
No	Reference	Reference	Reference	Reference
Yes	2.46 (2.11-2.85)*	1.52 (1.16-2.00)*	2.57 (2.21-2.99)*	1.69 (1.25-2.30)*
Close friends are smokers				
No	Reference	Reference	Reference	Reference
Yes	2.51 (2.10-3.00)*	1.98 (1.36-2.88)*	2.66 (2.23-3.17)*	1.97 (1.35-2.88)*
Smoke if best friends offer cigarettes				
No	Reference	Reference	Reference	Reference
Yes	38.90 (30.77-49.19)*	20.32 (15.11-27.34)*	51.97 (40.67-66.39)*	31.85 (22.31-45.47)*

OR: Odds ratio, 95% CI: 95% Confidence interval, *$P \leq 0.05$

in China, Jordon and Taiwan were more likely to smoke. Males were significantly more likely to be smokers compared to females in the multivariate models. This gender difference was documented among the subsamples from Jordan [9], China [12], and Taiwan [13] while it was not observed in the Indian subpopulation [11]. In Saudi Arabia, previous reports indicate higher smoking rates among males compared to females for cultural reasons, but our study evaluating predictors of cigarette smoking in Saudi Arabia included only males because of low percentage of women in the sample [10]. The increases in social

acceptability of cigarette smoking for males compared to females have been previously described in the literature as well [16-20]. Other forms of tobacco use such as waterpipe smoking (argeela) seem to be considered more socially acceptable for women especially in Middle Eastern populations [21-24]. Participants, who were 25 or older, were more likely to be smokers compared to those younger than 25. Similar findings were reported in the Jordanian [9] and Indian [11] subsamples. In the Taiwan subsample, the younger age group was more likely to smoke [13] while age was not a significant predictor in the Saudi Arabian and Chinese subsamples [10,12]. Those suffering from dyspepsia symptoms were less like to be smokers compared to those that rarely have such symptoms after controlling for country and potential confounders. As dyspepsia can be worsened by smoking, the symptom may be a reason to avoid cigarette use. As this finding was not shown in the subpopulations separately [9-13], the increased sample size by combining the data might have given more power to detect this difference. Participants studying or working in the medical field were more likely to be smokers compared to those that work in other fields. This was unexpected as one would expect the knowledge of harms may help prevent tobacco use. A potential explanation could be that the school or job related stresses may have triggered an initiation of smoking that was later difficult to reverse after becoming addicted. Those with higher education levels and better school performance were less likely to be smokers in the multivariate models highlighting the importance of education in prevention of cigarette smoking. Similar findings for education were observed in the Chinese [12] and Jordanian [9] subsamples and for academic performance in the Saudi, Taiwan [13], and Jordan [9] subsamples. Participants who had been exposed to anti-smoking messages from their teachers were less likely to be smokers in the multivariate model for the combined data. This underscores the importance of early intervention by teachers in young age groups to prevent them from starting the habit. The predictor was observed in the Taiwanese subpopulation [13] but not the other subpopulations from Jordan [9], India, China [12], and Saudi Arabia [10], which is possibly due to higher power in this study with the larger sample. This finding highlights the importance of school-based intervention programs as a preventative strategy, particularly among young groups prior to initiation of cigarette smoking. Participants who reported they felt lonely or were bothered by events the week prior to filling out the survey were also more likely to be smokers indicating an influence of stress and personal emotions on smoking practices.

Other substances use was also a strong predictor of cigarettes smoking. The study revealed that those with past history of alcohol, cigar, and chewing tobacco use were more likely to be smokers after controlling for potential confounders. A potential reason could be that individuals who use cigarettes tend to try other forms of tobacco and addictive substances in addition to cigarettes. Similar findings were reported with alcohol in the Taiwan [13] subsamples and cigars in the Chinese [12] and Jordan [9] subsamples.

Social acceptability, especially among family and close friends was another strong predictor. Participants who have siblings and close friends that smoke was more likely to be smokers in the multivariate models. This was also documented in the Saudi [10], Taiwan [13], and Indian [11] subsamples. The study also showed that peer pressure was a strong predictor of cigarette smoking as participants who think they will smoke if their best friends were to offer them a cigarette were more likely to be smokers in the adjusted models. Similar findings were reported in the Jordan [9] and Chinese [12] subsamples. Other studies have also reported the strong influence of family and friends smoking on a person's practices [25-27], and any successful intervention should take into account the social environment.

This study suffers the limitations of convenience sampling as we were unable to characterize nonparticipants which may limit generalizability of results. Causality between the predictors and cigarette smoking cannot be inferred based on the cross-sectional design and the data was based on self-report, which may have Led of recall bias. Follow up studies using random sampling techniques and other study designs are warranted to confirm study findings.

CONCLUSIONS

Despite these limitations, this study being first of its kind, combined data from five countries and evaluated predictors that remained significant across these countries. Findings indicate high smoking rates of approximately 40% in the past day and 44% in the past month across the five countries and emphasize the urgent need for interventions to control tobacco use in these countries. Predictors found include: Male gender, age over 25, lower education level and school performance, medical profession, dyspepsia, feeling lonely and bothered by events, using other tobacco products like cigars and chewing tobacco as well as alcohol use and family and friend smoking. Those who received antismoking messages from teachers in school were less likely to be smokers. Predictors identified in this study should be considered and incorporated when designing prevention and cessation interventions across the globe. Results of the study draw attention to the importance of teachers and school based antismoking programs in prevention and underscores the prominence of social peer pressure and smoking family members as major predictors of smoking that must be incorporated in any potential smoking prevention or cessation program.

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