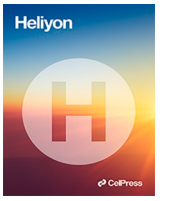
Heliyon 9 (2023) e19923

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Exploring the knowledge, practices & determinants of antibiotic self-medication among bangladeshi university students in the era of COVID-19: A cross-sectional study

Abrar Wahab [a,b,*], Mohammad Morshad Alam [b,c], Shahriar Hasan [b], Sangeeta Halder [b,d], Md Obayed Ullah [e], Ahmed Hossain [b,f]

[a] Centre for Injury Prevention and Research Bangladesh, Dhaka, Bangladesh
[b] Department of Public Health, North South University, Dhaka, Bangladesh
[c] Health Nutrition and Population Global Practice, The World Bank, Dhaka, Bangladesh
[d] Army Medical Core Centre and School, Tangail, Bangladesh
[e] Department of Microbiology, Noakhali Science and Technology University, Noakhali, Bangladesh
[f] Department of Health Services Administration, College of Health Sciences, University of Sharjah, Sharjah, United Arab Emirates

ARTICLE INFO

Keywords:
Self-medication with antibiotics
Antibiotic resistance
University students
Knowledge and practice
Determinants of self-medication with antibiotics
Bangladesh

ABSTRACT

Self-medication with antibiotics is a growing public health concern. Antibiotics are easily accessible on requested from pharmacies throughout the majority of developing countries. The present study aimed to determine the prevalence of self-medication with antibiotics among university students in Bangladesh, as well as to evaluate their knowledge and practices related to antibiotics and its resistance. A structured questionnaire was administered to 1000 students over a month in January 2022 at three universities of Bangladesh. The results showed that 61.0% of the participants had self-medicated with antibiotics in the last six months. In regards to the participants' level of knowledge and practice, a significant proportion, 60.0% exhibited a substandard understanding of antibiotic resistance and appropriate antibiotic usage. Male students (61.7%) were found to self-medicate more often than female students (38.3%). The highest prevalence of self-medication was observed in the age group of 22–25 years (32.2%). The most common reasons for self-medication were previous experience with the illness (40.9%) and the belief that the illness was not serious (36.2%). The most common illnesses for which self-medication was practiced were fever (40.9%) and cough and cold (29.3%). During multivariate logistic regression analyses age, gender, maintaining diet chart, and habit of exercising regularly were found to be associated with the increased risk of self-medication with antibiotics. The study highlighted the critical need for targeted interventions to promote responsible antibiotic use, enhance knowledge about antibiotic resistance, and discourage self-medication among university students in Bangladesh. Addressing these factors would enable the government to mitigate risks associated with self-medication, prevent antibiotic resistance, and alleviate the burden on health and the economy at large.

* Abrar Wahab, MPH, Centre for Injury Prevention and Research Bangladesh, Dhaka, Bangladesh.
E-mail address: abrar.wahab07@gmail.com (A. Wahab).

https://doi.org/10.1016/j.heliyon.2023.e19923
Received 16 March 2023; Received in revised form 4 September 2023; Accepted 6 September 2023
Available online 11 September 2023

1. Introduction

According to the World Health Organization (WHO), self-medication has been defined as "use of medicinal products by the user to treat self-recognized disorders or symptoms" [1]. Self-medication with antibiotics (SMA) is a widespread phenomena in underdeveloped and developing countries and becoming a growing public health problem [2]. The danger is in the unnecessary and excessive use of antibiotics, as it provides an environment for the emergence of antibiotic resistance. This phenomenon occurs when bacteria adapt and become resistant to the effects of antibiotics, diminishing their efficacy in treating infections [3]. Antibiotic resistance, treatment failures, and drug toxicity have all been linked to the inappropriate use of antibiotics, particularly in the context of self-medication [4]. Every year, over 20,000 patients in North America, 25,000 patients in Europe, and more than 90,000 patients in Southern Asia lose their lives due to multi-drug resistant bacteria [5]. In Asia, the prevalence of SMA varies from 54% to 75% among the population. The percentage of patients who had used SMA was 25% in South America. Among the African population, the prevalence of SMA varies from 24% to 73.9%. Whereas the percentage was just 19% in Central America, 3% in northern Europe, 6% in central Europe, and 19% in southern Europe [6]. The low percentages of self-medication with antibiotics in specific European regions may be due to a combination of factors, including the availability of healthcare services, strict regulation of antibiotics, and socio-economic and cultural factors [7,8].

Currently, people worldwide have experienced and continue to endure the effects of the COVID-19 pandemic [9]. The COVID-19 pandemic has further exacerbated the challenging situation for healthcare systems in low- and middle-income countries. Lockdown measures and restricted access to hospitals have resulted in a rise in self-medication practices. The fear of contracting the virus from healthcare workers or other patients has also contributed to this trend [10]. Monitoring self-medication is crucial, particularly in low and middle-income countries with poor education and healthcare facilities facing an economic crisis due to COVID-19 [11]. Because antibiotics are easily accessible on requested from pharmacies throughout the majority of developing countries. In middle-income countries like Bangladesh, where drugs can be purchased without proper prescriptions, it is crucial to address this issue before it becomes a burden. The improper practice of treating minor ailments with antibiotics, which can potentially harm patients, has become widespread [12]. In Bangladesh, there is a significant lack of awareness and knowledge regarding the appropriate use of antibiotics among the general population. A recent study conducted to assess the current situation of antibiotic resistance in Bangladesh revealed that the country plays a significant role in contributing to antibiotic resistance due to its inadequate healthcare standards and the widespread misuse and overuse of antibiotics. The findings of the study indicated a high prevalence of antibiotic resistance, resulting in the reduced effectiveness of many commonly used drugs [13–15]. Furthermore, a mobile phone survey conducted during the COVID-19 pandemic in Bangladesh showed that approximately 32.7% of respondents had used antibiotics for general illnesses in the previous four weeks [16].

While previous studies have shown that self-medication is influenced by an individual's highest level of education and understanding of medications, this association appears to be applicable only to specific segments of the population [12,17,18]. However, when considering self-medication practices among university students, it necessitates specific attention and consideration. The issue of self-medication poses a concern for both any specific community and the general public, emphasizing the need for increased research on this topic and its associated variables within the field of public health in Bangladesh. It is worth noting that in our country, the attitudes and practices related to medication use and the literacy levels exist at opposite ends of the spectrum [19].

