Antibiotic Abuse: A Cross-Sectional Study on Knowledge, Attitude, and Behavior Among the University Students in Dhaka, Bangladesh

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ABSTRACT
Objective: Antibiotic abuse has contributed to the development of antimicrobial resistance (AMR) and has become a global concern. With a poorly regulated health system and a general lack of data, Bangladesh remains under high risk of AMR spread. To minimize the existing gap in the literature, this study was conducted to assess the knowledge, attitude, and behavior regarding antibiotic use and misuse among university students.

Methods: A cross-sectional study design was used to survey 1400 students using a self-administered questionnaire from the University of Dhaka, Bangladesh. Descriptive and inferential analyses were performed with statistical significance defined as p < 0.05.

Results: More than half of the respondents had poor knowledge and neutral attitude towards antibiotics. The students from bioscience were found to have better knowledge and attitude than arts and business. Respondents with good knowledge were more likely to show a positive attitude, p<0.05. Most of the respondents did not know that antibiotics are ineffective against most coughs and cold; and above 60% practiced self-medication. About one-third did not know that antibiotics mainly target bacteria, and surprisingly, more than four-fifth perceived that humans & animals could become resistant to antibiotics. Also, half of the participants did not fulfill their prescribed antibiotic course.

Conclusion: There is a substantial amount of knowledge and attitude gap about and non-compliance to the proper use of antibiotics among the university students. The research findings, therefore, reflect the need for policy-level interventions to increase awareness and develop effective countermeasures to prevent the misuse of antibiotics.

Keywords: antibiotic resistance, Bangladesh, abuse, self-medication, university students

INTRODUCTION

Antimicrobials once coined as the ‘magic bullet’, are now rendered futile to fight bacterial infections as antimicrobial resistance (AMR) has emerged as a global threat to public health. Inappropriate and rampant use of such invaluable lifesaving drugs is among the key factors for the rapid development of superbugs and subsequent treatment failures with increased mortality rates [1]. Unless effective measures are taken, a substantial amount of death could occur globally due to antibiotic resistance [2]. The developing countries are at greater risk primarily due to irrational consumption of antibiotics, non-human antibiotic use, limited knowledge regarding AMR, malnutrition, inapprpriate surveillance, and poor healthcare standards [3]. Besides, inadequacy in developing newer drugs implies that the existing options should be pursued for the rational use of antibiotics to maximize the therapeutic benefits.

The use and misuse of antibiotics largely differ across countries influenced by social and cultural perception [4]. Purchase of antibiotics from pharmacies without a valid prescription, self-medication, partial fulfillment of the course and sharing left-over antibiotics are among the common malpractices. In a global study conducted in 11 countries, 22% of the adult respondents admitted to non-compliance to antibiotic therapy [5]. The role of the physicians is also in question at times as they are requested and pressurized to prescribe antibiotics both by the aggressive drug marketing policy and by the patients as a means for quick relief in trivial reasons.

Like most other developing countries, Bangladesh also faces the challenge of AMR and is inflicted with infections owing to the widespread presence of multi-drug resistant (MDR) and extensive-drug resistant (XDR) bacterial strains. A study on children from rural areas of Bangladesh showed that more than 80 per cent had MDR Escherichia coli bacteria in their gut [6]. Presence of MDR Staphylococcus aureus was also
confirmed in ready-to-eat foods, processed raw meat and fish samples from retail vendors in Dhaka city [7]. A substantial number of pharmacies is non-licensed, and the sellers have little-to-no formal training about the use of antibiotics. Consumption of antibiotics for acute respiratory infections (ARI) including cold, cough and viral flu is a common scenario as both patients and drug sellers are unaware of the risks linked to the needless medication [8]. In line with the WHO (World Health Organization) guidelines, one way to minimize excessive antibiotic use is by improving the knowledge and prescribing actions of healthcare practitioners [9]. Although physicians play a key role in the choice and use of medicine, the awareness of the patients is also equally important [10]. So, addressing the current states of public awareness and perception helps identify the point at issue and provides comparable data to influence decisions to be sought in the healthcare systems. Since epidemiological data on this theme is scarce in Bangladesh, it necessitates to fill up the void of information. Thus, this study was designed: (i) to evaluate the knowledge, attitude and behavior about the proper use of antibiotics among the university students who represent the educated class in the society, (ii) to determine whether the field of study influences attitude or behavior towards antibiotics, and (iii) to identify which groups within the population require improved awareness.

