



# Waterpipe Tobacco Smoking and Associated Risk Factors among Bangladeshi University Students: An Exploratory Pilot Study

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## Abstract

Over the past two decades, there has been a global rise in the prevalence of waterpipe tobacco smoking. Waterpipe tobacco smoking involves the inhalation of heated tobacco smoke after passing through water, and it has been associated with an identified dependence effect similar to that found with cigarette smoking. Despite the popularity of waterpipe tobacco among youth (and in particular, university students) in many countries, detailed data of its usage are lacking in Bangladesh. Therefore, the present study was conducted to explore waterpipe tobacco smoking behavior and normative beliefs among university students in Bangladesh and to assess the factors associated with waterpipe tobacco use. A quantitative cross-sectional survey was carried out among 340 Bangladeshi university students (64.4% male; mean age 21.6 years). Among participants, 13.5% reported they had ever smoked tobacco from a waterpipe and 9.4% had it in past 30 days. Among past 30-day users, 72% were categorized as having waterpipe smoking dependence ( $n = 23$ ). No females in the sample had ever smoked using a waterpipe. Maternal occupation, monthly expenditure, and regular smoking status were major predominant factors associated with waterpipe smoking behavior of the students. The study is of existential value given that there are no prior studies ever carried out in Bangladesh previously. Recommendations are provided based on the study's findings, particularly in relation to what action is needed from universities in Bangladesh.

**Keywords** Smoking · Waterpipe tobacco smoking · Student tobacco use · Bangladeshi university students · Waterpipe dependence

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## Introduction

Waterpipe tobacco smoking involves the inhalation of heated tobacco smoke after passing through water. Waterpipe tobacco smoking is known by many different names in various cultural settings including *shisha*, *hookah*, *calyan*, *narghile*, or *hubble-bubble* (Knishkowsky and Amitai 2005). About 10 g of flavored tobacco, sometimes mixed with other substances such as honey and molasses, are placed on the head of an apparatus, and once consumed, it can be replaced with new tobacco to enable the waterpipe session to continue (Jawad et al. 2016a; Jawad et al. 2013b). As with any tobacco smoking, waterpipe smoking also exposes users to clinically harmful levels of tobacco-specific nitrosamines (Al Ali et al. 2015; Helen et al. 2014; Radwan et al. 2012), polycyclic aromatic hydrocarbons, as well as other common toxicants found in tobacco (Jacob et al. 2013; Nguyen et al. 2013; Sepetdjian et al. 2010). Therefore, waterpipe smoking is as dangerous as cigarette smoking. Relative to non-users, evidence suggests that waterpipe users are at increased risk of cardiovascular diseases (Selim et al. 2013; Sibai et al. 2014), lung cancer (Akl et al. 2010), and other respiratory conditions (Boskabady et al. 2012; Raad et al. 2011). However, a global spread in its use has been witnessed over the past 20 years (Maziak et al. 2015). The rise in waterpipe use among young population has prompted the World Health Organization to declare the behavior a growing public health concern in its 2015 advisory note (WHO 2015).

Despite the similar kind of health risks associated with waterpipe smoking as with cigarette smoking, the use of this product continues to spread among the youth and adults in the USA (Lipkus et al. 2014). Among university students in the UK, research showed that between 38 and 52% had tried waterpipes and 8–11% of the students had engaged in waterpipe smoking in the past 30 days (Jackson and Aveyard 2008; Jawad et al. 2013a). The most recent Global Youth Tobacco Survey also identified a relatively high prevalence of the past 30-day waterpipe use in Lebanon (36.9%), the West Bank (32.7%), and Latvia (22.7%) (Jawad et al. 2016b). A significantly higher prevalence of waterpipe smoking was found among males than females in some Arab countries (Al Ghobain et al. 2018; Morton et al. 2014), and in Iran, men initiated waterpipe smoking at an earlier age than women (Danaei et al. 2017). Despite the popularity of waterpipe tobacco among youth worldwide, detailed data of its usage are lacking in Bangladesh.

