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ORIGINAL RESEARCH article

Prevalence of antibiotic misuse among the general public in Libya: a cross-sectional study

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Abstract: Antibiotic misuse is a global issue, especially in developing nations. It has a potentially serious effect, as it leads to the development of antibiotic resistance. This study aims to identify the prevalence of six types of antibiotic misuse and associated factors of use and misuse among the public in Tripoli City, Libya, using a descriptive cross-sectional approach. A validated questionnaire was distributed to a convenience sample of 640 individuals. The response rate was 93.8%. Antibiotics were used by 47.5% (n=285, 95% CI: 43.5-51.5) of the participants in the previous two months. The prevalence of specific antibiotic misuse behaviours included using without medical consultation (27.4%, n=78/285, 95% CI: 22.5-32.9), terminating the course early (24.9%, n=71/285, 95% CI: 19.9-29.9), keeping leftovers for next use (36.1%, n=103/285, 95% CI: 30.5-41.7), throwing leftovers in garbage (21.8%, n=62/285, 95% CI: 17-26.6), compensating for a missed dose by increasing the next dose (2.4%, n=4/170, 95% CI: 0.1-4.5), and self-adjusting the dose by either taking more or less than the recommended dose (14.4%, n=41/285, 95% CI: 10.3-18.5). The recent antibiotic use was significantly associated with the employment status, the frequency of seeking physician consultation, and the practice of receiving a prescription by phone. In contrast, overall antibiotic misuse (any type) was significantly associated with the frequency of seeking physician consultation. There is a need to review the accessibility of antibiotics in pharmacies and to improve the quality of medical consultations.

Introduction

Antibiotics are widely used and prescribed medications to manage infections and are cost-effective, life-saving medications and help to extend lifespan [1]. Their effectiveness, however, depends on correct diagnosis, which involves selecting the right one for each condition [2], as well as on adherence to the five-right principle of using medicines (right patient, right drug, right time, right dosage regimen, and right duration). When one or more of these requirements is not satisfied, medication usage becomes irrational or unnecessary [1]. The inappropriate use of antibiotics is a widespread problem with a global pooled prevalence of 36.5% based on studies collected data from patients [3]. Its prevalence is notably 14.0% higher in lower-income countries compared to high-income countries [3]. The main identified reasons for inappropriate antibiotic use are lack of legislation that prevents dispensing these types of medications without prescription issued by a licensed physician, weak application of regulations, limited number of qualified physicians, high cost of medical consultation, lack of medical insurance, lack of awareness by patient and/or provider, unavailability/underuse of diagnostic services, limited availability of antibiotics and/or lack of alternative treatments, and patient

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solicitation [3, 4]. Self-medication with antibiotics is a phenomenon used to describe the obtaining and self-administering antibiotics for managing what is perceived as an infection, this is a global issue [5-7]. The self-medication rate with antibiotics is high, as it is reported to be 50.0% in Africa, 40.0% in the Middle East region, and 80.0% in Libya [8]. In this case, large proportion of people use antibiotics irrationally, which negatively contributes to increase antimicrobial resistance and presents a more significant risk to the global health [9].

The irrational use of antibiotics could lead to several negative clinical consequences and increase economic burden to the health care system. The main clinical consequence is the development of antibiotic-resistant bacterial strains, which makes the condition difficult to treat [2]. The ever-increasing antimicrobial resistance has recently been considered a global crisis by the World Health Organization, leading to life-threatening infection, longer hospitalization period, illness complications, and raised morbidity and fatality rates [10]. A recent report revealed that antimicrobial resistance caused 1.27 million deaths and was associated with 4.95 million deaths globally in 2019 [9]. Based on the current trends and inadequate efforts, these figures are expected to increase by 2050, potentially leading to 1.91 million deaths and 8.22 million contributed deaths [9]. Antibiotics can be misused in several ways, including obtaining them without a prescription, shortening the duration of the treatment course, keeping leftover quantities for future use or sharing them with others, improper disposal of them in the garbage, and self-adjustment of dosage [1, 11, 12]. While each type of misuse requires specific intervention strategies, existing research in Libya has been fragmented. Several studies focused on the use of antibiotics and certain types of misuse among parents [13], physicians [14], pharmacists [15], and students [8, 12]. However, to the best of our knowledge, no previous study has concurrently addressed the prevalence of all these misuse types within a single general public sample. This lack of integrated assessment limits a comprehensive understanding of the problem's true magnitude. Therefore, this study was conducted to explore six types of antibiotic misuse among the general public in Tripoli, Libya, and to identify the factors associated with any of these misuses.

