
Effects of Smoking on Body Mass Index among University Students in Bangladesh

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Abstract: Both smoking and being overweight are two major global public health issues nowadays that can raise the risk of cancer, cardiovascular disease, and metabolic disorders and that can lead to death. This study aims to determine the association between smoking and body mass index (BMI) among university students in Bangladesh. A cross-sectional research design is adopted; the target population of the study is university students including all religions and races. With the aid of a non-probability convenience sampling technique, a total of 910 university students participated in the study. Descriptive statistics and parametric statistical analyses were used to analyze the data collected from the respondents. Among the respondents, smokers and non-smokers represented 496 (54.5%) and 414 (45.5%) respectively. Among the 496 smokers of respondents, their smoking intensity score showed 70.6% of respondents were low dependent on nicotine and 29.4% were high dependent on nicotine. There was a significant difference between subjects who smoked cigarettes and those who did not smoke cigarettes regarding gender, age, study group, current living status, socio-economic class, and religion ($p < 0.05$). The present study showed a significant association between high smoking intensity with overweight ($p < 0.05$). According to the study, smoking cigarettes over an extended period is associated with a lower BMI and vice versa. We find that 54.5% of the university students in our sample were smokers, and we think that if awareness programs are introduced or increased in universities with regular activities of universities the percentage of smoking is decreased. When someone managing their body weight, smoking status and quitting techniques should also be taken into consideration.

Keywords: Smoking, BMI, Overweight, University Students, Bangladesh

1. Introduction

Bangladesh has a lower smoking prevalence (23.19%) than many other developed and developing countries among them male smokers are 48.28% and female smokers 1.47% [1]. The percentage of male smokers in those aged 24 is 21.53% and 27.68% in those aged 25 and above. However, the commonness of smokers in Pakistan is 15.2%, and in Nepal is 19.7% which shows Bangladesh exceeds most of the developing countries of the SAARC [2, 3]. In addition, the smoking percentage among university students is 43% in the first year 26%, in the second year 11%, in the third year 4%, and in the fourth year [4]. Furthermore, most of the smokers use cigarettes (13.86%), bidi (9.40%), and water pipes (0.88%) [1].

Among many risk factors smoking, overweight, and heavy drinking are major reasons for chronic health illness like cancer, diabetes, and heart disease. These factors are widespread, however, only the overweight has elevated through the earlier twenty-five years [5]. Smoking has been incriminated as a leading cause of preventable deaths, killing nearly 6 million people each year, which is observed to be variably associated with lower body weight in individuals. However, the relation between smoking and overweight is incompletely understood [6]. In the United States, the proportion of deaths is about one-fifth of the population; because of smoking, 28% of lung cancer which it's the major cause of impermanence and is considered the most common cause of death from smoking, 37% of vascular disease and other respiratory diseases by 26% [7-10]. Compared to other type of cancers, lung cancer has higher smoking risk.

However, oral, pharyngeal, and esophageal cancers are considered a chief hazard from the amalgamation of both smoking and alcohol consumption [11, 12]. Moreover, in the United States, poor educational attainment, deprived neighbourhoods, and low income at a young age are the most common reasons for smokers' steadiness in the smoking pathway. Nevertheless, there are further justifications like regulating mood and maintaining the stability of the nicotine concentration in the brain; to avert the adverse effects of nicotine withdrawal. Thus, signs of nicotine withdrawal include decreased arousal, increased impulsivity, and increased stress [10]. Substance abuse, depression, and anxiety illnesses are the most subtle psychiatric co-morbidity conditions. Nonetheless, the most prevalent mental illness in the US is nicotine dependency, and research has shown that nicotine addiction is the psycho-pharmacologic mechanism that sustains smoking behavior. [10]. Body mass index (BMI), smoking habits, and eating habits are inversely correlated, and both dietary habits and secondary lifestyle are currently the main causes of overweight [13]. Additionally, the opposite relation becomes more solid with age and smoking length [14].