Waterpipe smoking has been associated with an identified dependence effect similar to that found with cigarette smoking (Hammal et al. 2008). However, there is a need to identify the risk factors associated with waterpipe tobacco use and how this is integrated with changing tobacco epidemiology among young people (Jawad et al. 2016a). Different social factors also add to the potentially addictive effects of waterpipe smoking because it is commonly performed as a social activity and a key feature of it is the sharing with other users (Ali and Jawad 2017). Greater social acceptability and tolerance toward waterpipe smoking than cigarette smoking are the motivations for female students in some Arab countries to use waterpipe (Babar and Riaz 2015; Maziak et al. 2004), and some female students also feels empowered by using it (Baheiraei et al. 2015). Several socio-demographic predictors of waterpipe tobacco smoking among the university students have been identified in recent studies including being male, being older in age, frequent alcohol consumption, higher sensation-seeking behavior, and perceived peer acceptability toward waterpipe and cigarette smoking (Lee et al. 2020; Salloum et al. 2019; Sidani et al. 2019). Increasing use of waterpipe smoking is also associated with the perception of many young adults concerning its relatively less harmful effects than

cigarette smoking (Sidani et al. 2019; Cobb et al. 2010). Other recent research into waterpipe smoking have examined such areas as toxicity (Hauser et al. 2020), waterpipe device cleaning practice and waste disposal (Kassem et al. 2020), effects on the cardiovascular system (Qasim et al. 2019), and severity of polycythemia (AlQahtany et al. 2020), although none of this research has implications for the psychological consequences or risk factors.

Waterpipe tobacco usage among students is increasing (Arrazola et al. 2015), and university students are one of the important target groups in preventing their uptake of waterpipe smoking. One possible reason for the increase in waterpipe smoking among university students is because of their normative perceptions about waterpipe smoking (Leavens et al. 2018). There are different types of normative perceptions. Descriptive and injunctive perceptions are two different types of normative perceptions which includes perceptions of a frequency of a behavior or perceptions of approval of a specific behavior (Larimer and Neighbors 2003; Neighbors et al. 2007). Theory from normative social behavior posits that individuals overestimate the influence of peer engagement in risky behaviors (Perkins 2002). These misrepresentations can lead individuals to be less concerned about their own health which results in increased engagement in risky behaviors (Baer et al. 1991; Borsari and Carey 2003) such as waterpipe smoking.

Similarly, the false consensus effect, which is another type of cognitive bias, asserts that individuals who engage in a target behavior believe that others are also engaged with similar kind of behavior at relatively similar frequencies (Ross et al. 1977). Existing research suggests that waterpipe smoking is innately social, and that peer group pressure in waterpipe smoking is an influential factor in personal waterpipe smoking (Leavens et al. 2018). Other factors such as gender differences have also shown that males are more likely to smoke waterpipes than females (Eissenberg et al. 2008; Primack et al. 2010).

Identifying the characteristics of university students susceptible to waterpipe use is critical to design targeted intervention to prevent waterpipe use. However, study concerning the predictors of waterpipe use is non-existent in Bangladesh. No previous study has ever investigated waterpipe tobacco smoking among Bangladeshi students. Therefore, the present study was conducted to explore waterpipe tobacco smoking behavior and normative beliefs among university students in Bangladesh and to assess the factors affecting waterpipe tobacco use. The present study also attempted to explore the patterns of behavior including frequency of use and dependence on waterpipe smoking.

## Method

### Participants and Study Design

A quantitative cross-sectional study was carried out among the students of Patuakhali Science and Technology University (Bangladesh) to explore the study objectives (outlined above). Data were collected from August to October 2019. The only inclusion criterion for the study sample was being enrolled as a full-time student at the university. A power analysis was carried out based on the population size of the university (4000 students) with a margin of error of 5%, a confidence level of 95%, and a 50% response distribution which showed that at least 351 participants were needed for the survey (Dean et al. 2014). Hoping to get a 90% response, a 10% non-response rate was added. The number of students asked to participate was 385.