MATERIALS AND METHODS

Study Site, Population and Sample Size

A cross-sectional study was conducted at the University of Dhaka, Bangladesh, from July 2018 to October 2018 involving university students of both undergraduate and graduate level. The university holds 13 faculties, 83 departments, 12 institutes and 20 residential halls in which 37,018 students are actively studying. As Bangladesh’s largest public university in terms of population, it serves as the epicenter of higher education that includes students of diverse backgrounds coming from all over the country.

For the study, the sample size was calculated using the Raosoft online sample size calculator (www.raosoft.com) by assuming a 95% confidence level, 3% margin of error and 50% response distribution. The minimum recommended sample size was 1038. Assuming a response rate of 50%, the sample size was enlarged to 1600 students to improve reliability, of which 1400 data were enrolled in the final analysis after careful removal of incomplete questionnaires.

Survey Instrument and Data Collection

The data were collected using a structured questionnaire developed based on literature review and expert opinions to assess knowledge, attitude, and behavior towards antibiotics among the university students. Based on an earlier questionnaire developed by Vallin et al, our questionnaire consisted of 5 modules: (a) antibiotic consumption, (b) antibiotic accessibility, (c) antibiotic use and its effects, (d) side effect and resistance, and (e) patient experience (4). The internal consistency reliability of the questionnaires was checked, and their Cronbach’s Alpha value was 0.72. In addition to the queries on basic demographics, there were 30 questions distributed equally for the assessment of knowledge (K), attitude (A) and behavior (B). There was also an open-ended question. In the case of the field of study, the university departments were sorted into larger simplified categories of “Arts”, “Business”, “Bioscience”, and “Physical Science” for the ease of analysis.

The convenience sampling method was used to approach students to complete a self-administered questionnaire. The inclusion criterion was that the participants belonged to the University of Dhaka and were currently enrolled at either undergraduate or graduate level. To increase the generalizability of the study, the students were approached in classrooms, cafeterias, libraries, open space, halls, university buses and via social networks using ‘google form’. The google form, however, was distributed through personal communication. The data from both hardcopies (n=1106) and online forms (n=294) were included in the analysis.

Statistical Analysis

A scoring system was applied to measure the respondents’ knowledge and attitudes towards antibiotics. For each correctly chosen choice to a question, a value of ‘1’ was awarded, whereas both wrong and “don’t know” response had a value of ‘0’. Participants’ overall knowledge was categorized based on the response to 10 statements using modified Bloom’s cut-off point, as good if the score was between 80 and 100% (8-10 points), moderate if the score was between 50 and 79% (5-7 points), and poor if the score was less than 50% (0-4 points). The attitude was categorized in the same way using responses to 10 statements based on the score between 80 and 100% (8-10 points) as positive, neutral if the score was between 50 and 79% (5-7 points), and negative if the score was less than 50% (0-4 points).

Data were entered manually and analyzed in SPSS Software Version 25 (SPSS Inc., Chicago, IL, USA). The descriptive statistics was used to measure central tendency and dispersion (mean, median and range) and to obtain frequencies and percentages for categorical variables. Cross-tabulation with Pearson’s chi-square test was performed for testing association between categorical data. It was hypothesized that there was variation in the knowledge and attitude of the participants with respect to their field of study. Since the scores were not normally distributed based on the Shapiro-Wilk test, a non-parametric test of difference (Kruskal Wallis H test and median test) at the level of significance (α) of 0.05 was carried out. The missing values for the cases were excluded listwise. Binary logistic regression analyses were conducted, odds ratios and 95% confidence intervals were estimated, and a p-value ≤0.05 was considered statistically significant.

