

Use of Cigarettes and Other Tobacco Products among Primary and Secondary School Students in Khartoum State, Sudan

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Abstract

Introduction: In Sudan, tobacco use is common; it is used in some form by 20% of the population. As most users start during adolescence, we aimed to determine the prevalence of ever use of tobacco products (*i.e.* cigarettes, herbal cigarettes, shisha and tombak) among Sudanese adolescent males and females, and to assess associations between tobacco ever use and personal characteristics. **Methods:** This cross-sectional study was conducted in Khartoum State, Sudan. The study data were collected in June 2014. The target population consisted of adolescents in 8th grade of primary education or 1st and 2nd grade of secondary education. They were asked to fill in a written questionnaire during the school break. Schools were randomly selected using a stratified two-stage cluster sampling design method. **Results:** A total of 1229 respondents (56.4% male), with a mean age of 14.5 years, were included in the analysis. Prevalence of cigarettes, herbal cigarettes, shisha and tombak ever use were 13%, 7.8% 5.9% and 3.5%, respectively. Older respondents were significantly more likely to have ever smoked cigarettes. Males were found to be significantly more likely to have ever used any tobacco products. Urban adolescents were significantly more likely to have ever used shisha. Respondents were in the bottom third percentiles with regard to academic achievements, had an almost three-fold increased risk of having ever smoked a cigarette and were at least five-fold more likely to have ever smoked herbal cigarettes. Moreover, respondents in the middle third percentiles were more than twice as likely to have ever smoked herbal cigarettes. **Conclusion:** As uptake of tobacco products increased significantly with age among males with a middle and lower school performance living in urban areas, timely prevention targeting adolescents, such as school-based tobacco control programmes, are recommended. Our findings show that prevention should start in primary school.

Keywords

Cigarettes, Tobacco, School Students

1. Introduction

Tobacco use is the leading cause of death, illness and impoverishment. It is estimated that by 2030, using tobacco will cause more than eight million deaths worldwide every year; more than 80% of these deaths will be in low- and middle-income countries in South-East Asia and Africa [1] [2]. Studies revealed that the onset of tobacco use usually starts in early adolescence and continues into adulthood [3] [4]. To avoid long-term health consequences, activities to prevent and stop smoking would, therefore, be most beneficial in adolescence.

In the Sudanese context, previous studies have already reported on prevalence of cigarette smoking in adolescents. For instance, the prevalence of ever having smoked cigarettes ranged from 6.5% to 33% among males and 5.1% to 13% among females aged 11 - 17 years [5] [6] [7] [8] [9].

In addition to cigarette smoking, other tobacco products, such as shisha (*i.e.* water-pipe smoking), tombak (*i.e.* oral snuff) and herbal cigarettes, are also commonly used in Sudan. Use of these products has substantial health consequences; for instance, the toxicant exposure of shisha can be equivalent to that of smoking up to 50 cigarettes. One of the major health concerns reported by smokers of herbal cigarettes was that they were just as carcinogenic as regular cigarettes [10] [11]. Furthermore, the use of these products is substantial among Sudanese adolescents: in 2007, 11% of males and 9.3% of females reported they were currently using shisha [12]. The most recent available data on tombak (2013-2014) show that 10.9% of adolescents in Sudan reported using this tobacco product (no data are available for males and females separately). No prevalence rates of herbal cigarettes are known.

As no recent information is available on prevalence rates of herbal cigarette use or shisha use for adolescents in Sudan, it is not clear at which age tobacco use prevention and cessation strategies should be offered, or which tobacco products should be targeted. Furthermore, it is important to understand which adolescent groups are more at risk of using tobacco products [13]. Previously conducted studies in comparable communities have shown that tobacco users differ from non-users in terms of age (older), gender (males) and academic achievement (lower) [5] [6] [14] [15] [16]. When this information becomes available for Sudanese adolescents, it will be possible to target interventions aimed at them stopping or not starting to use tobacco products in order to achieve maximum effect [17] [18] [19].

The aim of this study is, firstly, to determine the prevalence of use of four tobacco products (cigarettes, herbal cigarettes, shisha and tombak) by Sudanese adolescents, and secondly, to assess associations between tobacco use and per-

sonal characteristics, such as gender, age and academic achievement.

2. Methods

2.1. Respondents and Recruitment

The target population consisted of school-going adolescents in 8th grade of primary education or 1st and 2nd grade of secondary education in Khartoum State, Sudan. Khartoum State is divided into three areas: greater Khartoum, greater Omdurman, and greater Bahri. Schools from all three areas were included in this study. The Sudanese educational system is comprised of eight years of primary education and three years of secondary education. The age of students within the target population was, usually, between 13 and 17 years. Recruitment occurred via the students' schools; schools registered with the Ministry of Education of Khartoum were randomly selected using a stratified two-stage cluster sampling design method. The Ministry's ethics committee approved the study.