In Bangladesh, overweight and obesity in children, adolescents, and adults are on the rise. In children and adolescents, girls are far more likely than boys to be overweight or obese, and in adults, females are more likely than men to be overweight or obese. Prevalence rates of overweight and obesity are also higher in urban people compared to rural people living in Bangladesh [15]. The World Health Organization reports that globally 600 million people are obese and 1.9 billion adults are overweight [16]. The risk factors such as mortality, coronary heart disease, osteoarthritis, diabetes mellitus, hypertension, and cancer are increased with increasing BMI [5].

The percentage of overweight and obese was greater among non-smokers compared with smokers that underweight and there is a connotation factor such as gender and economic status has a noteworthy effect on BMI [6].

1.1. Rationale of the Study

Bangladesh is a densely populated country in the southeast region. It has a population of over 160 million of which among university students (36.1%) male students smoke tobacco [4]. Recently, the percentage of overweight and obesity among university students has been steadily increasing in urban areas in Bangladesh [17-19]. Reduced playground availability probably resulted in more sedentary lifestyles and engaged in less physical exercise, which will fuel the growing problem of overweight and obesity among students [20]. University students are consuming cigarettes both occasionally and regularly which may raise their chance of being overweight, obese, and other related health issues, which would raise the expense of medical expenses. There is compelling evidence linking metabolic syndrome to smoking, being overweight, being obese, and other related factors. Moreover, there is a lack of information on whether an association between smoking status and BMI. Thus, the

purpose of this study is to explore these relationships in a sample of Bangladeshi university students.

1.2. Objective of the Study

The main objective of the study is to find the prevalence of smoking and also to determine the association between smoking and BMI among university students.

2. Literature Review

Camp et al. showed that among regular smokers, the percentage of white female smokers is higher than white male smokers who reported using smoking to control their appetite and weight and they also stated that smoking as a weight-control strategy did not predict regular smokers versus non-smokers. They also revealed that white female who controlled their eating habits were the most likely to use smoking as a weight-control strategy [21]. Molarius et al. investigated the magnitude and consistency of the associations between smoking and body mass index (BMI) in different populations in their study. They explored that compared to non-smokers, regular smokers had significantly lower median BMI in men than women and they found that there was no population in which smokers had a significantly higher BMI than non-smokers. They also showed that among men, the association between leanness and smoking was less apparent in populations with relatively low proportions of regular smokers and high proportions of ex-smokers [14]. Kvaavik et al. examined the associations between smoking habits, dietary habits, physical activity, and body mass index (BMI) in Norway in their study. They found that mean BMI was higher for non-smokers than for current smokers. They also showed that the prevalence of obesity among never-smoking women and men was less than among smokers women and men and they finally stated that non-smokers had healthier eating habits and higher levels of physical activity than did smokers, whereas the prevalence of obesity was lower in smokers [22]. Lahti-Koski et al. investigated the associations of body mass index (BMI) and obesity with physical activity, food choices, alcohol consumption, and smoking history. They found that obesity was associated with alcohol consumption and smoking history [23]. Sturm compared the effects of obesity, overweight, smoking, and problem drinking on healthcare use and health status based on national survey data in his study. He showed obesity has roughly the same association with chronic health conditions as does twenty years of aging; this greatly exceeds the associations of smoking or problem drinking [5]. Cooper et al. found that an inverse relationship between smoking and body weight in their study [24]. Sneve and Jorde evaluated the effects of smoking and other lifestyle factors on body mass index (BMI), and changes in BMI about changes in smoking status [13]. Chhabra and Chhabra showed in their study that smoking had a negative effect on Body Mass Index (BMI). Besides, they found that this association may be confounded by demographic factors. They also found that the BMI values were higher among non-smokers while

smokers had a higher proportion of underweight after adjusting for gender and economic status [6]. Shipa et al. conducted their study on smokers and non-smokers to observe the changes in total count of leukocytes in cigarette smokers about body mass index (BMI) and blood pressure (BP) [25].

As per the above literary works, there are a number of studies which were done universally about the relationship between smoking and BMI as we can see there is no recent work about the relationship between smoking and BMI in the context of Bangladesh and this situation formulates a study gap. We want to see the updated state of the impact of smoking associated with BMI, so we wish to conduct this study.