Ethical Consideration

In this survey, no vulnerable groups were included, and the study did not involve the risk of psychological or informational harms. The study protocol followed the 1964 declaration of Helsinki and its later amendments. Signed informed consent was obtained from the participants. They were adequately informed of the nature and purpose of the study, of the right to withdraw their data, and were assured of maintaining the confidentiality of the data being used in the research. Those who agreed to voluntarily take part in the study were given the survey forms. On average, the participants required only 15 minutes to complete the questionnaire.
The majority (836; 59.7%) of the respondents did not know that resistance could develop and spread from antibiotics. Although about 60% (829) were correct about bacteria becoming resistant to antibiotics, about 85% (1187) incorrectly showed an overall poor knowledge among the students. More male (60.4%) and undergraduates (83.9%) responded to this survey who were mainly in the age group of 20-25 years with a mean age of 21 ± 0.5 years. More than 75% of the participants agreed positively that it is incorrect to acquire antibiotics from relatives without being examined by a doctor. They also positively answered that it is neither okay to take an antibiotic prescription from a doctor via phone (892; 63.7%), nor by the suggestion of the medicine seller of the pharmacy (1105; 78.9%). In response to the attitude question that stated about the leftover antibiotics, about 48% (670) respondents disagreed to save antibiotics for future use, whereas about 25% was unsure as what to do and 27.5% agreed to save leftover antibiotics for personal use or to give to someone else.

A negative attitude was recorded in response to the statement: “a persistent cough (longer than one week) always needs to be treated with antibiotics to heal” as 41.2% of the respondents incorrectly agreed to it followed by 31.3% disagreements and 27.5% being unsure. About 48% of students think that it is not appropriate to self-medicate antibiotics for diarrhea, and about two-thirds (66.2%) agreed that the body can usually fight mild infections on its own without antibiotics. It is noteworthy that the majority of the participants (980; 70.2%) think that antibiotic resistance is now a big problem for Bangladesh (Table 3).

Table 1. Demographic characteristics of the respondents, (n = 1400)

| Characteristics          | n (%)       |
|--------------------------|-------------|
| Sex                      |             |
| Male                     | 845 (60.4%) |
| Female                   | 555 (39.6%) |
| Study Level              |             |
| Undergraduate            | 1174 (83.9%)|
| Graduate                 | 226 (16.1%) |
| Age                      |             |
| <20                      | 283 (20.2%) |
| 20-25                    | 1065 (76.1%)|
| >25                      | 52 (3.7%)   |
| Faculty                  |             |
| Arts                     | 607 (43.4%) |
| Business                 | 154 (11.0%) |
| Bioscience               | 290 (20.7%) |
| Physical Science         | 349 (24.9%) |

Table 2. Respondents’ knowledge regarding antibiotics (n = 1400)

| Items                                                                 | Correct | Incorrect |
|-----------------------------------------------------------------------|---------|-----------|
| 1. Antibiotics are supposed to kill - (Bacteria)                       | 479 (34.2%) | 921 (65.8%) |
| 2. Antibiotics make one recover faster when having a cold- (D)        | 280 (20%) | 1120 (80%) |
| 3. Antibiotics often cause side effects e.g. diarrhea, stomach upset - (A) | 1092 (78.0%) | 308 (22.0%) |
| 4. Antibiotics cause harm on the body’s gut microbiota - (A)         | 812 (58%) | 588 (42%) |
| 5. One can terminate a partially completed antibiotic therapy after feeling better - (D) | 705 (50.4%) | 695 (49.6%) |
| 6. Bacteria can become resistant to antibiotics- (A)                  | 829 (59.2%) | 571 (40.8%) |
| 7. The more we use antibiotic, the higher the risk that resistance develops - (A) | 927 (66.2%) | 473 (33.8%) |
| 8. Human and animal can become resistant to antibiotics- (D)          | 213 (15.2%) | 1187 (84.8%) |
| 9. Use of antibiotics for animals can reduce effectiveness of human antibiotic treatment - (A) | 465 (33.2%) | 935 (66.8%) |
| 10. Antibiotic resistance can spread from animal to human - (A)       | 564 (40.3%) | 836 (59.7%) |