Complete data were collected from 340 students (response rate 88%). Students were selected from each of seven university faculties. The probability proportional to size (PPS) technique was used to determine the number of students to recruit in each faculty.

## Data Collection

Data were collected face-to-face using a pre-tested structured questionnaire. Six volunteer research assistants with previous survey experience were recruited to collect data. Students were selected from the faculty classroom. A list of the students with their registration number was collected from the respective faculty dean office, and this list was used as a sampling frame. From the sampling frame, students were selected randomly using a lottery method. Data collectors approached the randomly selected participants and informed them about the objectives of the study and confidentiality of the data. After having signed consent form, the data were collected from the students. Each interview took approximately 20–30 min and it was held in a private setting.

## Measures

**Socio-Demographics** Socio-demographic data were collected including age in years, gender, study program (undergraduate vs. postgraduate), field of study, parental educational and occupational status, family monthly income (in Bangladeshi Taka [BDT]), permanent residency status (rural vs. urban area), smoking status, and monthly expenditure on tobacco products.

**Waterpipe Use** To assess the waterpipe smoking behavior among the students, two dichotomous items were used: (i) have you *ever* smoked tobacco from a waterpipe (hookah, shisha, narghile), even one or two puffs? (yes/no); (ii) during the *past 30 days*, have you smoked tobacco from a waterpipe (hookah, shisha, narghile), even one or two puffs? (yes/no). This part of the survey was adapted from a previous study conducted among the US university students (Primack et al. 2008). Participants' perception relating to harm and addictiveness of waterpipe use was also assessed. These questions were designed by comparing the harm/addictiveness of waterpipe tobacco smoking versus that of cigarette smoking. Two separate items were asked to assess students' belief regarding harm and addictiveness of smoking tobacco from a waterpipe. One item asked "Would you say that smoking from a waterpipe is more harmful or less harmful than smoking regular cigarettes?", and students were provided with four response categories, i.e., "waterpipe is more harmful," "waterpipe is the same harm as cigarettes," "waterpipe is less harmful," and "do not know". A similar item asked "Would you say that smoking from a waterpipe is more addictive or less addictive than smoking regular cigarettes?", and responses were similarly divided into four categories. This type of structure has been commonly used in previously published studies (Primack et al. 2008; Smith-Simone et al. 2008; Tamim et al. 2003).

**Waterpipe Dependence** Waterpipe dependence was assessed using the Lebanon Waterpipe Dependence Scale (LWDS-11) (Salameh et al. 2008). This scale comprises 11 items consisting of four components: nicotine dependence, positive reinforcement, negative reinforcement, and psychological craving (e.g., number of times an individual was able to stop using waterpipes for more than 7 days, the number of days an individual can spend without using waterpipes).

Responses for each question were scored 0–3, and total score was calculated by adding all the individual scores (total score 33). Individuals scoring  $\geq 10$  on the LWDS-11 are classed as having a waterpipe smoking dependence based on the original study (Salameh et al. 2008). Dependency level was assessed only for those who responded “yes” to past 30 days use of waterpipes. For this present study, the Cronbach’s alpha of the LWDS was very good (0.81).

## Ethics

All study procedures were carried out following the guidelines of the Helsinki Declaration. Written ethical approval was obtained from the Institutional Ethical Committee of Patuakhali Science and Technology University (Ref. PSTU/IEC/2019/03). Written informed consent was obtained from the participants before each interview. Participants were informed that their participation was voluntary, and they had the right to withdraw from the study at any time. They were also assured about the confidentiality and anonymity of the data.

## Data Analysis

After completion of data entry, frequency analysis was run to check the consistency of the data. If any inconsistencies were found (such as incorrect or ambiguous entries), data were re-checked with the survey questionnaire. At first, prevalence of the major variables (i.e., waterpipe tobacco use ever and past 30 days) was assessed. Prevalence of each variable for each socio-demographic variable was computed. Chi-square tests were performed to assess the associations between categorical variables and Pearson’s correlation tests were performed to assess the relationship between continuous variables. Logistic regression was used to determine the association between independent and dependent variables. The tests for the main effects were considered significant at  $p < 0.01$  level. A binary and multiple logistic regression analysis was conducted to determine the odd ratios (ORs) and adjusted odd ratios (AORs) with 95% confidence intervals. All statistical analyses were performed using SPSS for Windows Version 23 (IBM, Armonk, NY, USA).