Evaluating SMA among university students in Bangladesh is of paramount importance for several reasons. Firstly, it would help to identify the prevalence and patterns of SMA, shedding light on the extent of antibiotic misuse and potential risks. Secondly, it would allow for an understanding of the factors driving SMA, which can inform targeted interventions. Finaly, evaluating SMA assists in addressing antibiotic resistance, a pressing global health concern, by highlighting behaviors that contribute to it. Thus, the objective of the study is to find the current proportion of SMA practices right after the COVID-19 pandemic, and also to explore the determinants of SMA among the university going students.

2. Methods

2.1. Study population

The study included participants from three different institutions: North South University (private), Manarat International University (private), and Noakhali Science and Technology University (public). These universities represented diverse academic fields such as biological science, engineering, social science, and business departments. North South University, located in Dhaka, the capital of Bangladesh, had a student population of 22,000. Manarat International University had 3000 students, also situated in Dhaka. Noakhali Science and Technology University, located in the Noakhali District of Chattogram division, had a student population of 7000.

2.1.1. Sampling process

The size of the sample was approximated using the following factors: the anticipated percentage of the population in developing countries that will treat themselves with antibiotics (P) = 0.5 (to get the highest number of sample size); margin of error (d) = 0.04; confidence interval (CI) = 95%; and design effect = 1.5. After using the formula,

$$n = [DEFF * Np(1-p)] \Big/ \left[\left(d^2 \Big/ Z^2_{1-\alpha/2} * (N-1) + p * (1-p)\right]\right.$$

the calculated sample size was 900. Allowing non-response rate of 10% in the above estimated sample size, the adjusted sample size was 1000. Thus a total of 1000 university-based online questionnaire was distributed over a month in January 2022 at these institutions. Only the current students of the selected universities were included in this research.

2.1.2. Survey instruments

To collect the necessary information for the study, a structured questionnaire was employed. The questionnaire consisted of three sections, each focusing on different aspects of the study characteristics. Here is a description of each section.

2.1.3. Socio-demographic and behavioral characteristics

This section of the questionnaire gathered data on the students' socio-demographic and behavioral characteristics. It included items such as age, gender (male/female), type of university (public/private), department, current residence (with family/hall/hostel/mess), current monthly allowance, occupation of the father and mother (health professional, service holder, other), attendance in any seminar or workshop on antibiotic resistance, reading newspaper, maintaining a diet chart, exercising regularly, use of antibiotics in the last 6 months, reasons for self-medication, and types of illnesses for self-medication.

2.1.4. Knowledge regarding SMA

This part of the questionnaire consisted of 10 questions designed to assess the participants' knowledge regarding self-medication with antibiotics. Each question had three response options: "right," "wrong," or "uncertain." The questions covered topics such as the economic aspect of self-medication, the necessity of a qualified doctor's prescription for purchasing antibiotics, the effectiveness of antibiotics for viral infections, the use of strong antibiotics, the prevention of skin infections, the impact of taking multiple antibiotics simultaneously on healing, the preference between intravenous and oral administration, discontinuing treatment once symptoms disappear, the relationship between antibiotic overuse and resistance, and the impact of non-compliance to antibiotics on bacterial resistance.

2.2. Practice related to SMA

This section of the questionnaire assessed the respondents' practices related to the administration of antibiotics, compliance with prescribed dosages, and the duration of treatment. Likert scales with five points were used to measure the respondents' responses. It consisted of 10 questions covering topics such as the frequency of storing antibiotics, using antibiotics to prevent common colds, reading the instructions on the package, selecting strong or new/expensive antibiotics when ill, taking multiple antibiotics simultaneously, altering the dosage during the course of treatment, switching antibiotics during treatment, and relying on recommendations from friends or family for antibiotic usage.

Previously published articles that formed the foundation for the design of the questionnaire analyzed the knowledge and practices of people in different nations about the use of antibiotics [20,21]. The questionnaire's reliability was assessed using Cronbach's alpha coefficient. The knowledge section demonstrated a high level of internal consistency with an alpha coefficient of 0.87, while the practice section yielded a satisfactory level of reliability with an alpha coefficient of 0.82.

2.3. Data analysis

The statistical analysis program IBM SPSS Version 24.0 was used to analyze the data. The questionnaire was piloted on a subset of relevant respondents in order to ensure its maximum validity. During the piloting phase of our study, we aimed to ensure the maximum validity of the questionnaire by testing it on a subset of relevant respondents. This process helped us identify possible questions that did not make sense to the participants and potential problem areas or deficiencies in the research instrument. By observing how participants understood and responded to each question, we were able to detect any ambiguities or confusion that needed to be addressed.

2.3.1. Knowledge related to SMA

To analysis knowledge of the study participants, a score of 1 was awarded for each correctly given answer to the questions, while a score of 0 was given to responses that were incorrectly answered. The scores for the knowledge section were determined based on the total number of correct answers (ranging from 0 to 10).

2.4. Practice related to SMA

To analysis practice of the study participants, points of 5, 4, 3, 2, and 1 for were allotted for "always, often, sometimes, seldom, and never" respectively, to the each positive practice questions. Conversely, for each negative practice questions, the scores were assigned as 1, 2, 3, 4 and 5 for "always, often, sometimes, seldom, and never" respectively. The highest possible score was 50, and the lowest possible score was 10.

In the analysis of knowledge and practice, a score exceeding 80% was regarded as good, a score that was lies between 60% and 80% was regarded as moderate, and a score that was less than 60% was regarded as poor. The data on the demographics and socioeconomic backgrounds of the study population was reported in the form of percentages. In order to analyze the correlation between the degree of knowledge and practices and the demographic and behavioral features of the participants, a chi-square test analysis was used.

A binary logistic regression was used in order to predict any risk factors that are connected with self-medication of antibiotics. At

first a bivariate logistic regression was conducted to identify the important covariates. Then a multivariate logistic regression was conducted only wilth the selected variables using a purposeful selection method [22].

$$L = \Pr\,(W = 1 \mid M = m)$$

W, was the binary response of the depenent variable.Where, $W_i = \begin{cases} 1, \textit{if the participants used SMA within last 6 months, at the time of data collection} \\ 0, \textit{if the participants didn't used SMA within last 6 months, at the time of data collection} \end{cases}$.

So, finally the binary logistic regression model was build as follows:

$$L\_(i) = \Pr\left(W\_(i) = 1 \mid M\_(i) = m\_(i)\right)$$

$$= \frac{exp\,(\beta_o + \beta_i m_i)}{1 + exp\,(\beta_o + \beta_i m_i)}$$

A Hosmer and Lemeshow goodness of fit test was performed to evaluate the strength of the model. In our analysis, the chi-square value was = 10.43 with 8 degrees of freedom (p = 0.236). A p-value of <0.05 was used to draw the level of statistical significance in the result. A multi-collinearity test was also performed to find out if there is any internal association among the independent variables.