Materials and methods

Data collection tool: A validated previously published self-administered questionnaire was adopted [16]. The questionnaire was selected specifically for its conditional branching design. The instrument comprises 18 questions, that were grouped broadly into two categories: Socio-demographic characteristics and self-medication practices. It was translated into Arabic using the standard forward and backward translation method [17]. Subsequently, it was pilot-tested on 30 individuals. Based on the pilot results, minor linguistic adjustments were made to the final version.

Ethical approval: The Ethical approval was obtained from the Scientific Research and Ethics Committee at the University of Tripoli (SREC-UOT), Tripoli, Libya, reference: SREC-UOT 11-2021. Participants were provided with an introductory letter explaining the study's purpose, and verbal informed consent was obtained from each individual. The sole inclusion criterion applied was being an adult (age >18). All data were collected anonymously.

Study design and questionnaire distribution: A descriptive, cross-sectional survey was conducted among the general public in Tripoli City, Libya. Data were collected between January and April 2024, using a structured self-administered questionnaire. The minimum sample size (n=320) was calculated using the single population proportion formula for an infinite population [18]. This was based on a 95.0% confidence level (z=1.96), a 5.0% margin of error, and a 70.0% expected proportion of antibiotics users [19]. This size was doubled to 640 to account for the filtering question, which separates nonusers from users within the previous two months. The questionnaires were conveniently distributed to adult participants at public places, including supermarkets, hospitals, universities, and schools in five regions of the capital city (Tripoli), namely:Tajoura, Janzour, Soug Algumaa, Al-Khalla, and Al-Hadba. The data collection was carried out by two senior pharmacy students.

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Statistical analysis: The data were coded and entered into the Statistical Package for the Social Sciences (SPSS) Software (version 25). Prior to analysis, the dataset was screened for entry errors or coding inconsistencies. Descriptive statistics (frequency, percentage, and 95% confidence interval) were performed for categorical data. For continuous data, means and standard deviations or medians and ranges were used as appropriate. Inferential statistics, specifically the Chi-square and Fisher's Exact tests, were used where appropriate to assess the association between sociodemographic characteristics and the recent antibiotics use (within the last two months), and the occurrence of any antibiotics misuse. The $p<0.05$ was considered significant.

Results

Demographic characteristics: The mean age of the respondents was 34.9 years (SD±12.8). The majority of the participants were female (63.7%), held a university-level education (74.2%), were currently employed (63.7%), and lived in households with more than four family members (67.5%), as presented in **Table 1**.

Table 1: Socio-demographic characteristics of respondents

Characteristics	Frequency	Percent
Gender		
Male	218	36.3
Female	382	63.7
Age: mean (SD) 34.9 (12.8), range: 19-86		
Educational level		
Uneducated	03	00.5
Primary	38	06.3
Secondary	84	14.0
University	445	74.2
Post-graduation	30	05.0
Currently working		
Yes	382	63.7
No	218	36.3
Family members		
≤ 2	53	08.8
3-4	142	23.7
5-6	241	40.2
> 6	164	27.3