## Results

### Participants

The socio-demographic characteristics of participants are shown in detail in Table 1. Of the 340 participants, the majority were male 64.4% ( $n = 219$ ). Participants were aged between 18 to 25 years (mean age = 21.6 years;  $SD \pm 1.73$ ). The majority of the students were enrolled in undergraduate programs (78%) and came from rural areas (56%). No female was reported having ever engaged in waterpipe tobacco smoking in their life.

### Prevalence of Waterpipe Tobacco Smoking

Among participants, 13.5% reported they had smoked tobacco from a waterpipe ( $n = 46$ ) and 9.4% had smoked tobacco from a waterpipe in past 30 days ( $n = 32$ ). Table 1 shows

that the use of waterpipes was higher among the younger 18–21-year age group than the 22–25-year age group (14.9% had used waterpipes and 10.9% has used them in the past 30 days). Use of waterpipe tobacco consumption was only reported among male students.

**Table 1.** Characteristics of the participants by waterpipe tobacco smoking use.

Characteristics	Students (N=340)	Ever use (n=46)		Past 30-day use (n=32)	
		n (Row%)	<i>p</i> -value <sup>a</sup>	n (Row%)	<i>p</i> -value <sup>a</sup>
<i>Age (years)</i>					
18-21	174	26 (14.9)	0.526	19 (10.9)	0.358
22-25	166	20 (12.0)		13 (7.8)	
<i>Gender</i>					
Male	219	46 (21.0)	< 0.001	32 (14.6)	< 0.001
Female	121	0 (0.0)		0 (0.0)	
<i>Study program</i>					
Undergraduate	266	44 (16.5)	< 0.001	31 (11.7)	< 0.01
Graduate	74	2 (2.7)		1 (1.4)	
<i>Study area</i>					
Agricultural science	244	25 (10.2)	< 0.05	16 (6.6)	< 0.01
Engineering	28	5 (17.9)		3 (10.7)	
Business studies	68	16 (23.5)		13 (19.1)	
<i>Father's occupation</i>					
Agriculture based	37	2 (5.4)	0.367	2 (5.4)	0.628
Labor	5	1 (20.0)		0 (0.0)	
Business	99	15 (15.2)		9 (9.1)	
Job	143	23 (16.1)		17 (11.9)	
Others	56	5 (8.9)		4 (7.1)	
<i>Mother's occupation</i>					
Housewife	262	12 (4.6)	< 0.001	11 (4.2)	< 0.001
Working outside	78	34 (43.6)		21 (26.9)	
<i>Permanent residence</i>					
Rural area	190	13 (6.8)	< 0.001	9 (4.7)	<0.001
Urban are	150	33 (22.0)		23 (15.3)	
<i>Family size</i>					
≤ 4	162	22 (13.6)	0.979	17 (10.5)	0.579
> 4	178	24 (13.5)		15 (8.4)	
<i>Household income (BDT)</i>					
< 15k	34	4 (11.8)		3 (8.8)	0.835
15k – 30k	121	16 (13.2)		10 (8.3)	
> 30k	185	26 (14.1)		19 (10.3)	
<i>Monthly expenditure (BDT)</i>					
< 5k	144	8 (5.6)	< 0.001	4 (2.8)	< 0.001
≥ 5k	196	38 (19.4)		28 (14.3)	
<i>Smoking status</i>					
Smoker	84	41 (48.8)	< 0.001	30 (35.7)	< 0.001
Non-smoker	256	5 (2.0)		2 (2.0)	
<i>Parental smoking</i>					
Yes	92	21 (22.8)	< 0.01	15 (16.3)	< 0.05
No	248	25 (10.1)		17 (6.9)	