2.2. Sampling Method and Data Collection

Study data were collected in June 2014. Firstly, schools were randomly selected, with probability proportional to the number of enrolled students. The school's inclusion criteria included an agreement to participate and an ethical approval letter. If the selected school failed to fulfill the inclusion criteria, another school was selected. The sample initially included 36 schools: 16 primary schools (public and private), and 20 secondary schools (public and private). Five schools were closed at the time of the study, resulting in a total number of 31 schools (14 primary, 17 secondary schools). All target group students who were present at the selected schools at the time of data collection were eligible to participate in the study. In each school, one or two classes (dependent on the class size) were randomly selected to be approached for participation.

Selected classes were visited by the research team staff, who distributed written questionnaires during break times. The questionnaires were completed in classroom settings in the absence of the teachers but under the supervision of trained data collectors. Written informed consent was requested from participating students and their parents through the schools' administration. Regular teachers and parents were not present, in order to emphasize the confidentiality of the answers provided by students. Students were free to refuse participation at any time. The questionnaires could be filled in anonymously; questionnaire labels only identified the school location and students' grades. Completed questionnaires were handed back to the research team staff in sealed envelopes. Participation in the study took approximately 45 minutes.

The required sample size was calculated using the equation ($n = Z^2 \times P \times (1 - p/e^2)$) [20] where n is the sample size, Z^2 is the level of confidence (95%) which equal 1.96, P is the proportion of the cigarette smoking among student population in Sudan (ranged 6.5% to 33% among males and 5.1% to 13% among females aged 11 - 17 years) and e is the desired margin of error (0.05). Using this

equation, the desired sample size was 322. We increase the sample more than 3 folds to get the best results. The sample size for this study is 1229.

2.3. Questionnaire

The written questionnaire with 73 items assessed personal characteristics and tobacco use. Demographic factors included age, gender (female = 0, male = 1), living situation and academic achievements. Living situation was assessed by asking the student to describe the composition of those with whom they shared their home (mother = 1, father = 2, both parents = 3, both grandparents = 4, grandfather = 5, grandmother = 6, another relative = 7, other = 8). Data were recoded to reflect if students lived with one or both parents (1 - 3 = yes, 4 - 8 = no). Academic achievement was measured by asking students to select the statement that described their academic achievements best (I am in the bottom third of my class = 1, in the middle third of my class = 2 and in the top third of my class = 3).

Tobacco use was assessed in terms of regular cigarettes, herbal cigarettes, shisha, and tombak. Individual tobacco product ever use was assessed by asking students if they had ever used any of the tobacco products, (yes/no). Students were classified as either ever users (=1) or never users (=0) for each tobacco product (regular cigarettes, herbal cigarettes, shisha and tombak).

2.4. Analysis

Data were analyzed using SPSS version 20. Frequencies were used to identify the prevalence of ever use of regular cigarettes, herbal cigarettes, shisha and tombak. Chi-square tests were used to analyze the relationships between personal characteristics and individual tobacco product ever use. Binary logistic regression analysis was used to identify the factors that had the strongest association with individual tobacco product ever use. For all analyses, the significance level was $p < 0.05$.

3. Results

3.1. Sample Characteristics

Table 1 provides an overview of the characteristics of the study sample. A total of 1229 primary and secondary school respondents were included in the analyses (response rate = 100%). The mean age was 14.5 years; the sample consisted of 56% males. Fifty-one percent of respondents were taught at a public school; 54% lived in an urban area. With regard to distribution of the students in classes: 34% were in 8th-grade primary school, 29% in 1st-grade secondary and 37% in 2nd-grade secondary school.

3.2. Tobacco Products Ever Use Prevalence

Table 1 shows that regular cigarettes were the most often tried tobacco product (13%), followed by herbal cigarettes (8%), shisha (6%) and tombak (4%). Overall,

Table 1. The prevalence of the samples of ever smokers, ever herbal cigarettes smokers, ever shisha and tombak users ($n = 1229$).