In **Table 2**, 19.7% of the respondents indicated they were not willing to consult a physician when they were feeling sick. 37.0% of the participants obtained a prescription via telephone. Nearly half of the total sample (47.5%, 95% CI: 43.5-51.5) had taken antibiotics during the previous two months, with a median treatment duration of four days. Among the antibiotic users, 27.7% (95% CI: 22.5-32.9) reported using antibiotics without a physician's recommendation. One quarter of the respondents (24.9%, 95% CI: 19.9-29.9) reported that they did not complete their treatment course. More than one-third of the participants (43.0%) kept the unused antibiotics for future use or gave them to others, while less than one-quarter disposed of them in the garbage or sewage system. A large proportion of the participants (60.0%) admitted to forgetting doses during the treatment course. A few participants (2.3%, 95% CI: 0.1-4.5) tended to increase the subsequent dose to compensate for a missed dose (**Table 3**). During the treatment course, 14.4% (95% CI: 10.3-18.5) of the participants self-adjusted their recommended dose. For the type of dose adjustment, the respondents were allowed to choose more than one option. Taking less than the recommended dose was the most common modification, reported by 82.6% (n=34/41). The three primary reasons for reducing the dose were included feeling better (20.0%), concerns regarding side effects (17.8%), and being tired and forgetting to take it (17.8%). Conversely, taking more than the recommended dose was reported by 51.2 % (n=21/41) of the participants. The three main reasons for increasing dosage were feeling severely sick (25.0%), forgetting the previous dose (18.8%), and perceiving no notable improvement with the recommended dose (15.6%), **Table 4**.

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Table 2: Recent use of antibiotics by the respondents

Characteristic	Frequency	Percent	95% CI
Consulting a physician when feeling sick			
Never	17	02.8	(1.5-04.1)
Rarely	101	16.8	(13.8-19.8)
Sometimes	309	51.5	(47.5-55.5)
Always	173	28.8	(25.2-32.4)
Receiving a prescription by phone			
Yes	222	37	(33.1-40.9)
No	378	63	(59.1-66.9)
Taking antibiotic in the past two months			
Yes	285	47.5	(43.5-51.5)
No	315	52.5	(48.5-56.5)
Duration of the last treatment with antibiotics (n=285)			
Median 4 days, Min 2 days, Max 270 days for TB patient.			
Last treatment was a recommendation from (n=285)			
Physician	207	72.6	(67.4-77.8)
Pharmacist	44	15.4	(11.2-19.6)
I had them at home	19	06.7	(3.8-9.6)
Family	11	03.9	(1.7-6.1)
Friends	04	01.4	(.00-2.8)

Table 3. Self-reported adherence to the recommended antibiotic regimen among users

Characteristic	Frequency	Percent	95% CI
Completion of the last course of treatment			
Yes	209	73.3	(68.2-78.4)
No	71	24.9	(19.9-29.9)
Still using them	5	1.75	(0.2-3.3)
Action taken with left unused antibiotics			
No left quantity	118	41.1	(35.4-46.8)
Kept for the next time	103	36.1	(30.5-41.7)
Disposed in the garbage or sewage system	62	21.8	(17-26.6)
Given to someone	20	07.0	(4-10)
Forgetting to take any of doses			
Sometimes	141	49.5	(43.7-55.3)
Often	29	10.1	(6.6-13.6)
Never	115	40.4	(34.7-46.1)
Action taken when skipping a dose (n=170[a])			
Continue the following doses normally	105	61.7	(54.1-68.7)
Took it as soon as I remembered	62	36.4	(29.1-43.5)
Increased the following dose	04	02.4	(0.1-04.5)

[a] Denominator: participants who reported forgetting to take any doses of their treatment

The use of antibiotics among the participants was associated with employment status (p=0.008), the frequency of medical consultation (p=0.025), and the behaviour of obtaining the prescription via telephone (p<0.001). Specifically, employed participants reported higher antibiotics use (32.8%) than unemployed participants (14.7%). Furthermore, a clear association was observed with consultation: as the frequency of consulting a physician is increased, antibiotic use also increased among the participants (ranging from 1.0% for those who never consult to 22.5% for those who sometimes consult). Among the antibiotics users (n=285), 74.1% reported practicing at least one of the six studied misuse behaviours. This behaviour was significantly associated with the frequency of seeking medical advice (p=0.003), **Table 5**.