2.5. Ethical consideration

Prior to the commencement of the research, approval was obtained from the Institutional Ethics Committee at North South University in Dhaka, Bangladesh. The Ethical approval number is 202109 S T. The students were provided an explanation of the goals of

Table 1
Socio-demographic and behavioral characteristics of the study population based on their self-medication with antibiotics practice.

Variable	Total (%)	Self-medication in the past 6 months		p-value
		Yes (%)	No (%)	
Age groups				
18–21 years	156 (16.4%)	82 (52.6%)	74 (47.4%)	0.04*
22–25 years	581 (61.1%)	369 (63.5%)	212 (36.5%)	
>25 years	214 (22.5%)	129 (60.3%)	85 (39.7%)	
Sex				
Female	364 (38.3%)	281 (77.2%)	83 (22.8%)	<0.001**
Male	587 (61.7%)	299 (50.9%)	288 (49.1%)	
Residence type				
Family	449 (47.2%)	280 (62.4%)	169 (37.6%)	0.41
Hall/Hostel/Mess	502 (52.8%)	300 (59.8%)	202 (40.2%)	
University Type				
Public	479 (50.4%)	299 (62.4%)	180 (37.6%)	0.36
Private	472 (49.6%)	281 (59.5%)	191 (40.5%)	
Monthly Allowance◆				
<10,000	482 (50.7%)	284 (58.9%)	198 (41.1%)	0.41
10,000–25,000	414 (43.5%)	262 (63.3%)	152 (36.7%)	
>25,000	55 (5.8%)	34 (61.8%)	21 (38.2%)	
Fathers Occupation				
Health professional	60 (6.3%)	29 (48.3%)	31 (51.7%)	0.002*
Service	492 (51.7%)	283 (57.5%)	209 (42.5%)	
Others	399 (42.0%)	268 (67.2%)	131 (32.8%)	
Mothers Occupation				
Health professional	48 (5.0%)	20 (41.7%)	28 (58.3%)	0.01*
Service	461 (48.5%)	294 (63.8%)	167 (36.2%)	
Others	442 (46.5%)	266 (60.2%)	176 (39.8%)	
Attended in any seminar or workshop on "antibiotic resistance"				
Yes	346 (36.4%)	194 (56.1%)	152 (43.9%)	0.02*
No	605 (63.6%)	386 (63.8%)	219 (36.2%)	
Reading Newspaper daily				
Yes	544 (57.2%)	328 (60.3%)	216 (39.7%)	0.61
No	407 (42.8%)	252 (61.9%)	155 (38.1%)	
Maintain Diet Chart				
Yes	429 (45.1%)	243 (56.6%)	186 (43.4%)	0.01*
No	522 (54.9%)	337 (64.6%)	180 (35.4%)	
Exercise regularly				
Yes	376 (39.5%)	196 (52.1%)	180 (47.9%)	<0.001**
No	575 (60.5%)	384 (66.8%)	191 (33.2%)	

◆ Monthly Allowance was collected in BDT (1 USD = 104.87 BDT)
* The association is statistically significant
** The association is highly statistically significant

the research project, and a written consent was taken from the participants who had shown an interest to participation in the research.

3. Results

From the findings of this study we have observed that, 61.7% of the study population were male, with more than half (52.8%) of the participants residing in halls, hostels, or messes. In terms of monthly allowance, 50.7% reported receiving less than 10,000 BDT, followed by 43.5% receiving 10,000–25,000 BDT, and only 5.8% receiving more than 25,000 BDT. Additionally, only 36.4% of the students had attended any seminar or workshop on antibiotic resistance. It was found that 57.2% of the students read newspapers regularly, while 45.1% and 39.5% maintained a diet chart and exercised regularly, respectively (Table 1).

A totall of 61.0% of the participants reported to SMA in the six months prior to data collection. Table 1 shows that the age groups of 22–25 years and over 25 years had the highest prevalence of SMA. Among female students, 77.2% reported using antibiotics in the last six months without a prescription. Students from families where either the father or mother was a health professional were found to have the lowest rate of antibiotic abuse (48.3% and 41.7%, respectively). Participants who did not attend any seminar or workshop on antibiotic resistance had a higher frequency of SMA (63.8%). Similarly, students who did not maintain a diet chart or exercise regularly were also more likely to use antibiotics without a prescription (64.6% and 66.8%, respectively).

The most commonly reported reasons for SMA were as follows: 45.6% of participants reported that they felt there was no need to visit a physician for minor illnesses, 32.9% mentioned previous successful treatment experiences, 31.7% sought quick relief, 21.8% relied on suggestions from family or friends, 12.0% expected the doctor to prescribe the same treatment, and 2.3% considered SMA to be more cost-effective than seeking treatment at a hospital (Table 2).

Fig. 1 provides insight into the diseases for which students engaged in SMA. The results revealed that the most frequently mentioned condition was fever, with a significant percentage of 72.5%. Diarrhea followed as the second most prevalent reason, with 41.9% of students resorting to self-medication for this ailment. Additionally, a considerable proportion of students, 27.8%, reported using antibiotics for the common cold, while 15.7% used them for treating skin infections. Abdominal pain was mentioned by 13.9% of students, and a smaller proportion of 4.7% resorted to self-medication for vomiting.

The study revealed different levels of knowledge regarding antibiotic resistance among different age groups. The results indicated that participants in the 18–21 years range showed the highest percentage of poor knowledge at 59.0%. Meanwhile, 30.1% of this age group had moderate knowledge, and only 10.9% exhibited good knowledge. Moving on to the 22–25 years age group, the majority still falls under the poor knowledge category (56.3%). Participants above 25 years old exhibited the lowest proportion with poor knowledge (45.8%), and highest proportion of good knowledge (22.4%), compared to rest two groups. When comparing genders, it was found that females had the poorest knowledge level (59.9%) on antibiotics and its resistance mechanism than males (50.9%). Considering residence, both groups (residing with families vs. living in halls/hostels/messes) displayed comparable percentages across the poor knowledge (56.3% vs. 52.6%), moderate knowledge (28.5% vs. 34.9%), and good knowledge (15.2% vs. 12.5%) respectively. In terms of educational background, participants from public universities showed a slightly lower percentage of poor knowledge (52.4%) compared to those in private universities (56.4%). The percentages of participants with poor, moderate, and good knowledge remain relatively similar across all three income categories: <10,000; 10,000–25,000; and >25,000. Attending seminars or workshops on antibiotic resistance had a positive impact on knowledge levels, with 43.4% having moderate knowledge and 17.9% having good knowledge. Among regular newspaper readers, 35.9% possessed moderate knowledge, and 15.1% had good knowledge regarding antibiotic resistance. Similarly, among students who engaged in regular exercise, 38.6% had moderate knowledge, and 19.7% had good knowledge about antibiotic resistance (Table 3).