<sup>a</sup> Chi-square test

## Association between Waterpipe Smoking Behavior and Beliefs Regarding Harmfulness and Addictiveness

Among those who had ever used waterpipes to smoke tobacco, just over one-quarter (27.6%) of the sample believed that waterpipe tobacco smoking was less harmful than cigarette smoking, whereas 18% believed that waterpipe tobacco smoking was more harmful, and 3.7% reported they did not know (Table 2). With regard to addictiveness, 30% believed waterpipe tobacco smoking was less addictive than cigarette smoking and 25% believed waterpipe tobacco smoking was more addictive. Among the past 30 days users, 20.7% believed that waterpipe tobacco smoking was less harmful than cigarette smoking and 23% believed it was less addictive. Those who believed that tobacco smoking from a waterpipe is less harmful than cigarette smoking were more commonly waterpipe tobacco smokers. This association was statistically significant for both those that had ever used waterpipes and those that had used them in the past 30 days users ( $p < 0.001$ ). A similar significant relationship ( $p < 0.001$ ) was found for the addictiveness of waterpipe smoking compared with cigarette smoking (i.e., those who thought tobacco smoking from a waterpipe is less addictive than cigarette smoking were more likely to have ever used waterpipes and used them in the past 30 days) (Table 2).

## Association between Waterpipe Smoking and Socio-Demographic Predictors

Table 3 shows the association between waterpipe smoking behavior and socio-demographic predictors. The regression analysis showed that there was a significant association between having ever used a waterpipe and mother's occupation. More specifically, students whose mothers were in employment had higher odds of using waterpipes than students whose mothers were housewives (OR = 16.09; 95% CI, 7.74–33.47). The odds remained high after adjusting the variables (OR = 27.81; 95% CI, 8.07–95.83). There was also a significant association between having ever used waterpipes and cigarette smoking status. Those who were smokers were more likely to use waterpipes compared with non-smokers (OR = 47.86; 95% CI, 17.90–127.94). The odds remained high after adjusting the other variables. A similar pattern was shown among past 30-day waterpipe users.

**Table 2.** Association between waterpipe use and belief regarding harm and addictiveness.

	Ever use			Past 30-day use		
	n (%)	$\chi^2$ test value	<i>p</i> -value	n (Row%)	$\chi^2$ test value	<i>p</i> -value
<i>Harm (versus cigarettes)</i>						
Waterpipe more harmful	16 (18.0)	29.858	<.001	12 (13.5)	27.838	<.001
Waterpipe same harm	1 (3.6)			1 (3.6)		
Waterpipe less harm	24 (27.6)			18 (20.7)		
Don't know	5 (3.7)			1 (0.7)		
<i>Addictiveness (versus cigarettes)</i>						
Waterpipe more addictive	13 (25.0)	51.971	<.001	8 (15.4)	41.227	<.001
Waterpipe same addictive	0 (0.0)			0 (0.0)		
Waterpipe less addictive	30 (30.0)			23 (23.0)		
Don't know	3 (1.8)			1 (0.6)		