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Table 4: Self-reported dose adjustment (underuse and overuse) of antibiotics among users

Characteristic	n	%	95% CI
Changing the dose on your own without medical advice			
Never	244	85.6	(81.5-89.7)
Sometimes	32	11.2	(07.5-14.9)
Often	09	03.2	(01.2-05.2)
Type of changing action without medical advice(n=41[a])			
Took less	34	02.9	(71.4-94.4)
Took more	21	51.2	(35.9-66.5)
Sometimes took more, and sometimes took less	11	26.8	(13.2-40.4)
Reasons for increasing the dose (n=32[b])			
Feeling very sick	08	25.0	(10.0-40.0)
Forgot the previous dose	06	18.8	(05.3-32.3)
Not feeling a notable improvement	05	15.6	(03.0-28.2)
Feeling better but wanted to improve even more	02	6.3	(00.0-14.7)
Reasons for reducing the dose (n=45[c])			
Feeling better	09	20.0	(08.3-31.7)
Being worried about the side effects	08	17.8	(06.6-29.0)
Being tired, and forgot	08	17.8	(06.6-29.0)
Being in a hurry and I forgot	04	08.9	(00.6-17.2)
Not liking to take medicine at night	04	08.9	(00.6-17.2)
Feeling that I was taking to many medicines	01	02.2	(00.0-06.5)

[a] Participants who modified their treatment regimen, [b] Participants who increased their treatment regimen, and [c] Participants who reduced their treatment regimen

Table 5: The patterns of antibiotics use and misuse during the previous two months by participants' sociodemographic characteristics

Characteristics	Use in the Last 60 Days (N=600)			Any Misuse[a] (N=285)		
	No (%)	Yes (%)	Statistics[b]	Yes (%)	No (%)	Statistics[b]
n=	315 (52.5)	285 (47.5)		211 (74.1)	74 (26.0)	
Gender						
Male	111 (18.5)	107 (17.9)	χ^2=*0.344*	82 (28.8)	25 (8.8)	χ^2=0.60
Female	204 (34.0)	178 (29.7)	*P*=0.558	129 (45.3)	49 (17.2)	*P*=0.438
Age						
18-35	168 (28.0)	168 (28)	χ^2=2.99	130 (45.7)	38 (13.4)	χ^2=2.41
36-53	123 (20.5)	92 (15.4)	*P*=0.223	64 (22.5)	28 (9.9)	*P*=0.301
≥54	24 (4.0)	25 (4.2)		17 (6.0)	08 (2.9)	
Educational level						
Uneducated	01 (0.2)	02 (0.4)	χ^2=5.18	02 (0.8)	0.0 (0.0)	χ^2=1.31
Primary	26 (4.4)	12 (2.0)	*P*=0.27	09 (3.2)	03 (1.1)	*P*=0.809
Secondary	41 (6.9)	43 (7.2)		34 (12.0)	09 (3.2)	
University	233 (38.9)	212 (35.5)		155 (54.4)	57 (20)	
Post-graduation	14 (2.4)	16 (2.7)		11 (03.9)	05 (01.8)	
Currently working						
Yes	184 (30.7)	197 (32.8)	χ^2=6.99	148 (52.0)	49 (17.2)	χ^2=0.39
No	131 (21.8)	88 (14.7)	***P*=0.008**	63 (22.2)	25 (8.8)	*P*=0.529
Family members						
≤2	24 (4.0)	29 (4.8)	χ^2=6.62	19 (06.7)	09 (3.2)	χ^2=0.00
3-4	87 (14.4)	55 (9.2)	*P*=0.085	39 (13.7)	16 (5.7)	*P*=0.572
5-6	125 (20.9)	116 (19.4)		85 (29.9)	31 (10.9)	
> 6	78 (13.0)	86 (14.4)		68 (23.9)	18 (6.4)	
Consulting a physician when feeling sick						
Never	09 (1.5)	08 (1.4)	χ^2=9.34	08 (2.9)	00 (0.0)	χ^2=**13.33**
Rarely	58 (9.7)	43 (7.2)	***P*=0.025**	33 (11.6)	10 (3.6)	***P*=0.003**
Sometimes	174 (29)	135 (22.5)		109 (38.3)	26 (9.2)	
Always	74 (12.4)	99 (16.5)		61 (21.5)	38 (13.4)	
Receiving a prescription by phone						
Yes	90 (15.0)	132 (22.0)	χ^2=20.2	103 (36.2)	29 (10.2)	χ^2=2.04
No	225 (37.5)	153 (25.5)	***P*=0.0001**	108 (37.9)	45 (15.8)	*P*=0.153