The study also observed varying levels of practice regarding antibiotic usage among different age groups. Participants aged 18–21 years had the highest percentage of poor practice at 40.4%, followed by fair practice at 43.6% and good practice at 16.0%. In the 22–25 years old group, the percentage of poor practice was 36.5%, fair practice was 43.2%, and good practice was 20.3%. For participants above 25 years old, the percentage of poor practice was 32.7%, fair practice was 29.0%, and good practice was 38.3%. Females exhibited a higher percentage of poor practice at 45.3%, compared to males (30.7%). Regarding residence, no significant association was observed with practice levels. Among students in public universities, poor practice was 34.4%, fair practice was 42.8%, and good practice was 22.8%. Compared to students in private universities, the percentages were 38.1% for poor practice, 37.3% for fair practice, and 24.6% for good practice. Participants with a monthly allowance of less than 10,000 BDT had a higher percentage of poor practice (36.3%), while those with an allowance above 25,000 BDT had the lowest percentage of poor practice (21.8%). Both fathers' and mothers' occupations showed significant associations with practice levels. Among participants whose fathers were health

Table 2
Reasons for self-medication with antibiotics among the study participants (n* = 580).

Reason for SMA	Frequency	Percentage	Percentage of cases
No need to visit physician for minor illness	261	31.1%	45.6%
Same treatment experience	190	22.6%	32.9%
Quick relief	182	21.7%	31.7%
Suggested by family or friends	126	15%	21.8%
Doctor would prescribe the same	68	8.1%	12.0%
More economic than hospital	13	1.5%	2.3%
Total	840	100%	146.3%

n* = multiple responses.

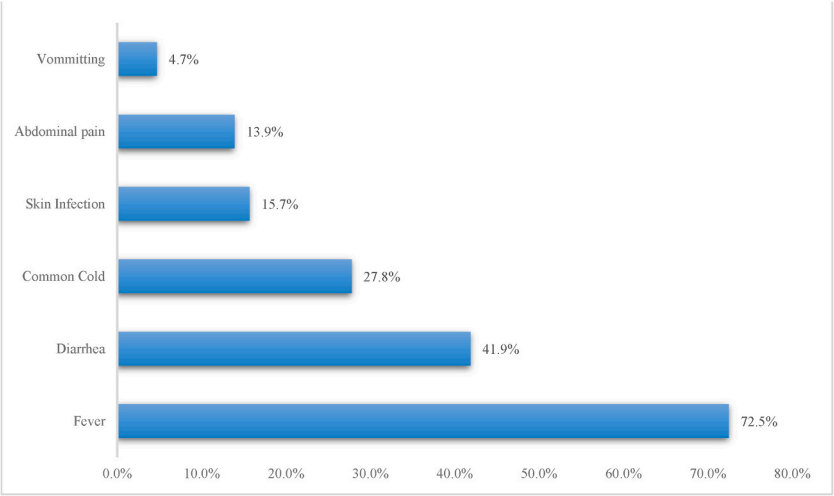


Fig. 1. Proportion of diseases for which self-medication with antibiotics was used (n = 580).

Table 3
Level of knowledge among the study population based on their demographic and behavioral characteristics.

Variable	Poor Knowledge	Moderate Knowledge	Good Knowledge	p-value
Age				
18–21 years	92 (59.0%)	47 (30.1%)	17 (10.9%)	0.001*
22–25 years	327 (56.3%)	188 (32.4%)	66 (11.4%)	
>25 years	98 (45.8%)	68 (31.8%)	48 (22.4%)	
Sex				
Male	299 (50.9%)	196 (33.4%)	92 (15.7%)	0.02*
Female	218 (59.9%)	107 (29.4%)	39 (10.7%)	
Residence				
Family	253 (56.3%)	128 (28.5%)	68 (15.2%)	0.09
Hall/Hostel/Mess	264 (52.6%)	175 (34.9%)	63 (12.5%)	
Type of University				
Public	251 (52.4%)	172 (35.9%)	56 (11.7%)	0.01*
Private	266 (56.4%)	131 (27.8%)	75 (15.8%)	
Monthly Allowance				
<10,000	253 (52.5%)	170 (35.3%)	59 (12.2%)	0.09
10,000–25,000	236 (57.0%)	118 (28.5%)	60 (14.5%)	
>25,000	28 (50.9%)	15 (27.3%)	12 (21.8%)	
Fathers Occupation				
Health professional	22 (36.7%)	30 (50.0%)	08 (13.3%)	<0.001**
Service	222 (45.1%)	190 (38.6%)	80 (16.3%)	
Others	273 (68.4%)	83 (20.8%)	43 (10.8%)	
Mothers Occupation				
Health professional	15 (31.3%)	21 (43.8%)	12 (25.0%)	0.002*
Service	240 (52.1%)	159 (34.5%)	62 (13.4%)	
Others	262 (59.3%)	123 (27.8%)	57 (12.9%)	
Attended in any seminar or workshop on "antibiotic resistance"				
Yes	134 (38.7%)	150 (43.4%)	62 (17.9%)	<0.001**
No	383 (63.3%)	153 (25.3%)	69 (11.4%)	
Reading Newspaper daily				
Yes	267 (49.1%)	195 (35.9%)	82 (15.1%)	0.001*
No	250 (61.4%)	108 (26.5%)	49 (12.0%)	
Maintain Diet Chart				
Yes	198 (46.2%)	149 (34.7%)	82 (19.1%)	<0.001**
No	319 (61.1%)	154 (29.5%)	49 (9.4%)	
Exercise regularly				
Yes	157 (41.8%)	145 (38.6%)	74 (19.7%)	<0.001**
No	360 (62.6%)	158 (27.5%)	57 (9.9%)	

professionals, the percentage of poor practice was 20.0%, compared to those with fathers in service occupations had 26.8% poor practice, and participants with fathers in other occupational category displayed the highest percentage of poor practice at 50.4%. A similarl trend was also observed for those participants whose mothers who were health professionals. Attendance at Seminars/

Workshops: Participants who attended seminars or workshops on antibiotic resistance had higher percentages of fair practice (48.8%) and good practice (32.7%). Daily newspaper readers showed higher percentages of fair practice (42.1%) and good practice (26.4%). Those who maintained a diet chart had higher percentages of fair practice (44.8%) and good practice (30.8%). Similarly, participants who exercised regularly had higher percentages of fair practice (45.5%) and good practice (34.6%) (Table 4).