**Table 3** Association between waterpipe smoking and socio-demographic predictors

	Ever use		Past 30-day use	
	OR (95% CI)	AOR <sup>a</sup> (95% CI)	OR (95% CI)	AOR <sup>a</sup> (95% CI)
<i>Study program</i>				
Undergraduate	7.13 (1.68-30.16)**	5.93 (0.86-40.52)	9.63 (1.29-71.76)*	5.57 (0.63-48.84)
Graduate	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>
<i>Study area</i>				
Agricultural science	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>
Engineering	1.90 (0.66-5.45)	2.55 (0.56-11.56)	1.71 (0.46-6.27)	1.65 (0.33-8.20)
Business studies	2.69 (1.34-5.40)**	3.04 (0.91-10.14)	3.36 (1.53-7.41)**	3.10 (0.99-9.62)*
<i>Mother's occupation</i>				
Housewife	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>
Working outside	16.09 (7.74-33.47)***	27.81 (8.07-95.83)***	8.40 (3.83-18.41)***	5.53 (1.84-16.60)**
<i>Permanent residence</i>				
Rural area	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>
Urban are	3.84 (1.94-7.60)***	1.70 (0.57-5.04)	3.64 (1.63-8.13)**	1.46 (0.49-4.30)
<i>Monthly expenditure (BDT)</i>				
< 5k	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>
≥ 5k	4.08 (1.84-9.06)***	2.02 (0.58-7.03)	5.83 (1.99-17.03)***	2.71 (0.69-10.55)
<i>Smoking status</i>				
Smoker	47.86 (17.90-127.94)***	50.82 (14.31-180.47)***	70.55 (16.36-304.16)***	41.36 (9.0-189.81)***
Non-smoker	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>
<i>Parental smoking</i>				
Yes	2.63 (1.39-4.99)**	2.95 (1.01-8.61)*	2.64 (1.26-5.55)**	2.18 (0.78-6.03)
No	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>	1.00 <sup>b</sup>

Note. OR= Odd Ratio, AOR= Adjusted Odd Ratio

<sup>a</sup> Adjusted for all variables in the table

<sup>b</sup> Reference

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

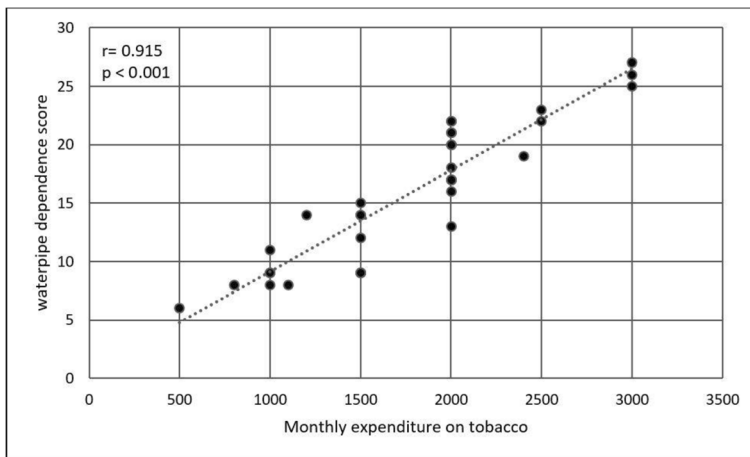
### Relationship between Waterpipe Dependence Score and Monthly Expenditure on Tobacco

Among past 30-day users, a higher level of waterpipe dependency level was found with 72% being categorized as waterpipe dependent ( $n = 23$ ). The mean score was 15.75 (out of 33;  $SD \pm 6.20$ ). There was a significant positive correlation ( $r = 0.915$ ,  $p < 0.001$ ) between waterpipe dependence score and monthly expenditure on tobacco products (Fig. 1).

### Discussion

Given the lack of data concerning the use of waterpipe tobacco smoking in Bangladesh, the present study sought to collect some baseline data from one of the most vulnerable groups (i.e., university students). Results demonstrated that 13.5% of the sample had engaged in smoking tobacco from a waterpipe and 9.4% had done so in past 30 days. The prevalence rate of having ever used waterpipes to smoke tobacco was much lower than that reported among UK university students (38–52%) but had a similar prevalence rate for past 30-day use (8–11%)





**Fig. 1** Relationship between Lebanon waterpipe dependence score and monthly expenditure on tobacco

(Jackson and Aveyard 2008; Jawad et al. 2013a). Past 30-day waterpipe use in Bangladesh (9.4%) was much lower than the past 30-day prevalence rates in Lebanon (36.9%), West Bank (32.7%), and Latvia (22.7%) (Jawad et al. 2016b).