3. Materials and Methods

3.1. Study Design and Participants

This study utilized a descriptive, cross-sectional research design. The study was conducted among Bangladeshi university students. The respondents were aged between 18 – 26 years who are current students of Bangladeshi universities. Omission criteria were ex-smoker, history of any disease that affect BMI and weight such as cardiovascular disease, respiratory disease, thyroid gland disease, diabetes, hypertension, and osteoarthritis. Participants encompassed all religions and races and represented various socioeconomic groups.

3.2. Data Collection Tool

After a preliminary review of relevant literature, a draft questionnaire was developed. The questionnaire contained two sections. Section A contained the question about the participant's demographic background such as age, gender, and living status. Anthropometric measurements were also taken which included participants' weight and height. Section B contained seven items Fagerstrom Tolerance Scale (English version) questionnaire [26] which was used to measure the smoking status of the participants.

The Fagerstrom Tolerance Scale (English version) questionnaire is one of the globally used tests for nicotine dependence to quantify the exposure to cigarette smoke and to regulate the smoking intensity level in research as well as clinical studies is considerable to be valid [26]. Individual scores on Fagerstrom Tolerance Scale questionnaire can range from 0 to 10. This can be divided into very low (0 – 2), low (3 – 4), medium (5), high (6 – 7) and very high (8 – 10) groups. This self-report is still a dependable tool for monitoring the changes in smoking behaviour in the population [27]. Other studies on smoking selected this assessment because of its acceptable reliability and validity [28].

Our intent was to identify whether the smoking intensity had affected the respondents' BMI. For which they had to answer a question (Are you a smoker?) by clicking either "Yes" or "No". If "Yes", they were requested to answer six

items Fagerstrom Tolerance Scale questionnaire to measure the smoking intensity. In this study, we classified the smoking intensity as high (high and very high) and low smoking intensity (very low and low).

3.3. Data Collection

The study was conducted by applying a non-probability purposive sampling technique. The study was conducted from November 01, 2023, to December 15, 2023. Data were collected by using a structured questionnaire administered by interviewers through face-to-face interviews. Before collecting information from the participants, the aim of the study was clearly articulated, and formal oral consent was taken from each of them. Participants were allowed to join freely in the survey and also were given the option to terminate the survey at any time. A total of 910 university students participated in the study during the above-mentioned timeline. The survey did not require any personal information thus, confidentiality and anonymity of the respondents were confirmed.

3.4. Anthropometric Measurements

The participants were asked to measure his/her height and weight in the morning according to written standardized procedures. Bodyweight was asked to measure in a kilogram (kg) scale and height was asked to measure in a meter scale. Measurements were done with clothes and without shoes. Body Mass Index (BMI) was calculated as the ratio of weight (kg) to height squared (m^2). For adults over 18 years old, BMI falls into one of the following categories [29].

Table 1. Nutritional Status.

BMI	Nutritional status
Below 18.5	Underweight
18.5–24.9	Normal weight
25.0–29.9	Overweight
30.0 and above	Obese

3.5. Statistical Analysis

Statistical analysis was carried out using the Statistical Package for Social Sciences program (SPSS, version 25.0). Based on the objectives of the study, descriptive statistic (mean, percentage, and standard deviation) was used to describe the demographical data. Parametric statistical analysis (chi-square test and binary logistic regression with 95% confidence intervals (95% CI)) was used to explore the bivariate associations between smoking and body mass index (BMI). A p-value of less than 0.05 indicates the results are statistically significant at a 5% level of significance.

4. Results

4.1. Socio-Demographic Characteristics

A total of 942 participants were interviewed within the allotted period, of which, 910 (96.6%) individuals completed the survey and 32 (3.4%) refused to participate with a mean

(\pm SD) age of 22.67 (\pm 1.74) years. The distribution of socio-demographic characteristics of respondents was demonstrated in Table 2. Among the participants, male and female participants represented 742 (81.5%) and 168 (18.5%) respectively. The present survey comprised of university students from public 766 (84.2%), private 86 (9.5%) and national 58 (6.4%) respondents. Of them, 410 (45.1%) were from science, 304 (33.4%) from engineering and technology, 130 (14.3%) from social science and 66 (7.3%) from business administration group. In this study, 138

(15.2%) respondents were from 1st year, 224 (24.6%) respondents were from 2nd year, 192 (21.1%) respondents were from 3rd year, 288 (31.6%) respondents were from 4th year, and rest of them were from M.Sc. On the other hand, 522 (57.4%) respondents lived with family while 388 (42.6%) respondents lived in hall or mess. Of the respondents, more than half (62.9%) of the respondents' monthly income was between BDT 25,000 to BDT 50,000. Most of the respondents were Muslim (86.4%) (Table 2).