During bivariate logistic regression analyses, being female (COR: 3.26; 95% CI: 2.43–4.37), fathers' occupation-others (COR: 2.19; 95% CI: 1.27–3.78), mothers' occupation-service (COR: 2.47; 95% CI: 1.35–4.51), mothers occupation-others (COR: 2.12; 95% CI: 1.16–3.87), not attending a seminar or workshop on antibiotic resistance (COR: 1.38; 95% CI: 1.06–1.81), not reading paper daily (COR: 1.08; 95% CI: 0.82–1.39), not maintaining a diet chart (COR: 1.39; 95% CI: 1.07–1.81), and not exercising regularly (COR: 1.85; 95% CI: 1.41–2.41) were associated with the increased risk of self-medication. Other factors were not statistically significant (Table 5).

During multivariate logistic regression analyses, after adjusting for variables (age, sex, fathers' and mothers' occupation, maintaining diet chart, and exercising regularly), age group between 18 and 21 years old (AOR: 0.62; 95% CI: 0.40–0.96), female (AOR: 3.91; 95% CI: (2.98–4.18), maintaining diet chart (AOR: 1.40; 95% CI: 1.04–1.86), and exercise regularly (AOR: 1.73; 95% CI: 1.30–2.31), remained to be associated with the increased risk of SMA (Table 5).

4. Discussion

The high prevalence of self-medication with antibiotics among university students is indeed a concerning issue, as it can contribute to the emergence of antibiotic resistance. The irrational use of antibiotics, such as taking them without a prescription or not completing the full course, can lead to the development of resistant strains of bacteria, making infections harder to treat. The finding that 61.0% of the participants reported self-medication with antibiotics in the last six months indicates a significant prevalence of this practice among university students, and which is significantly higher compared to other studies [23]. The high prevalence of self-medication among university students can be attributed to several factors. Firstly, their advanced level of education may lead to overconfidence, making them believe they possess sufficient knowledge to self-diagnose and treat their problems. The living environment in university campus can also influence their behavior, although our study have not found any statistical differences among students living in families or in hall/hostel/mess. Nevertheless peer pressure can influence the students to encourage them on self-medication practices.

Table 4
Level of practices among the study population based on their demographic and behavioral characteristics.

Variable	Poor Practice	Fair Practice	Good Practice	p-value
Age				
18–21 years	63 (40.4%)	68 (43.6%)	25 (16.0%)	<0.001**
22–25 years	212 (36.5%)	251 (43.2%)	118 (20.3%)	
>25 years	70 (32.7%)	62 (29.0%)	82 (38.3%)	
Sex				
Male	180 (30.7%)	261 (44.5%)	146 (24.9%)	<0.001**
Female	165 (45.3%)	120 (33.0%)	79 (21.7%)	
Residence				
Family	178 (39.6%)	161 (35.9%)	110 (24.5%)	0.04*
Hall/Hostel/Mess	167 (33.3%)	220 (43.8%)	115 (22.9%)	
Type of University				
Public	165 (34.4%)	205 (42.8%)	109 (22.8%)	0.22
Private	180 (38.1%)	176 (37.3%)	116 (24.6%)	
Monthly Allowance				
<10,000 BDT	175 (36.3%)	192 (39.8%)	115 (23.9%)	0.05
10,000–25,000 BDT	158 (38.2%)	167 (40.3%)	89 (21.5%)	
>25,000 BDT	12 (21.8%)	22 (40.0%)	21 (38.2%)	
Fathers Occupation				
Health professional	12 (20.0%)	28 (46.7%)	20 (33.3%)	<0.001**
Service	132 (26.8%)	241 (49.0%)	119 (24.2%)	
Others	201 (50.4%)	112 (28.1%)	86 (21.6%)	
Mothers Occupation				
Health professional	05 (10.4%)	27 (56.3%)	16 (33.3%)	<0.001**
Service	154 (33.4%)	201 (43.6%)	106 (23.0%)	
Others	186 (42.1%)	153 (34.6%)	103 (23.3%)	
Attended in any seminar or workshop on "antibiotic resistance"				
Yes	64 (18.5%)	169 (48.8%)	113 (32.7%)	<0.001**
No	281 (46.4%)	212 (35.0%)	112 (18.6%)	
Reading Newspaper daily				
Yes	171 (31.4%)	229 (42.1%)	144 (26.4%)	0.001*
No	174 (42.8%)	152 (37.3%)	81 (19.9%)	
Maintain Diet Chart				
Yes	105 (24.5%)	192 (44.8%)	132 (30.8%)	<0.001**
No	240 (46.0%)	189 (36.2%)	93 (17.8%)	
Exercise regularly				
Yes	75 (19.9%)	171 (45.5%)	130 (34.6%)	<0.001**
No	270 (47.0%)	210 (36.5%)	95 (16.5%)	

Table 5
Binary logistic regression of factors associated with self-medication with antibiotics.

