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Practice and associated factors determination of self-medication with antibiotics among community residents in Boyolali, Indonesia: A cross-sectional study

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ABSTRACT

This study investigated the prevalence, practice, and factors associated with self-medication with antibiotics (SMA) in the general community in Boyolali, Indonesia. This cross-sectional study used a validated questionnaire with the cluster sampling method applied to select households. Data were analyzed using chi-square and multivariate logistic regression analysis. During the study, 961 respondents participated (46.9% male and 53.1% female). The prevalence of SMA was 16%. Amoxicillin (50.0%) and tetracycline (33%) were frequently used as antibiotics for self-medication. The reasons for SMA were mainly personal experience and not consulting with a doctor to save money. Most respondents reported that antibiotics could kill viruses (84.3%) and reduce fever (73.2%). They do not know that antibiotics must be bought in a pharmacy after being prescribed by a doctor (66.8%) and do not know how to use antibiotics correctly (63.5%). Age, marital status, employment status, knowledge of antibiotic access, and knowledge of antibiotics misuse effect were significantly associated with SMA ($p < 0.05$). This study determined 16% SMA, but the tolerance to SMA should be zero because any single percent of SMA could spread antibiotic resistance widely among the whole community. Therefore, educating and encouraging people to avoid SMA is recommended to prevent ABR development and spread among societies.

INTRODUCTION

Resistance has become a significant problem globally (CDC, 2020; WHO, 2020). The possible cause of the rise in resistance is the unreasonable and irresponsible use of antibiotics in healthcare centers such as hospitals and the community. Excessive prescribing, inappropriate use of antibiotics, and self-medication with antibiotics (SMA) may accelerate antibiotic resistance (ABR) (Ventola, 2015). ABR results in bacteria failing to respond to treatment, resulting in prolonged infectious diseases, extended hospital stays, and an increased risk of death (WHO, 2020).

Antibiotics are a type of drug used to treat and prevent bacterial infections. According to Law No. 419, dated December 22, 1949, antibiotics can only be obtained in pharmacies with a doctor's prescription. Nevertheless, many people practice SMA for their illnesses. SMA practice occurs in developing and developed countries (Abduelkarem *et al*., 2019; Alhomoud *et al*., 2017; Al Rasheed *et al*., 2016). SMA is defined as self-initiative

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in using drugs to treat health problems or symptoms of disease based on self-diagnosis or advice from those who are not health professionals toward intermittent disease or prolonged use of drug prescription for chronic or recurrent disease (WHO, 2000).

A previous study conducted as preliminary and qualitative research in Boyolali Regency, Central Java, Indonesia, revealed that respondents consumed antibiotics for self-medication for diseases that did not require antibiotics, such as flu, fever, cough, headache, and toothache (Karuniawati *et al*., 2020). In addition to using antibiotics for self-medication for symptoms due to viruses, previous studies also suggested that more than 50% of respondents fed antibiotics to livestock based on self-initiative (Karuniawati *et al*., 2021a). Therefore, the inappropriate use of antibiotics should be reduced so that the increase in ABR can be minimized.

Understanding the prevalence of SMA, reasons for using antibiotics for self-medication, and factors that influence the use of antibiotics for self-medication, is fundamental to reducing the inappropriate use of antibiotics and improving the rational use of antibiotics. This information will guide the formulation of educational interventions, especially for identifying and determining educational content and the priorities of respondents who need to be reached so that the intervention is carried out according to the respondent's needs. According to WHO (2012), good educational materials must be in accordance with the needs of the individual or community to be educated. Although studies on the prevalence and factors influencing the use of antibiotics in self-medication are available in both developed and developing countries, such research is still limited in Indonesia. A study conducted in Indonesia in 2011 reported the prevalence and factors that influence SMA (Widayati *et al*., 2011). However, this study did not test knowledge of antibiotics as a contributing factor for SMA. On the other hand, a study has stated that knowledge influences antibiotic behavior (Karuniawati *et al*., 2021b). Therefore, it is necessary to conduct further research to determine the prevalence of and reasons for SMA and contributing factors (demographics and antibiotics knowledge) associated with SMA.