Table 2. Socio-demographic characteristics of the respondents ($n = 910$).

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	742	81.5
	Female	168	18.5
Age (years)	18 – 21	312	34.3
	22 – 25	586	64.4
	Above 25	12	1.3
University	Public	766	84.2
	Private	86	9.5
	National	58	6.4
Study group	Science	410	45.1
	Engineering and Technology	304	33.4
	Social Science and Humanities	130	14.3
	Business Administration	66	7.3
Academic year	1 st year	138	15.2
	2 nd year	224	24.6
	3 rd year	192	21.1
	4 th year	288	31.6
	M.Sc	68	7.5
Current living status	With family	522	57.4
	Hall/Mess	388	42.6
Socio-economic class	Low (< BDT 25,000)	226	24.8
	Middle (BDT 25,000 – BDT 50,000)	572	62.9
	High (> BDT 50,000)	112	12.3
Religion	Muslim	786	86.4
	Non-Muslim	124	13.6

4.2. Level of Smoking Intensity by Fagestorm Tolerance Scale

Among the participants, smokers and non-smokers represented 496 (54.5%) and 414 (45.5%) respectively. Among the smoker, 128 (25.8%) smoked their first cigarette after 30 minutes of awaking, 174 (35.1%) were smoked between 31 to 60 minutes after awaking, 142 (28.6%) were smoked between 6 to 30 minutes after awaking and the rests of them were smoke within 5 minutes of awake. The first

cigarette in the morning (52%) were reported that hates most to give up. 55.6% and 39.1% of respondents smoke 10 or less and 11 to 20 cigarettes per day respectively. The majority of the participants (65.3%) do not smoke during illness. Almost half 244 (49.2%) respondents smoke more frequently during the first hours after awakening than during the rest of the day. More than half 274 (55.2%) respondents face difficulties in refraining from smoking in places where it is forbidden such as the library, theatre, or doctor's office (Table 3).

Table 3. Characteristics of the smoker of the study respondents ($n = 496$).

Characteristics	Category	Frequency (n)	Percentage (%)
Smoke first cigarette after awaking	After 30 minutes	128	25.8
	31-60 minutes	174	35.1
	6-30 minutes	142	28.6
	Within 5 minutes	52	10.5
Cigarette that hates most to give up	The first one in the morning	258	52.0
	All others	238	48.0
Number of cigarette smoke per day	10 or less	276	55.6
	11-20	194	39.1
	21-30	22	4.4
	31 or more	4	0.80
Smoke more frequently during the first hours after	Yes	244	49.2

Characteristics	Category	Frequency (n)	Percentage (%)
awakening than during the rest of the day	No	252	50.8
	Yes	172	34.7
Smoke during illness	No	324	65.3
	Yes	274	55.2
Difficulties to refrain from smoking in places where it is forbidden such as the library, theatre or doctors' office.	Yes	274	55.2
	No	222	44.8

Among the 496 smokers of the respondents, their smoking intensity score showed 70.6% of respondents were low dependent on nicotine and 29.4% were highly dependent on nicotine (Table 4).

Table 4. Smokers' intensity score by Fagerstorm Tolerance Scale questionnaire (n = 496).

Smoking Intensity	Smoker, n (%)
Low	350 (70.6)
High	146 (29.4)

Multinomial logistic regression analysis for smoking

intensity comparison

Table 5 illustrates the comparison of smoking status in study respondents by the chi-square test between who smokes cigarettes and who does not smoke cigarettes. This table showed that there was a significant difference between subjects who smokes cigarettes and who does not smoke cigarettes regarding gender, age, study group, current living status, socio-economic class, and religion ($p < 0.05$). Nevertheless, there was no significant association between university and study years with smoking status (Table 5).