Variable	CRUDE			ADJUSTED		
	SE	COR (95% CI)	p-value	SE	AOR (95% CI)	p-value
Age groups						
18–21 years	0.213	0.73 (0.48–1.11)	0.14	0.222	0.62 (0.40–0.96)	0.03*
22–25 years	0.164	1.15 (0.83–1.58)	0.40	0.174	1.23 (0.88–1.74)	0.23
>25 years	–	–	–	–	–	–
Sex						
Female	0.150	3.26 (2.43–4.37)	<0.001**	0.166	3.91 (2.98–4.18)	<0.001**
Male	–	–	–	–	–	–
Residence type						
Family	0.133	1.12 (0.86–1.45)	0.41	a	a	a
Hall/Hostel/Mess	–	–	–	–	–	–
University Type						
Public	0.133	1.13 (0.87–1.47)	0.36	a	a	a
Private	–	–	–	–	–	–
Monthly Allowance						
<10,000	0.293	0.89 (0.50–1.57)	0.68	a	a	a
10,000–25,000	0.296	1.07 (0.60–1.90)	0.83	a	a	a
>25,000	–	–	–	–	–	–
Fathers Occupation						
Health professional	–	–	–	–	–	–
Service	0.274	1.45 (0.85–2.48)	0.18	0.313	1.26 (0.68–2.32)	0.47
Others	.0279	2.19 (1.27–3.78)	0.01*	0.320	1.97 (1.05–3.68)	0.03
Mothers Occupation						
Health professional	–	–	–	–	–	–
Service	0.308	2.47 (1.35–4.51)	0.003*	0.348	2.33 (1.18–4.62)	0.02
Others	0.308	2.12 (1.16–3.87)	0.02*	0.350	1.35 (0.68–2.68)	0.39
Attended in any seminar or workshop on "antibiotic resistance"						
Yes	–	–	–	–	–	–
No	0.137	1.38 (1.06–1.81)	0.02*	a	a	a
Reading Newspaper daily						
Yes	–	–	–	–	–	–
No	0.135	1.08 (0.82–1.39)	0.61	a	a	a
Maintain Diet Chart						
Yes	–	–	–	–	–	–
No	0.134	1.39 (1.07–1.81)	0.01*	0.148	1.40 (1.04–1.86)	0.02*
Exercise regularly						
Yes	–	–	–	–	–	–
No	0.136	1.85 (1.41–2.41)	<0.001**	0.147	1.73 (1.30–2.31)	<0.001**

a Multivariate estimates were not selected through purposeful selection method and therefore ommitted.

Furthermore, the desire for quick relief from symptoms could also play a significant role in motivating students to SMA.

In a recent study conducted in Nepal, the incidence of self-medication among students was found to be 95.4% [24]. However, our study revealed a lower percentage, with 61% of participants reporting engaging in self-medication practices. One possible reason for the variation in the percentages could be attributed to a recent government law implemented in Bangladesh. This law prohibits pharmacies from selling antibiotics without a valid prescription [25]. While larger pharmaceutical chain shops comply with this regulation, smaller pharmacies owned by individuals may not adhere to the law.

A significant finding from this research was the identification of a subgroup of study participants who were determined to be the most likely to treat themselves with antibiotics were 22–25 years old and >25 years old. Several reasons could potentially explain this trend. Firstly, individuals within this age range often experience increased independence and autonomy in managing their healthcare decisions, which may lead to a higher likelihood of self-diagnosis and self-medication with antibiotics. Furthermore, societal perceptions of antibiotics as a quick fix for various health issues may influence young adults' decision to self-treat with antibiotics without seeking professional medical advice. Lastly, a lack of awareness about the dangers of antibiotic resistance among young adults could further contribute to their inclination for self-treatment with antibiotics. There was a recent study conducted among chinese residents have not found any statistical significance between age and self-medication with antibiotics [26]. The variations could be attributed to several factors such as different study setting, variations in the level of awareness and education and disparities in the measurement methods employed.

Studies have shown that children of health professionals are less likely to abuse antibiotics [27]. We have observed that students who have at least one parent working in the healthcare field exhibit the lowest rates of antibiotic misuse. Similarly, a study conducted in China revealed that students with parents having medical backgrounds demonstrated better antibiotic usage behavior [28]. One possible explanation for this finding is that parents with medical knowledge may possess a better understanding of the proper utilization of antibiotics and the potential risks associated with their inappropriate use. They may also be more cognizant of the growing issue of antibiotic resistance and the importance of using these medications prudently. This finding highlights the significant influence

of parental education and awareness on children's behaviors regarding antibiotics. In conclusion, it is crucial for parents to receive education regarding appropriate antibiotic usage and to be aware of the potential consequences stemming from their misuse.

Previous studies, including our own, have identified a correlation between gender and self-medication practices (SMA). Our study findings align with previous research, indicating that females tend to engage in self-medication more frequently. One possible explanation for this gender difference could be attributed to women's menstrual cycles and other gynecological issues. These factors may lead women to seek self-treatment with medications to address symptoms associated with their reproductive health. However, further investigation is needed to fully understand the relationship between gender, self-medication, and specific health conditions in order to provide more comprehensive insights [29].

Behavioral factors were also found to be associated with SMA among university students. Participants who did not attend seminars or workshops on antibiotic resistance, did not read newspapers regularly, did not maintain a diet chart, and did not engage in regular exercise were more likely to engage in self-medication with antibiotics. These findings suggest a lack of awareness and knowledge regarding the appropriate use of antibiotics, as well as a potential disregard for healthcare professionals' advice. The reasons provided by the participants for self-medication further emphasize the need for targeted interventions. The most commonly cited reasons included the perception that minor illnesses do not require a physician's visit, previous positive treatment experiences, and the desire for quick relief. Ateshim et al. (2019) identified similar causes for antibiotic self-medication, including prior positive experience and mild sickness that did not need medical attention [30]. These misconceptions and attitudes towards self-medication highlight the importance of educational initiatives that emphasize the potential risks of inappropriate antibiotic use and the significance of seeking professional medical advice.

To address the issue of SMA among university students, comprehensive interventions are needed. Educational programs should be implemented to increase awareness about the appropriate use of antibiotics, the consequences of antibiotic resistance, and the importance of seeking medical advice for illness management. These programs could be delivered through seminars, workshops, and information campaigns tailored to the specific needs and preferences of the target population. Involving healthcare professionals, such as physicians and pharmacists, in these educational initiatives can enhance the credibility of the messages delivered and emphasize the importance of professional guidance in medication-related decisions. Collaboration between universities, healthcare institutions, and public health authorities is crucial to establish comprehensive interventions that address the cultural, social, and economic factors influencing self-medication practices.

Another factor contributing to self-medication with antibiotics (SMA) is the practice of keeping antibiotics at home, which increases the likelihood of engaging in SMA [31]. A study conducted by Sun et al., in 2019 revealed that keeping antibiotics at home is widespread in China and is associated with a higher propensity for SMA [32]. A similar trend can be observed in Bangladesh, where individuals often retain leftover antibiotics beyond the recommended dosage, consequently elevating the risk of SMA. Policymakers must recognize the significance of these practices and establish regulations and interventions to address them. Implementing measures such as dispensing exact quantities of antibiotics, restricting over-the-counter availability, and promoting the return of unused medication can be effective strategies in curbing SMA. However, to the best of our knowledge, no study has yet investigated this issue in Bangladesh, highlighting the need for future research to gain a deeper understanding of the problem.