	N (Mean \pm SD)	%
Gender		
Male (students)	693	56.4%
Female (students)	536	43.6%
Age (mean)	14.5	
Classes		
8th-grade primary school	421	34.3%
1st-grade secondary school	356	29.0%
2nd-grade secondary school	452	36.8%
School type		
Public	677	55.1%
Private	552	44.9%
School location		
Urban	665	54.1%
Rural	564	45.9%
Area		
Greater Khartoum	107	8.7%
Greater Omdurman	929	75.6%
Greater Bahri	193	15.7%
Family monthly income in USD (mean)	353.4	
Family situations		
Full family environment	1070	87.1%
No family environment	159	12.9%
Family Living		
Lives with both parents	1170	95.2%
Does not live with both parents	59	4.8%
Academic achievements		
Top third	361	11.2%
Middle third	679	58.0%
Bottom third	131	30.8%
Tobacco product use		
Cigarettes	160	13%
Herbal cigarettes	96	7.8%
Shisha	72	5.9%
Tombak	43	3.5%

31% had used some tobacco products at some stage in their life. The results showed different prevalence rates of tobacco products, ranging between 5.5% to 19.3% among males and 0.9% to 4.9% among females.

3.3. Associations between Personal Characteristics and Tobacco Product Use

Table 2 presents the personal characteristics comparing tobacco product ever users and never users.

Table 2. The personal characteristics of ever users and never users of cigarettes, herbal cigarettes, shisha and tombak ($n = 1229$).

Demographic characteristics	Cigarette smoking status		Herbal cigarettes status			Shisha use status		Tombak use status				
	Ever smokers	Never smokers	Ever herbal cigarettes smokers	Never herbal cigarettes smokers		Ever shisha user's	Never shisha user's	Ever tombak user's	Never tombak user's			
	(n) %	(n) %	χ^2	(n) %	(n) %	χ^2	(n) %	(n) %	χ^2	(n) %	(n) %	χ^2
Total	160 (13)	1069 (87)		96 (7.8)	1113 (92.2)		72 (5.9)	1157 (94.1)		43 (3.5)	1185 (96.5)	
Gender			56.00***			38.29***			10.77**			18.57***
Male	134 (19.3)	559 (80.7)		83 (12)	610 (88)		54 (7.8)	639 (92.2)		38 (5.5)	654 (94.5)	
Female	26 (4.9)	510 (95.1)		13 (2.4)	523 (97.6)		18 (3.4)	518 (96.6)		5 (0.9)	531 (99.1)	
Classes			1.01			5.44			1.09			2.14
8th-grade primary school	50 (11.9)	371 (88.1)		32 (7.6)	389 (92.4)		27 (6.4)	394 (93.6)		11 (2.6)	410 (97.4)	
1st-grade secondary school	46 (12.9)	310 (87.1)		37 (10.4)	319 (89.6)		17 (4.8)	339 (95.2)		12 (3.4)	343 (96.6)	
2nd-grade secondary school	46 (14.2)	388 (85.8)		27 (6)	425 (94)		28 (6.2)	424 (93.8)		20 (4.4)	432 (95.6)	
School type			0.43			1.20			1.30			0.04
Public	92 (13.6)	585 (86.4)		58 (8.6)	619 (91.4)		35 (5.2)	642 (94.8)		23 (3.4)	653 (96.6)	
Private	68 (12.3)	484 (87.7)		38 (6.9)	514 (93.1)		37 (6.7)	515 (93.3)		20 (3.6)	532 (96.4)	
School location			8.79*			0.19			13.44***			0.929
Urban	104 (15.6)	561 (84.4)		54 (8.1)	611 (91.9)		54 (8.1)	611 (91.9)		23 (3.5)	642 (96.5)	
Rural	56 (9.9)	508 (90.1)		42 (7.4)	522 (92.6)		18 (3.2)	546 (96.8)		20 (3.5)	543 (96.5)	
Family situations			0.70			5.77*			0.37			0.463
Full family environment	136 (12.7)	934 (87.3)		76 (7.1)	994 (92.9)		63 (5.8)	1028 (94.2)		36 (3.4)	1043 (96.6)	
No family environment	24 (15.1)	135 (84.9)		20 (12.6)	139 (87.4)		9 (6.5)	129 (93.5)		7 (4.4)	151 (95.6)	
Family Living			0.02			0.85			0.07			0.01
Lives with both parents	152 (13)	1018 (87)		91 (7.8)	1079 (92.2)		69 (5.9)	1101 (94.1)		41 (3.5)	1198 (96.5)	
Does not Live with both parents	8 (13.6)	51 (86.4)		5 (8.5)	54 (91.5)		3 (5.1)	56 (94.9)		2 (3.4)	57 (96.6)	
Academic achievements			12.60*			16.17***			2.18			2.07
Top third	37 (10.2)	324 (89.8)		16 (4.4)	345 (95.6)		20 (5.5)	341 (94.5)		11 (3.1)	349 (96.9)	
Middle third	83 (12.2)	596 (87.8)		53 (7.8)	626 (92.2)		35 (5.2)	644 (94.8)		20 (2.9)	659 (97.1)	
Bottom third	29 (22.2)	102 (77.8)		20 (15.3)	111 (84.7)		11 (8.4)	120 (91.6)		7 (5.3)	124 (94.7)	

Table 2 reveals an overall pattern showing that there are differences, though not significant, between the classes in the ever smoking prevalence rate; they remain stable in this age group over the three grades studied.