The results also found that no females in the present study reported that they had engaged in waterpipe smoking. Previous studies conducted in different Arab countries and Iran shows that male participants were more prone to addicted by waterpipe smoking (Al Ghobain et al. 2018; Danaei et al. 2017; Morton et al. 2014), and the prevalence was higher among them compared with their counterparts (Eissenberg et al. 2008; Primack et al. 2010). As tobacco consumption among the females is socially and culturally unacceptable in Bangladesh, the study result might be a reflection of his phenomenon.

Previous research indicates that smoking tobacco using a waterpipe is more harmful than cigarette smoking (Cobb et al. 2010). However, findings from the present study found that a slightly larger proportion of the sample (27.6%) believed that waterpipe tobacco smoking was less harmful than cigarette smoking, compared with 18% who believed that that it was not. This finding are in consistent with other findings which stated that the popularity of waterpipe smoking among young adults and adolescents is because of the perception of its relative less harmful effects than cigarette smoking (Combrink et al. 2010; Jackson and Aveyard 2008). Similarly, a slightly larger proportion of the sample (30%) believed that waterpipe tobacco smoking was less addictive than cigarette smoking compared with 25% who believed that it was not. A similar finding was found among university students in Jordan, where most of the waterpipe smoker believed that it was less harmful and less addictive than cigarette smoking (Primack et al. 2010).

Very few of the variables examined were associated with waterpipe smoking. Results demonstrated that students whose mothers were employed were more likely to using waterpipes than students whose mothers were housewives. Unsurprisingly, cigarette smokers were more likely to smoke tobacco from a waterpipe. This result is similar with a previous study conducted in Jordan shows that cigarette smokers were more prone to consume waterpipe (Primack et al. 2010). A previous study also shows that maternal occupation is closely related to the risk of tobacco consumption among Bangladeshi university students (Hassan et al. 2018).

Results also demonstrated that 72% among those who had smoked using a waterpipe in the past 30-days were classed as being dependent using the Lebanon Waterpipe Dependence Scale. Unsurprisingly, there was a significant relationship between waterpipe dependence score and monthly expenditure on tobacco products. A previous study conducted in the UK shows that those who smoked from waterpipe daily were more dependent on waterpipe smoking (Kassim et al. 2013).

The present study is not without its limitations. Firstly, the sample (while randomly selected) was modest in size and not necessarily representative of all Bangladeshi students. Therefore, replications are required with bigger sample sizes from a wider range of Bangladeshi university students. Secondly, all the data were self-report which is subject to well-known method biases including such things as social desirability biases and memory recall biases. The data were also cross-sectional in nature meaning that issues concerning causality could not be determined. Future studies should attempt to use other methodologies (such as qualitative interviews and focus groups, as well as longitudinal survey studies) to gain richer data than the basic kinds of information collected here using a survey. Finally, the number of variables examined was modest, and other variables should be examined in future studies to gain a more rounded overall picture of what factors contribute to waterpipe smoking and dependence upon it. Despite these limitations, the study is of existential value given that there are no prior studies ever carried out in Bangladesh previously. Therefore, the present study provides novel benchmark data for other future studies to replicate and extend.

Findings of this study could be useful for the development of (i) different health promotions program in Bangladesh to prevent students from different types of tobacco consumption, and (ii) national policymaking concerning tobacco use. Educational institutions such as universities can play a significant role in helping prevent tobacco use among students. Based on the findings here, it is recommended that each university in Bangladesh should have its own regulation and monitoring team to control tobacco use in university campus and students dormitory. University authorities should arrange different awareness campaign including workshops, incorporate such information into campus counseling programs, and promote the concept of tobacco-free campus.

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## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they do not have any interests that could constitute a real, potential or apparent conflict of interest with respect to their involvement in the publication. The authors also declare that they do not have any financial or other relations (e.g. directorship, consultancy or speaker fee) with companies, trade associations, unions or groups (including civic associations and public interest groups) that may gain or lose financially from the results or conclusions in the study. Sources of funding are acknowledged.

**Ethical Approval** All procedures performed in this study involving human participants were in accordance with the ethical standards of University's Research Ethics Board and with the 1975 Helsinki Declaration.

**Informed Consent** Informed consent was obtained from all participants.

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