While the study revealed significant associations between certain variables and self-medication practices, it is important to consider the limitations of the study. The findings are based on self-reported data, which may be subject to recall bias and social desirability bias. Additionally, the study focused on university students, limiting the generalizability of the findings to other populations. Another limitation of the study is the study participants were selected through a convenient sampling method, which may not fully represent the diversity and characteristics of the broader population. As a result, the findings and conclusions drawn from the study may not be applicable or representative of other populations or settings. To better address these limitations, future research should consider longitudinal studies with larger and more diverse samples, and also employ a more comprehensive and rigorous sampling strategy to further explore the factors influencing self-medication practices.

5. Conclusion

In conclusion, this study provided valuable insights into the prevalence of self-medication with antibiotics among university students and identified several associated factors. According to the findings, more than half of the students engaged in SMA within the past six months, and 60.0% of study participants exhibited a substandard understanding. Age, gender, maintaining a diet chart, and the habit of exercising regularly were found to be associated with an increased risk of self-medication with antibiotics. These findings underscored the urgent need for targeted interventions aimed at promoting responsible antibiotic use, enhancing knowledge about antibiotic resistance, and encouraging students to seek professional medical advice. Efforts to reduce self-medication practices included educational initiatives, collaboration between healthcare professionals and institutions, and a comprehensive understanding of the cultural and social factors that influenced antibiotic use behaviors. By addressing these factors, the government of Bangladesh would have a chance to mitigate the risks associated with self-medication and contribute to the prudent use of antibiotics among university students. This, in turn, would help prevent antibiotic resistance and alleviate the burden on both health and the economy among the general population. It is worth noting that this study solely focused on university students; therefore, examining all segments of the population would have been helpful in enriching the findings.

Ethics statement

Prior to the commencement of the research, approval was obtained from the Institutional Ethics Committee at North South

University in Dhaka, Bangladesh. The Ethical approval number is 202109 S T. The students were provided an explanation of the goals of the research project, and a written consent was taken from the participants who had shown an interest to participation in the research.

Contribution

Abrar Wahab and Prof. Ahmed Hossain: Conceived and designed the experiments; performed the experiments; wrote the paper, and critically revised the paper's important intellectual content.

Mohammad Morshad Alam and Shahriar Hasan: Contributed reagents, materials, analysis tools or data; analyzed and interpreted the data.

Sangeeta Halder and Md. Obayed Ullah: Acquisition of data and analyzed and interpreted the data.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Availability of data and materials

There are no supporting data presented and linked with this study. Supporting data is available from the authors on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

The authors thank North South University, Manarat International University, and Noakhali Science & Technology University for their invaluable help and cooperation throught the study, and all of the study participants for their contribution to the study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e19923.

References

[1] Who, WHO Guidelines for the regulatory assessment of medicinal products for use in self-medication, WHO Drug Inf. 14 (2000) 18–26.
[2] C.O. Attah, D.N. Aryee, A study of antibiotic use and abuse in Ghana: a case study of the cape coast metropolis, Internet J. Health 11 (2012), https://doi.org/10.5580/bec.
[3] S.P. Xavier, A. Victor, G. Cumaquela, M.D. Vasco, O.A.S. Rodrigues, Inappropriate use of antibiotics and its predictors in pediatric patients admitted at the Central Hospital of Nampula, Mozambique, Antimicrob. Resist. Infect. Control 11 (2022) 1–8, https://doi.org/10.1186/S13756-022-01115-W/TABLES/3.
[4] F. Alhomoud, Z. Aljamea, R. Almahasnah, K. Alkhalifah, L. Basalelah, F.K. Alhomoud, Self-medication and self-prescription with antibiotics in the Middle East—do they really happen? A systematic review of the prevalence, possible reasons, and outcomes, Int. J. Infect. Dis. 57 (2017) 3–12, https://doi.org/10.1016/j.ijid.2017.01.014.
[5] A.K.M. Zaidi, S. Awasthi, H.J. DeSilva, Burden of infectious diseases in South Asia, BMJ Br. Med. J. (Clin. Res. Ed.) 328 (2004) 811, https://doi.org/10.1136/BMJ.328.7443.811.
[6] H. Pan, B. Cui, D. Zhang, J. Farrar, F. Law, W. Ba-Thein, Prior knowledge older age, and higher allowance are risk factors for self-medication with antibiotics among University students in Southern China, PLoS One 7 (2012), e41314, https://doi.org/10.1371/journal.pone.0041314.
[7] D. Lescure, J. Paget, F. Schellevis, L. van Dijk, Determinants of self-medication with antibiotics in European and Anglo-Saxon countries: a systematic review of the literature, Front. Public Health 6 (2018) 370, https://doi.org/10.3389/FPUBH.2018.00370/FULL.
[8] E. Jakubowski, M.R.P.H. Busse, G.R. Chambers Ba, J. Kahan, P. Kanavos, J. Bastida-Lopez, E. Mossialos, M. Wiley, F. Sassi, T. Schersten, J. Teperi, Euro. Parliament Directorate General Res. Health Care Syst. Eu Comparative Stud. Publ. Health Consumer Protect. Ser. Saco 101 EN (1998).
[9] Z.Y. Zu, M. Di Jiang, P.P. Xu, W. Chen, Q.Q. Ni, G.M. Lu, L.J. Zhang, Coronavirus disease 2019 (COVID-19), A Perspective from China, Radiol. 296 (2020) E15–E25, https://doi.org/10.1148/radiol.2020200490.
[10] N. Choudhary, K. Lahiri, M. Singh, Increase and consequences of self-medication in dermatology during COVID-19 pandemic: an initial observation, Dermatol. Ther. 34 (2021), https://doi.org/10.1111/dth.14696.
[11] M. Malik, M.J. Tahir, R. Jabbar, A. Ahmed, R. Hussain, Self-medication during Covid-19 pandemic: challenges and opportunities, Drugs Ther. Perspect. 36 (2020) 565–567, https://doi.org/10.1007/S40267-020-00785-Z/METRICS.
[12] M. Biswas, M.N. Roy, M.I.N. Manik, M.S. Hossain, S.T.A. Tapu, M. Moniruzzaman, S. Sultana, Self medicated antibiotics in Bangladesh: a cross-sectional health survey conducted in the Rajshahi City, BMC Publ. Health 14 (2014) 1–7, https://doi.org/10.1186/1471-2458-14-847/FIGURES/5.
[13] M.R. Saha, S. Sarwar, M.C. Shill, M. Shahriar, Patients' knowledge and awareness towards use of antibiotics in Bangladesh: a cross-sectional study conducted in three tertiary healthcare centers in Bangladesh, Stamford J. Pharm. Sci. 3 (1970) 54–58, https://doi.org/10.3329/sjps.v3i1.6799.
[14] N. Chowdhury, M. Rashedul Islam, M. Mehedi Hasan, M. Mahmudur Rouf, Prevalence of self-medication of antibiotics among people in Bangladesh, Int. J. Pharm. Teach. Pract. 4 (2013) 504–510.