METHODS

Study design and sampling

This study is a community-based cross-sectional study. The research was conducted in Boyolali from November 2019 to May 2020. Data were probed on respondents in seven subdistricts in Boyolali. One subdistrict was in the city's center, the other was the most backward area, and the remaining were randomly selected (WHO, 2005). The Raosoft sample size calculator was used to calculate the sample size (Raosoft, 2018). The minimum estimated sample size was 576 for a population of 1 million (Boyolali Regency, Indonesia, according to the Department of Statistics, Indonesia), with a 95% confidence interval, a 5% margin of error, and a 50% increase to reduce the weakness of cluster sampling and increase the representative sample (Hardon *et al*., 2004). A total of 130–140 respondents were selected in each subdistrict. The inclusion criteria in this study were as follows: the general public over the age of 17 years can read and write and become respondents by completing the questionnaire. Exclusion criteria were those with a health education history and working in the health sector to minimize the bias because they had received health education, including antibiotics. Data were procured using a questionnaire validated in previous studies (Karuniawati *et al*., 2022). Respondents were visited and asked to fill out a questionnaire. The main target of the respondent was the head of the family. Still, if at the time of data collection, the head of the family was not present, then the questionnaire was left or other family members with a minimum age of 17 years may fill out the questionnaire under the condition that the head of the family was not present for a long time. A family with several members was only given one questionnaire.

Study instrument

This study administered a questionnaire that had been validated and tested for reliability (Karuniawati *et al*., 2022). The questionnaire consists of three sections with closed- and open-ended questions. Part one comprises respondents' demographic data, namely, gender, age, marital status, background education, domicile, employment status, and family income. The second part contains questions related to the practice of SMA, including sources of antibiotics for SMA (if the patient gets antibiotics from a friend or relative, buys them at a stall, buys them in supermarkets, buys them at the pharmacy without a doctor's prescription, or uses leftover antibiotics from previous treatment, this is categorized as SMA), reasons for practicing SMA, symptoms treated with SMA, types of antibiotics for SMA, and side effects of antibiotics. Finally, the third part is a question about the respondents' knowledge of antibiotics, with "yes," "no," and "don't know" responses.

Ethical approval

This study obtained ethical clearance from the health research ethics committee, Faculty of Medicine, Universitas Muhammadiyah Surakarta, No. 2063/B.1/KEPK-FKUMS/III/2019. Before filling out the questionnaire, respondents were informed about the research and signed the informed consent form to participate in this study. The confidentiality of participants' information was guaranteed.

Analysis

The obtained data were inserted into a Microsoft Excel spreadsheet and then exported to Statistical Package for the Social Sciences. The data were analyzed in a descriptive and analytical manner. Descriptive analysis was applied to describe demographic data and data related to SMA practices in percentage and mean (SD) scope. The results on the respondent's knowledge of antibiotics are presented in two categories: "true" and "wrong" answers. Responses of "don't know" are categorized as "wrong" answers. The "true" answer to the knowledge question about antibiotics scored 1, while the "wrong" or "don't know" earned 0. The total score for the correct answer to the question regarding antibiotic knowledge was 20 (Karuniawati *et al*., 2021b). All the responses to the knowledge question were summed, and the median score was calculated. Scores above the median value were categorized as good knowledge (Alkhalifah *et al*., 2022). A chi-square analysis was employed to find the relationship between demographics and knowledge of SMA practice. Furthermore, multivariate logistic regression was used to determine the factors

influencing the behavior of SMA. A *p*-value less than 0.05 is deemed significant.

RESULTS

In this study, 961 respondents participated, with nearly equal percentage of male and female respondents (46.9% *vs.* 53.1%). More than 50% of respondents were 30 and 50 years old (mean 36.9 ± 12.7, range 17–77), were married, lived in rural areas, were employed, and had an income per capita below the regional minimum wage. The demographic profiles of the respondents are presented in Table 1.