Correct Answer: A = Agree; D = Disagree

RESULTS

A total of 1600 students at the University of Dhaka were approached; out of which 1442 agreed to participate in the study making a response rate of 90.1%. However, 2.9% of the data were discarded due to incompleteness and inadequate responses. About 48% (670) respondents disagreed to save antibiotics for future use, whereas about 25% was unsure as what to do and 27.5% agreed to save leftover antibiotics for personal use or to give to someone else. More than 75% of the participants agreed positively that it is incorrect to acquire antibiotics from relatives without being examined by a doctor. They also positively answered that it is neither okay to take an antibiotic prescription from a doctor via phone (892; 63.7%), nor by the suggestion of the medicine seller of the pharmacy (1105; 78.9%). In response to the attitude question that stated about the leftover antibiotics, about 48% (670) respondents disagreed to save antibiotics for future use, whereas about 25% was unsure as what to do and 27.5% agreed to save leftover antibiotics for personal use or to give to someone else.
knowledge (8.7%; 121). Students from bioscience had better knowledge (26.5%; N= 290) about antibiotics than physical Science (6.3%; N=349), arts (2.96%; N =607) and business (2.59%; N= 154) faculty (Figure 1).

The overall median attitude score was 7 (IQR: 3) out of a maximum possible score of 10, which indicated a neutral attitude (51.3%; 718). The positive attitude (29.4%; 411) was higher as opposed to the negative attitude (19.4%; 271). Among the faculties, bioscience had more positive attitude (44.82%; N = 290) followed by physical Science (30.08%; N=349), business (24.6%; N= 154) and arts (22.73%; N =607) faculty (Figure 2).

In Kruskal-Wallis H test, a statistically significant difference was found between the knowledge scores and the faculties, \( \chi^2 (3, N = 1400) = 116.68, p <0.05 \), with a mean rank knowledge score of 941.20 for bioscience, 718.51 for physical science, 603.30 for business and 599.81 for arts. Similarly, a statistical significance was also found between attitude scores and the faculties, \( \chi^2 (3, N = 1400) = 48.02, p <0.05 \), with a mean rank attitude score of 846.86 for bioscience, 716.98 for physical science, 696.19 for business and 622.19 for arts (Table 4).

In logistic regression analysis, respondents with good knowledge were more likely to show a positive attitude (OR: 4.62; CI: 3.05-7.05; p<0.05). The students from the faculty of science (OR: 2.11; CI: 1.66-2.69; p<0.05), and particularly of bioscience were found to be more knowledgeable than those from other faculties (OR: 8.89; CI: 5.95-13.30; p<0.05). Two independent variables had an influence on the respondents’ overall attitude towards the use of antibiotics. Students in the age range of 20-25 years (OR: 1.76; CI: 1.21-2.57; p=0.003) and particularly of bioscience were found to be more knowledgeable than those from other faculties (OR: 8.89; CI: 5.95-13.30; p<0.05). Two independent variables had an influence on the respondents’ overall attitude towards the use of antibiotics. Students in the age range of 20-25 years (OR: 1.76; CI: 1.21-2.57; p=0.003) and particularly of bioscience faculty were more likely to show favorable attitude (OR: 2.87; CI: 1.88-4.39; p <0.05). No other independent variables showed any significant association to influence respondents’ knowledge or attitude level.