Table 5. The relationship between demographic variables and smoking status.

Characteristics	Category	Smoking Status		χ^2 value (p value)
		Smoker, n (%)	Non-smoker n (%)	
Gender	Male	466 (62.8)	276 (37.2)	111.598 (.000)
	Female	30 (17.9)	138 (82.1)	
Age (years)	18 – 21	132 (42.3)	180 (57.7)	28.654 (.000)
	22 – 25	356 (61.8)	230 (39.2)	
	Above 25	8 (66.7)	4 (33.3)	
University	Public	420 (54.8)	346 (45.2)	2.681 (.262)
	Private	50 (58.1)	36 (41.9)	
	National	26 (44.8)	32 (55.2)	
	Science	178 (43.4)	232 (56.6)	
Study group	Engineering and Technology	196 (64.5)	108 (35.5)	37.362 (.000)
	Social Science and Humanities	82 (63.1)	48 (36.9)	
	Business Administration	40 (60.6)	26 (39.4)	
Academic year	1 st year	68 (49.3)	70 (50.7)	6.485 (.166)
	2 nd year	124 (55.4)	100 (44.6)	
	3 rd year	102 (53.1)	90 (46.9)	
	4 th year	156 (54.2)	132 (45.8)	
Current living status	M.Sc	46 (67.6)	22 (32.4)	31.178 (.000)
	With family	326 (62.5)	196 (37.5)	
Socio-economic class	Hall/Mess	170 (43.8)	218 (56.2)	9.209 (.010)
	Low (< BDT 25,000)	120 (53.1)	106 (46.9)	
	Middle (BDT 25,000 – BDT 50,000)	300 (52.4)	272 (47.6)	
Religion	High (> BDT 50,000)	76 (67.9)	36 (32.1)	7.822 (.005)
	Muslim	414 (52.7)	372 (47.3)	
	Non-Muslim	82 (66.1)	42 (33.9)	

The present study showed a significant association between high smoking intensity with overweight ($p < 0.05$). Among the smokers, the gender, age, current living status, socio-economic class, and study group were significantly associated with a higher prevalence of smoking ($p < 0.05$). Multinomial logistic regression analysis further revealed that smokers were 0.296 times more likely to be overweight than non-smokers

(Odds Ratio = 0.296, 95% CI = 0.101 – 0.866, $p < 0.05$). Moreover, students aged 22 – 25 years who smoke ((Odds Ratio = 2.580, 95% CI = 1.336 – 4.984, $p < 0.05$) and (Odds Ratio = 2.869, 95% CI = 1.747 – 4.712, $p < 0.05$)) as well as students from engineering and technology who smoke were more likely to be overweight (Table 6).

Table 6. High smoking intensity in comparison to different variables identified by multinomial logistic regression analysis.

Variables	Category	Odds Ratio (95% CI)	p value
Body Mass Index	Normal weight	1 (Reference)	0.074
	Underweight	0.411 (0.155 – 1.091)	
	Overweight	0.296 (0.101 – 0.866)	
Gender	Female	1 (Reference)	0.026

Variables	Category	Odds Ratio (95% CI)	p value
Age (in years)	Male	53.613 (12.324 – 233.223)	0.000
	18 – 21	1 (Reference)	
	22 – 25	2.580 (1.336 – 4.984)	0.005
Current living status	Above 25	5.906 (0.666 – 52.390)	0.111
	With family	1 (Reference)	
	Hall/Mess	0.284 (0.174 – 0.463)	0.000
Socio – economic class	Low	1 (Reference)	
	Middle	1.110 (0.652 – 1.855)	0.721
	High	6.579 (3.056 – 14.164)	0.000
Study group	Science	1 (Reference)	
	Engineering and Technology	2.869 (1.747 – 4.712)	0.000
	Social Science and Humanities	1.070 (0.513 – 2.230)	0.857
	Business Administration	1.184 (0.471 – 2.978)	0.719

5. Discussion

From several universities in Bangladesh, 910 students contributed in this study with ages ranging between 18-26 years. They classified into two groups named smoker and non-smoker where smokers group consisted of 496 students and the non-smoker group included 414 students. Smoking concentration and BMI were calculated from the outcomes of Fagerstrom Tolerance Scale questionnaire. We found that there is a noteworthy difference between smoking intensity and overweight ($p < 0.05$). Our results were similar to those studies reported in [14] by Rasky *et al.*, (1996); Jacobs and Gottenborg, (1981), and Molarius *et al.*, (1997) [14, 30, 31]. However, there were dissimilarities with many other studies, in those studies they showed that smoking and BMI are inversely related to lower BMI respondents who smoke more. Higher BMI respondents tend to be light or non-smokers [32, 33].