The bivariate analyses showed significant gender differences; males were significantly more likely to be ever users (19.3%, 12%, 7.8% and 5.5%) than females (4.9%, 2.4%, 3.4% and 0.9%) for all four tobacco products. Respondents from urban areas reported significantly more often that they were ever cigarette smokers and shisha users (15.6% and 8.1%) than those living in rural areas (9.9% and 3.2%). Respondents reporting an intact parental relationship were significantly more likely to be herbal cigarettes smokers than respondents without such a parental relationship. There was a significant difference in tobacco use among the three groups of academic achievements, the greatest difference being between low and high academic achievers.

Table 3 reveals the logistic regression analysis that was performed in order to identify factors that have unique associations with the target behaviours. The results reveal that older respondents were 1.35 times more likely to be ever smokers than younger respondents. Furthermore, males were more than five-fold more likely to have ever smoked a cigarette. Students who lived and studied in an urban area were found to be significantly more likely to have ever used shisha than students living and studying in a rural area. Respondents in the bottom third percentile for academic achievements had an increased risk of ever having smoked: three-fold increase for a cigarette and more than five-fold increase for an herbal cigarette. Finally, respondents in the middle third percentile were more than two-fold more likely to ever have smoked an herbal cigarette compared to respondents in the top third.

4. Discussion

The first goal of this study was to explore the prevalence rates of use of cigarettes

Table 3. The logistic regression result of ever use of regular cigarettes, herbal cigarettes, shisha and tombak users ($n = 1229$).

	Regular cigarette status		Herbal cigarettes status		Shisha user status		Tombak user status					
	OR	95% CI		OR	95% CI		OR	95% CI				
		Lower	Upper		Lower	Upper		Lower	Upper			
Age	1.35***	1.20	1.52									
Males (students)	5.28***	3.26	8.56	7.96***	4.05	15.66	2.37**	1.33	4.23	9.33***	2.85	30.51
School location a												
Urban a	1.70**	1.67	2.48				2.71**	1.52	4.83			
Academic achievements b												
Middle third b	1.29	0.83	2.00	2.33***	1.30	4.17						
Bottom third b	3.04***	1.70	5.44	5.66***	2.77	11.59						
		R ² = 17.3			R ² = 13.9			R ² = 5.8			R ² = 8.3	

* $P < 0.05$; ** $P < 0.01$. *** $P < 0.001$ a Reference category is rural; b Reference category is top third of the class.

and other tobacco products (*i.e.* herbal cigarettes, tombak, and shisha) among adolescent males and females in Sudan.

Overall, cigarette smoking was more prevalent (13%) than other tobacco products. Our figures largely correspond with those of other studies on cigarette smoking for the same age group in Sudan, South Sudan, Ghana and Saudi Arabia, ranging between 9.5% and 24% [5] [6] [14] [17] [18] [19]. These findings are also similar to other studies that reported a wide gender gap in smoking use in East Africa [21] reflecting a traditional norm of tobacco use in the region. Furthermore, our findings regarding shisha and tombak are in line with other studies for the same age group in Sudan, Jordan, Kuwait and studies on African populations ranging between 8.1% and 23.5% [6] [7] [14] [22] [23] [24]. Other studies showed evidence that both male and female adolescents in the region are publicly using shisha. The use of flavored cigarette products labeled as non-cigarette products in shisha use could be a “gateway” to cigarette smoking and the manufacturing effort to adolescents to use such product is high [25]. In addition, studies have shown that girls may develop signs of tobacco dependency at significantly faster rate than boys [26] [27]. The findings also show that, with regard to the target group, it may be most relevant to apply tobacco use prevention programmes before the 8th grade of primary school, as use of cigarettes and other tobacco products (*i.e.* herbal cigarettes, tombak, shisha) is already prevalent in these groups by the time they reach 8th grade [24] [28].