In terms of behavior, 94.3% of students reported that they consumed antibiotics - the majority of which was due to fever (53.2%), bacterial infection (21.1%) and cold (15.7%). More than one-third (34.8%) of the respondents took antibiotics for once in the past 12 months, and about 30.3% took it for two to five times. About half (49.3%) of the respondents said that they completed the antibiotic course while about 35% did not do the same. Respondents with good knowledge were more likely
to complete the antibiotic course (OR: 2.04; CI: 1.32-3.15; p=0.001). Although more than 50% of the students had direct experience of buying antibiotics from pharmacy, most of the participants (72.1%) responded that their recent purchase of antibiotics was done based on the prescription of a registered doctor. However, in response to a multiple-choice question to choose a common antibiotic name, about two-thirds (65.4%; 900) of the students identified azithromycin, followed by the wrong choice of paracetamol (18.5%; 255) and omeprazole (7.6%; 104) as antibiotics. Self-medication was excessively high among students as more than 60% reported that they had an experience of prescribing antibiotics for themselves and their kin. No independent variable was found to influence self-medication among students (Table 5).

In response (n=320) to the open-ended question of mentioning the name of any known antibiotic, azithromycin (32%) was found to be the most frequent choice, followed by ciprofloxacin (9%), amoxicillin (7%), penicillin (4%), cefixime (4%), and metronidazole (2%). Notably, omeprazole (3%), fluconazole (2%) and paracetamol (11%) were also perceived as antibiotics by the participants.

**DISCUSSION**

Bangladesh as a developing country has seen some rapid growth recently and managed to overcome many of the challenges in the health sector. Yet, population-based studies to explore knowledge, attitudes and behavior towards antibiotic use and misuse are scarce, and the lack of data cannot aid in policy development [11]. Hence our study is one of the few attempts in the literature to assess the status of university students regarding antibiotics in the context of Bangladesh.

In this study, the respondents showed poor knowledge compared to other countries such as Malaysia, Trinidad and Tobago but better than Lithuania and Ethiopia [12-15]. Since adequate knowledge translates into a positive attitude, so
good knowledge among the respondents is an important parameter for community awareness about antibiotics [16]. Understanding the proper antibiotic target is also important as it indicates knowledge about antibiotic use and helps prevent irrational consumption. But, the majority (>65%) of the participants failed to identify bacteria as the correct antibiotic target. This misconception is higher than what was found in the studies in Sweden, Nepal, Ethiopia, Kuwait, UK, Lithuania, and Taiwan, ranging from 6.3% to 60.8% except for Jordan (67%) [4,10,14,15,17-20]. Alarming, about half of the participants thought that it was okay to terminate the antibiotic therapy after starting to feel better, and more than one-third admitted about not completing the dose. In Pakistan, Saudi Arabia, Taiwan, Syria, Nigeria and Jordan, about 42% to 60% people stopped taking antibiotics after the symptoms disappeared, whereas the malpractice was close to 15% in Nepal and Italy [10,19,21-26]. The abuse in antibiotic course completion may put the patient at the risk of relapsing infections with probability for the development of resistance. Although antibiotics are ineffective against most coughs and cold, 80% of the respondents did not know about it. This finding is higher than Jordan, Ethiopia, Kuwait, Nigeria, Taiwan, Sweden varying from 67% to 13.4% [4,10,15,18,20,24].

In case of knowledge regarding antibiotic resistance, the majority (~85%) expressed that human and animal can become resistant to antibiotics which is higher than Kuwait (56.3%) but lower than Sweden (88%). It is notable that about 60% of the respondents in our study did not know that antibiotic