The most common effect of smoking is that reduces hunger and satisfies oral desires hence people typically smoke to either maintain or lose weight. Thus, smoking bowed into a perilous way of controlling the weight. From a psychiatric point of view, non-smokers are more health conscious than the smokers, and they put extra effort into keeping their lower weight. However, heavy smoking created a substance abuse behaviour such as alcohol consumption and overeating, whilst light smokers have smaller BMI [30].

In a study that was done to assess the connotation between smoking and BMI, they inferred that heavy smokers are connected with an increase in body weight and a change in metabolic process [34] which is similar to my study. The study demonstrated that the difference in personality and lifestyle traits that lead to overweight and obesity are one of the potential reasons for increasing body weight among smoker which is also shown in another study [35].

However, a different study concluded that heavy smokers significantly gain weight due to the higher consumption of alcohol in comparison to light smokers, although there is no considerable difference in BMI between smokers and non-smokers, heavy smokers exhibit an unfavourable distribution of metabolic fat [36]. Besides a study showed that heavy smokers are heavier in comparison to light smokers which suggests that their weight loss may be a fall in lean body

mass rather than a decrease in fat mass [37].

The study also showed that participants who are from a high socioeconomic classes are statistically significant with a high smoking intensity which is similar to another study [38]. The study also found that most students from private universities student in Bangladesh were involved in smoking, where the majority of smokers being males. This finding has similarities with a previously published study [39].

Increased body fat level is the most common health hazard that could inversely affect human beings. This condition can lead to social impairment and reduced work production among individuals. Moreover, several studies indicated that socio-economic factors including: consuming obese food, leading sedentary lives, heaving income specifically in Arabic countries, and extreme outdoor temperatures which impose staying indoors, using cars for short distances, and marrying people tend to be overweight [40].

6. Strength and Limitations

The strength of the study is that it incorporated university students which revealed important findings regarding smoking intensity and overweight whereas most of the other studies were conducted on adolescents or the prevalence of obesity. A convenience sampling technique adopted in this survey is a limitation of the study.

7. Conclusion and Recommendation

The findings of this study reveal that smoking is initiated by students during the early adolescent years and continues throughout the university years. Smoking was more prevalent among males, possibly due to fewer opportunities to smoke due to cultural and social restrictions among females. The study finds that there is a significant difference between smoking intensity and BMI. Globally, overweight/obesity is considered the risk of increasing various chronic diseases like diabetes, hypertension, and cardiovascular diseases. So, we need to ennoble our healthy lifestyle to efficiently address the increasing comorbidities of overweight and obesity. Public awareness measures, such as anti-smoking campaigns must be implemented to create awareness, reduce smoking levels, and avoid negative health consequences in Bangladesh. The findings also contribute to a knowledge

base from which to develop targeted tobacco control policies for university students. If we can establish a holistic approach to tobacco control at university level, the overall tobacco control movement in Bangladesh will be accelerated. Besides, a smoke-free campus policy will encourage other universities to create a healthy environment for education in the future.

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Author's Contributions

Mimma Tabassum conceptualized and designed the study, supervised, and framed the hypothesis, conducted the statistical analysis, critically reviewed the manuscript, and revised, and drafted the manuscript. Tahmina Akter conducted a literature review, collected data, and extracted data. Tahmina Akter drafted the journal's pre-proof manuscript. Tahmina Akter, Mimma Tabassum, and Mohammad Iftakhar Parvej revised and drafted the manuscript. All authors have read the manuscript and agreed with the authorship order that the work is ready for submission to the journal.

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Conflicts of Interest

The authors declare no conflict of interest.

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