The second goal of this study was to assess associations between tobacco use and personal characteristics. The results showed significant gender differences. Males were more likely to be cigarette smokers, herbal cigarettes smokers, shisha users, and tombak users. To some extent, these prevalence rates are similar to those in other countries [14] [18] [23] [24], although some studies in industrialized countries have now found that more females than males report tobacco smoking [29] [30]. A possible explanation of the current finding that males have a higher probability of being ever tobacco users than females, may reflect the way tobacco use is perceived in Sudanese culture and the advertisement effect of linking the use of tobacco with masculinity. The social acceptability and desirability of the use of tobacco products in Sudanese males, but not in females, might account for the difference in reported prevalence rates [7] [25] [31]. The results of this study also revealed that the respondents from urban areas reported significantly more often that they were ever smokers or ever users of shisha than those living in rural areas. This finding is in line with previous studies in other countries [7] [32] [33].

Furthermore, the results of our study showed that respondents with low academic achievements reported regular cigarette use significantly more often than their peers with high academic achievements, a finding also reported by studies from other countries [15] [16] [34] and other studies in Sudan [35] [36].

5. Strengths/Limitations

This study has several strengths. It is the first study that presents the prevalence

rates of herbal smoking among adolescents in Sudan, in addition to regular smoking, shisha and tombak use. Furthermore, our study provides tobacco use figures for both males and females on all tobacco products commonly consumed in Sudan.

This study is also subject to limitations. Firstly, the study was cross-sectional and we are, therefore, unable to draw conclusions about the causality of the associations found. Secondly, our study relied on self-report, both in smoking status and other personal characteristics, such as academic achievement. Self-reported smoking status was not tested nor evaluated biochemically. However, previous studies revealed that self-reported and biochemically assessed smoking rates are comparable [21]. Self-report in terms of academic achievement might be skewed due to overestimation, but as we ensured anonymous and confidential participation in the study, we expect its impact to be limited. We still consider that self-reporting could provide a useful substitute for some types of specific objective study.

6. Conclusions

Cigarettes smoking was the most prevalently used tobacco product in our sample of Sudanese adolescents; older respondents and males were more likely to be ever tobacco users. The onset of use of cigarettes and other tobacco products usually starts in early adolescence. Hence, prevention is critical to reducing the number of adolescents using all types of tobacco products and the long-term health consequences due to tobacco use.

As risks of uptake of tobacco products increase with age, timely prevention targeting adolescents, such as school-based tobacco prevention programmes, are recommended. The study results could provide guidance for policy-makers to develop such programmes which may be started in primary school.

However, before such programmes are developed, it is essential to distinguish underlying determinants of the smoking intention of adolescents, so that these can be specifically targeted.

Furthermore, based on our findings, the next research step is to study determinants of tobacco product use among the group of adolescents, as they seem to be a high-risk group, (*i.e.* for the stigmatization of lower academic achievements) and to reach the large population of Sudanese adolescents we would advise focusing on a school-based prevention programme.

7. What Is Known about This Topic

- Use of cigarettes and other tobacco products is the leading cause of death, illness and impoverishment;
- The onset of tobacco use usually starts in early adolescence and continues into adulthood;
- To avoid long-term health consequences, activities to prevent and stop smoking would, therefore, be most beneficial in adolescence.

8. What This Study Adds

- As no recent information is available on prevalence rates, this study provides valuable information on the prevalence of use of four tobacco products (cigarettes, herbal cigarettes, shisha and tombak) by Sudanese adolescents;
- The current study confirms the cigarettes smoking was the most prevalently used tobacco product in our sample of Sudanese adolescents;
- The study results could provide guidance for policy-makers to develop school-based tobacco prevention programmes which may be started in primary school.

Ethics Approval and Consent to Participate

Ethics approval of Ethical Committee of the Ministry of Education in Sudan was obtained (IRB). Written informed consent was requested from the participating students and their parents through the schools' administration, and the participation was voluntary and anonymous.

Regular teachers and parents were not present, in order to emphasize the confidentiality of the answers provided by students. Students were free to refuse participation at any time. In the questionnaire, we explained that the purpose of this study was to find out more about smoking among males and that answers would be treated confidentially. Apart from the research team, nobody had access to the data, an issue that was also outlined.

Availability of Data and Materials

The data that support the findings of this study are available from Department of Health Promotion School of Public Health and Primary Care (CAPHRI), Maastricht University, Maastricht 6200 MD, The Netherlands.

Authors' Contributions

The roles of the authors were: (Mohamed, Hoving, De Vries), contributed to the conception and design of the study, the acquisition of data, analysis and interpretation of data. Mohamed wrote the paper, Hoving, De Vries have critically read and edited the paper. All authors have read and approved the final manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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