### Table 5. Respondents’ behavior towards antibiotic use

| Items                                                                 | n (%)          |
|-----------------------------------------------------------------------|----------------|
| 1. Have you ever taken Antibiotics? (n=1400)                          |                |
| - Yes                                                                 | 1320 (94.3%)   |
| - No                                                                  | 57 (4.1%)      |
| - Don’t know                                                          | 23 (1.6%)      |
| 2. Reason of taking antibiotic - (n =1372)                            |                |
| - Cold                                                                | 215 (15.7%)    |
| - Flu                                                                 | 55 (4.0%)      |
| - Fever                                                               | 730 (53.2%)    |
| - Bacterial Infection                                                 | 290 (21.1%)    |
| - Other                                                               | 82 (6.0%)      |
| 3. How many times did you consume antibiotics in the past 12 months?  | (n=1393)       |
| - None                                                                | 486 (34.9%)    |
| - Once                                                                | 485 (34.8%)    |
| - 2 to >5 times                                                       | 422 (30.3%)    |
| 4. Do you always fulfill the antibiotic course? (n =1389)             |                |
| - Yes                                                                 | 685 (49.3%)    |
| - No                                                                  | 484 (34.8%)    |
| - I can’t remember                                                    | 220 (15.8%)    |
| 5. Did you make your recent purchase of antibiotics based on a doctor’s prescription? (n=1345) |                |
| - Yes                                                                 | 970 (72.1%)    |
| - No                                                                  | 289 (21.5%)    |
| - Don’t Know                                                          | 86 (6.4%)      |
| 6. I have experience of acquiring prescribed antibiotics from a pharmacy - (n =1397) |                |
| - Agree                                                               | 777 (55.6%)    |
| - Disagree                                                           | 467 (33.4%)    |
| - Don’t Know                                                          | 153 (11.0%)    |
| 7. I have experienced antibiotic prescription for myself or my kin - (n=1396) |                |
| - Agree                                                               | 856 (61.3%)    |
| - Disagree                                                           | 364 (26.1%)    |
| - Don’t Know                                                          | 176 (12.6%)    |
| 8. I usually know how antibiotics should be taken - (n= 1397)        |                |
| - Agree                                                               | 656 (47.0%)    |
| - Disagree                                                           | 422 (30.2%)    |
| - Don’t Know                                                          | 319 (22.8%)    |
| 9. Doctors run a thorough examination of whether a patient needs antibiotics or not- (n=1400) |                |
| - Agree                                                               | 739 (52.8%)    |
| - Disagree                                                           | 449 (32.1%)    |
| - Don’t know                                                          | 212 (15.1%)    |
| 10. Doctors prescribe antibiotic when a patient expects it - (n =1398) |                |
| - Agree                                                               | 544 (38.9%)    |
| - Disagree                                                           | 622 (44.5%)    |
| - Don’t know                                                          | 232 (16.6%)    |
resistance could spread from animal to human. Such misconception among the university students indicates that the percentage could be even higher among the general people, especially for the farmers who are often not well educated, as perceived through our field experience. According to a study conducted among African Americans, the lack of awareness about the use of medications such as antibiotics increased the likelihood of noncompliance and misuse of antibiotics [27]. Similar to a recently published study, our work demonstrated that the students of bioscience showed comparatively better knowledge and positive attitude while the faculty of arts had the highest percentage of poor knowledge and negative attitude followed by the faculty of business [28]. This is indicative of the importance of the inclusion of basic biology courses regarding bacteriology and antibiotics in the university level as well as developing educational programs and workshops to increase awareness among students about the misuse of medicines and the rise of antibiotic resistance [29].

The attitude of the participants was in the range of “neutral” viewpoint despite having an overall poor knowledge category. But notably, respondents, particularly with good knowledge, tended to show a positive attitude. This might explain that limited knowledge does not account for any strong correlation to positive attitude, whereas ensuring good knowledge can have a positive impact. This finding is supported by similar studies conducted in Ethiopia and Malaysia [15,16]. The majority of the participants in our study had a positive attitude about not acquiring antibiotics from a pharmacy without a prescription or based on the suggestion of the medicine seller. They were also against the opinion of obtaining a prescription from doctors via phone or acquiring medications from relatives. Telemedicine and Telehealth are not popular in Bangladesh, yet there is widespread malpractice of taking medicine via phone without going through proper diagnosis. The positive attitudes of the students about the misuse of antibiotics might contribute to mitigating the problem to some extent. Regarding leftover antibiotics, we reported about 27.4% students agreeing to save antibiotics for future-use or share with others, which is much lower than Saudi Arabia, Jordan, Nigeria and Pakistan but higher than Nepal, Italy, Sweden [4,19-22,24,26]. The storage of leftover antibiotics increases the likelihood of self-medication as well as consumption by others.