[15] I. Ahmed, M.B. Rabbi, S. Sultana, Antibiotic resistance in Bangladesh: a systematic review, Int. J. Infect. Dis. 80 (2019) 54–61, https://doi.org/10.1016/J.IJID.2018.12.017.
[16] Z. Akhtar, S. Mah-E-muneer, M.M. Rashid, M.S. Ahmed, M.A. Islam, S. Chowdhury, Z. Khan, M.Z. Hassan, K. Islam, S. Parveen, N. Debnath, M. Rahman, F. Chowdhury, Antibiotics Use and its Knowledge in the Community: A Mobile Phone Survey during the COVID-19 Pandemic in Bangladesh, 10, Antibiot., Basel, Switzerland, 2021, https://doi.org/10.3390/ANTIBIOTICS10091052.
[17] A. Jamhour, A. El-Kheir, P. Salameh, P.A. Hanna, H. Mansour, Antibiotic knowledge and self-medication practices in a developing country: a cross-sectional study, Am. J. Infect. Control 45 (2017) 384–388, https://doi.org/10.1016/J.AJIC.2016.11.026.
[18] R. Hasan, N. Yasmin, N.R. Seoty, M.M. Hasan, M. Shahjahan, Status of self-medication among the patients attending outpatient department in selected private hospitals in Dhaka City, Bangladesh Med, Res. Counc. Bull. 45 (2019) 185–190, https://doi.org/10.3329/BMRCB.V45I3.44650.
[19] I.J. Ira, Present condition of self-medication among general population of Comilla district, Bangladesh, Pharma. Innov. J. 4 (2015) 87–90. http://pharmacypractice.org/vol08/pdf/226-232.pdf. (Accessed 28 November 2022).
[20] S. Sarahroodi, A. Maleki-Jamshid, A. Sawalha, P. Mikaili, L. Safaeian, Pattern of self-medication with analgesics among Iranian University students in central Iran, J. Fam. Community Med. 19 (2012) 125–129, https://doi.org/10.4103/2230-8229.98302.
[21] B. Lv, Z. Zhou, G. Xu, D. Yang, L. Wu, Q. Shen, M. Jiang, X. Wang, G. Zhao, S. Yang, Y. Fang, Knowledge attitudes and practices concerning self-medication with antibiotics among university students in western China, Trop. Med. Int. Health 19 (2014) 769–779, https://doi.org/10.1111/tmi.12322.
[22] Z. Zhang, Model building strategy for logistic regression: purposeful selection, Ann. Transl. Med. 4 (2016), https://doi.org/10.21037/ATM.2016.02.15.
[23] E.V. Yeika, B. Ingelbeen, B.L. Kemah, F.S. Wirsiy, J.N. Fomengia, M.A.B. van der Sande, Comparative assessment of the prevalence, practices and factors associated with self-medication with antibiotics in Africa, Trop, Med. Int. Heal 26 (2021) 862–881, https://doi.org/10.1111/TMI.13600.
[24] K. Shah, S. Halder, S.S. Haider, Assessment of knowledge, perception, and awareness about self-medication practices among university students in Nepal, Heliyon 7 (2021), e05976, https://doi.org/10.1016/J.HELIYON.2021.E05976.
[25] Dhaka Tribune, No Sale of Antibiotics without Prescription: Cabinet Clears Draft Law, 2023. https://www.dhakatribune.com/bangladesh/2023/02/06/no-sale-of-antibiotics-without-prescription-cabinet-clears-draft-law. accessed June 18, 2023.
[26] X. Yin, K. Mu, H. Yang, J. Wang, Z. Chen, N. Jiang, F. Yang, G. Zhang, J. Wu, Prevalence of self-medication with antibiotics and its related factors among Chinese residents: a cross-sectional study, Antimicrob. Resist. Infect. Control 10 (2021), https://doi.org/10.1186/S13756-021-00954-3.
[27] L.E. Vaz, K.P. Kleinman, M.D. Lakoma, M.M. Dutta-Linn, C. Nahill, J. Hellinger, J.A. Finkelstein, Prevalence of parental misconceptions about antibiotic use, Pediatrics 136 (2015) 221, https://doi.org/10.1542/PEDS.2015-0883.
[28] D. Peng, X. Wang, Y. Xu, C. Sun, X. Zhou, Antibiotic Misuse Among University Students in Developed and Less Developed Regions of China: a Cross-Sectional Survey, 11, 2018, 1496973, https://doi.org/10.1080/16549716.2018.1496973.
[29] A.R. Sapkota, M.E. Coker, R.E. Rosenberg Goldstein, N.L. Atkinson, S.J. Sweet, P.O. Sopeju, M.T. Ojo, E. Otivhia, O.O. Ayepola, O.O. Olajuyigbe, L. Shireman, P. S. Pottinger, K.K. Ojo, Self-medication with antibiotics for the treatment of menstrual symptoms in southwest Nigeria: a cross-sectional study, BMC Publ. Health 10 (2010) 1–10, https://doi.org/10.1186/1471-2458-10-610/FIGURES/2.
[30] Y. Ateshim, B. Bereket, F. Major, Y. Emun, B. Woldai, I. Pasha, E. Habte, M. Russom, Prevalence of self-medication with antibiotics and associated factors in the community of Asmara, Eritrea: a descriptive cross sectional survey, BMC Publ. Health 19 (2019) 1–7, https://doi.org/10.1186/s12889-019-7020-x.
[31] P. Kardas, J.C. Pechère, D.A. Hughes, G. Cornaglia, A global survey of antibiotic leftovers in the outpatient setting, Int. J. Antimicrob. Agents 30 (2007) 530–536, https://doi.org/10.1016/J.IJANTIMICAG.2007.08.005.
[32] C. Sun, Y.J. Hu, X. Wang, J. Lu, L. Lin, X. Zhou, Influence of leftover antibiotics on self-medication with antibiotics for children: a cross-sectional study from three Chinese provinces, BMJ Open 9 (2019), e033679, https://doi.org/10.1136/BMJOPEN-2019-033679.