[a] Any misuse: participants who reported at least one type of antibiotic misuse
[b] Statistical analysis performed using the Chi-square test (χ^2) and Fisher's exact test (where applicable)

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Discussion

Antibiotics are vital element for treating bacterial infections; however, their frequent and inappropriate use has accelerated antimicrobial resistance, a critical global public health threat [20]. This study evaluated several types of antibiotic misuse and exploring the underlying personal factors among the public in Tripoli City, Libya. In the sample, approximately, three-quarters of antibiotic users reported at least one form of misuse, with all studied misuse were detected with varying frequencies. Nearly, half of participants had used antibiotics during the preceding two months. This proportion was lower than expected, considering the study was conducted during the winter- and spring-seasons [21], when the common cold is prevalent and often misidentified as bacterial infections requiring treatment, such as tonsillitis. Furthermore, this prevalence is lower than rates reported in Libya (68.7%, [19]), Egypt (64.0%, [22]), Saudi Arabia (75.5%, [23]), and Ethiopia (79.0%, [24]). The difference might be attributed to our shorter recall period, as previous studies often utilized a six to twelve months period. This variation in recall period also likely explains the difference in the reported prevalence of the specific misuse behaviours observed across studies.

The first type of antibiotic misuse identified was self-medication without physician consultation. Bypassing professional medical advice often results in an irrational antibiotic selection or use for non-bacterial conditions, which can delay accurate diagnosis and prolong the course of illness [9]. More than one-quarter of respondents reported this practice, with some obtaining antibiotics directly from pharmacy staff. This practice can be linked to a lack of restrictive legislation, poor enforcement of existing dispensing regulations, and the high cost of medical consultations. The current finding is lower than those reported in Libya (3.05% and 46.0%, [12, 19], Eastern Ethiopia (65.3%, [24]), China (49.3%, [25]), and Saudi Arabia (57.6%, [23]). The illness patterns and the timing of data collection are two factors that might be responsible for the observed disparity. These results suggest that non-prescription use remains a common practice, necessitating stricter enforcement of prescription-only laws.

The second type of antibiotic misuse was the premature discontinuation of the antibiotic course. While treatment duration varies significantly based on the infection type and clinical guidelines, ranging from short 3-day courses to extended months-long regimens for conditions like tuberculosis, adherence to the full prescribed duration is critical for complete microbe eradication. About one-quarter of respondents reported shortening their treatment course, typically incited by symptomatic relief. This misconception regarding 'symptom-driven' adherence poses a significant clinical risk, potentially leading to relapse with resistant pathogenic bacteria. In this study, the prevalence is lower than that reported in Ethiopia (34.0%, [24]) and Egypt (64.0%, [22]), yet it remains higher than the 14.0% reported in Benghazi, Libya [12]. To correct this misuse, pharmacists must provide explicit verbal and written instructions regarding treatment duration during the dispensing process. Effective patient counseling can improve health literacy, rectify misconceptions, and foster more positive attitudes toward antibiotic proper antibiotic use [26].

The third type of antibiotic misuse was the retention of leftover medication for subsequent personal use or for sharing with family members. More than one third (36.1%) of the participants intended to reuse leftover antibiotics for recurring illnesses, indicating a propensity for self-medication that bypasses clinical diagnosis. The present finding is significantly higher than the 12.7% reported in Ethiopia [24], yet lower than the 43.9% observed in Saudi Arabia [23]. The use of leftover antibiotics often leads to sub-therapeutic dosing and inappropriate drug selection, both of which are primary causes for the development of community-acquired antimicrobial resistance.