Self-medication is one of the major contributing factors for the development of antibiotic resistance. Although the majority considers antibiotic resistance is now a big problem for Bangladesh, self-medication yet occurs at an alarmingly high rate. Our study reported more than 60% of students practicing self-medication which is similar to Yemen but only lower than Saudi Arabia (70%), Syria (81%) and Palestine (87%) [22,23,30,31]. In comparison, the percentage of self-medication in New York, Trinidad & Tobago, and Honduras ranges from 14% to 26% [13,32,33]. However, the more improved scenario is observed in the European countries where the self-medication rate is within 5% only [34]. In the UK, people with better knowledge and a positive attitude about antibiotics were found to be more confident and hence more likely to self-medicate, but in our study, no such predictor could be attributed to self-medication among students [17]. It is an important finding based on our context that self-medication occurs regardless of perceived knowledge or seemingly positive attitude. A study conducted on the students from the Jahangirnagar University, Dhaka, Bangladesh also returned similar results [28]. A comparable study conducted in Honduras showed that self-medication was not associated with the level of education [33]. Therefore, policy development targeted towards enriching knowledge only may not be fruitful; and it is open to further research to identify the underlying factors.

High frequency of antibiotic use was recorded in this study which is lower than Syria, Jordan and Italy, but comparatively much higher than Malaysia, the UK and other European countries [16,17,20,23,26,34]. The incidence of increased antibiotic use in Bangladesh could be partly due to the high disease burden in areas with inadequate water, sanitation, and hygiene facilities. But concurrently, patients’ demand for antibiotics and a lack of knowledge in diagnosis by the physicians could contribute to the irrational consumption as well. Indeed, studies show that expectation of the patients is a key determinant and doctors are more likely to administer antibiotics under pressure [35]. According to our findings, about one-third of the participants had distrust about treatment and did not agree that doctors ran a thorough examination prior to prescribing. This underlines the importance of monitoring the antibiotic prescribing actions and consultancy behavior in the healthcare facilities along with deepening healthcare reform in Bangladesh. To prevent the irrational use of antibiotics, this study also emphasizes the need for pharmacies to adhere to the guidelines to stop selling antibiotics without a valid prescription. Nationwide inspection combined with educational campaigns should be undertaken for students, pharmacists as well as for the community members to improve awareness and to engage in community-based dialogues to decrease the inappropriate use of antibiotics [36].

**Limitation**

Our study has a few limitations. First, the convenience sampling method was applied for data collection which renders the possibility for selection bias, and therefore the results cannot be generalized to the whole Bangladeshi people. Second, due to cross-sectional nature, it was not possible to determine behavior over a long period. Third, while creating knowledge and attitude score, each question was given same importance without undertaking any weighting. Fourth, the study was based on a self-administered questionnaire which largely depends on the understanding, recall ability and honestly of the study participants. Furthermore, we would like to mention that the study area, Dhaka city, provides comparatively better healthcare access and facilities than other areas. Therefore, it is plausible for results to vary for people in rural areas [37]. Also, we did not include any information in our study about students’ socioeconomic background. This leaves out the options to see whether socioeconomic status have any role to play in determining attitude and behavior towards antibiotic use. Considering the limited literature available from Bangladesh, we believe that our study will add value to identify the scopes of the problems and help conduct future researches with more robust approaches.
CONCLUSION

The study reflects that the overall understanding regarding antibiotics and their proper use was poor among the university students, although those with biology background showed comparatively better knowledge. Increased self-medication was observed with a general lack of comprehension towards antibiotic resistance; and the level of knowledge was not a predictor for self-medication. The frequency of antibiotic use was very high, and the students showed non-compliance to fulfilling the antibiotic course. This implies that further large-scale research is necessary, both in urban and rural areas of Bangladesh, to understand the current states of antibiotic use and misuse among general population from different socioeconomic backgrounds. Development of policies aimed at raising awareness and establishing effective countermeasures to prevent the misuse of antibiotics are also essential.

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