The fourth type of antibiotic misuse was improper disposal of the remaining quantity. A considerable proportion of participants (21.8%) reported that they typically dispose of leftover antibiotics in the trash or sewage system. Such discharge into the environment can diminish antibiotic efficacy and drive the development of resistance, virulent pathogens [27]. Appropriate disposal of unused and expired antibiotics is of great importance because

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of the impending environmental hazards and public health risks [11]. This necessitates the establishment of a national disposal program and public awareness campaigns to educate the community on safe disposal methods that protect the environment.

The fifth category of antibiotic misuse examined was the management of missed doses. Consistent antibiotic administration is essential for maintaining optimal pharmacokinetic and pharmacodynamic parameters; failure to adhere to prescribed intervals can lead to sub-therapeutic drug levels, potentially increasing morbidity and mortality [28]. In this study, a significant majority of participants reported they would continue subsequent doses normally after a missed dose, while 36.3% indicated they would take the skipped dose as soon as it was remembered. Notably, only a small minority would incorrectly double the following dose. These findings demonstrate generally appropriate patient behaviour regarding dose-skipping protocols. However, pharmacists should emphasize specific 'missed dose' instructions during counselling sessions to ensure complete adherence and prevent sub-therapeutic or toxic dosing.

The sixth type of antibiotic misuse was self-adjustment of antibiotics dosage. Dose reduction was a more prominent practice than dose escalation, which primarily resulted from symptomatic relief, concerns regarding side effects, and forgetfulness due to busy schedules. This reflects a common misconception that symptom resolution equates to pathogen eradication, leading to the premature cessation or reduction of therapy. Conversely, dose escalation was also observed, with over half of the participants reporting an increase in dosage at some point. The primary motivators for overuse were the severity or a perceived lack of rapid improvement. These behaviors are clinically concerning. A good counselling session with the patients that includes warnings on never adjusting the prescribed dose is useful to prevent this type of antibiotic misuse.

The current analysis identified three socio-demographic factors significantly associated with antibiotic consumption. Notably, employment status emerged as a strong predictor, with employed participants using antibiotics more frequently. This may be attributed to higher income, better access to healthcare services, or perhaps a greater pressure to return to work quickly, leading to the use of antibiotics as a perceived 'quick fix' for illness. Furthermore, a positive association was observed between consultation frequency and antibiotic use. While increased consultation suggests better health-seeking behaviour, it also highlights the potential for over-prescription within clinical settings. This is further underscored by the significant association between antibiotic use and tele-prescriptions. Tele-prescribing, while convenient, often lacks a physical examination, increasing the risk of inappropriate antibiotic therapy for viral infections [29]. Interestingly, the frequent medical consultations were associated with increased antibiotic misuse. This suggests that frequent contact with healthcare providers does not necessarily translate to improved antibiotic literacy. Instead, frequent consulters may have more opportunities to obtain antibiotics without receiving the high-quality counseling necessary to prevent misuse. This implies that brief, symptom-focused encounters often fail to correct patient misconceptions, emphasizing that the quality of patient-provider communication is more critical for stewardship than the mere quantity of visits [30].

Several limitations must be acknowledged; the use of convenience sampling in a single city limits the generalizability of the results to all of Libya. The reliance on self-reported data may be accompanied by inaccurate information due to recall bias and social desirability bias. Finally, the findings represent a snapshot at a single time point and therefore cannot capture the changes over time. However, this study provides useful information about each type of antibiotic misuse that can be used to develop suitable strategies for tackling the misuse issue. To address these challenges, the implementation of nationwide public health campaigns focused on improving antibiotic literacy is imperative. It is crucial to shift the focus of medical consultations from mere symptomatic management to high-quality patient education. Finally, the role of the community pharmacist must be expanded to serve as a primary health educator and a strict gatekeeper against non-prescription dispensing [31]. Strengthening legal enforcement is an essential step toward mitigating the threat of antimicrobial resistance in Libya.

Conclusion: This study identifies several prevalent patterns of antibiotic misuse among residents of Tripoli, most notably unauthorized dose adjustment, the retention and sharing of leftover medication, and the acquisition of antibiotics without a physician's prescription. The findings reveal that antibiotic consumption is significantly higher among employed individuals and that frequent medical consultations paradoxically correlate with increased misuse behaviours.

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