During the study, 16% (154 of 961) of respondents used antibiotics for self-medication, and 72 (7.5%) obtained antibiotics from pharmacies without a doctor's prescription. Other sources show that some bought them at the shop, took leftover antibiotics from previous treatment, or got them from friends or relatives. The most frequent reasons for SMA practice are based on experiences that the same medicine could cure similar diseases and long queues of doctor's visits. The symptoms most often treated with SMA are flu/colds, fever, diarrhea, cough, toothache, and skin complaints such as itching or skin infections. Antibiotics often consumed are amoxicillin and tetracycline. The potential side effects experienced by respondents while using antibiotics as self-medication are itching, skin redness,

Table 1. Demographic characteristics of respondents.

Variables	Number (n = 961)	Percentage (%)
Gender		
Male	451	46.9
Female	510	53.1
Age		
<30	308	32.1
30–50	521	54.2
>50	132	13.7
Marital status		
Married	713	74.2
Single	215	22.4
Widow/widower/divorcee	33	3.4
Background education		
No formal education and elementary school	174	18.1
Junior high school	195	20.3
Senior high school	445	46.3
Diploma	20	2.1
Bachelor and higher	127	13.2
Domicile		
Rural	536	55.8
Urban	424	44.2
Employment status		
Unemployed	355	36.9
Employed	606	63.1
Family monthly income (IDR)		
<1,600,000	694	73.5
1,600,000–1,900,000	171	18.1
>1,900,000	79	8.4
Practicing SMA		
Yes	154	16
No	807	84

IDR = Indonesian Rupiah.

Table 2. Characteristics of SMA practice.

Variables	Number (154)	(%)
Source of antibiotic for SMA		
Obtained from the pharmacy without a doctor's prescription	72	46.8
Bought at store	40	26.0
Leftovers	26	16.9
Obtained from friends or relatives	16	10.3
Reasons for SMA		
Same drug cure the same illness	63	28.9
A long queue of doctor's visit	57	26.2
Money-saving	42	19.3
Already understand how to use antibiotics	27	12.3
The doctor's examination does not include antibiotic	17	7.8
Having leftover antibiotics	12	5.5
Symptoms treated with SMA		
Flu/cold	84	23.4
Fever	51	14.2
Diarrhea	37	10.3
Cough	37	10.3
Toothache	37	10.3
Itching	33	9.2
Skin infection	27	7.5
Sore throat	26	7.4
Sore/swelling	12	2.3
Fatigue	8	2.2
Others	5	1.4
Dysuria	2	0.6
Antibiotics used for SMA		
Amoxicillin	100	50.0
Tetracycline	66	33.0
Ampicillin	13	6.5
Metronidazole	7	3.5
FG troches	4	2.0
Ciprofloxacin	4	2.0
Erythromycin	3	2.0
Cefixime	2	1.0
Co-trimoxazole	1	0.5
Experienced side effects		
No	119	76.3
Itching	17	10.9
Skin redness	9	5.8
Diarrhea	8	5.1
Others	3	1.9

and diarrhea. More than 70% of respondents did not experience side effects. The characteristics of SMA are depicted in Table 2.

The characteristics of respondents' knowledge of antibiotics are displayed in Table 3. More than half of respondents answered incorrectly on the following items: paracetamol is an antibiotic, antibiotics can be used to treat infections due to viruses, antibiotics can reduce fever, antibiotics can be bought online, antibiotics can be purchased at a pharmacy without a doctor's prescription, antibiotics can kill bacteria in the intestines, antibiotics need to be stored in case of illness in the future, and antibiotics can be stopped if the ill has improved. Also, Table 3 describes the significant relationship between knowledge in the domains of identification of antibiotics (Q3), knowledge of antibiotics access (Q9–Q10), knowledge of antibiotics misuse effects (Q12), knowledge of side effects of antibiotics (Q16–Q17), and knowledge of antibiotic use (Q18–Q20) on SMA practice. Table 4 explains the relationship between respondent sociodemographic variables and SMA: age, marital status, and employment status related to SMA.

A multivariate logistic regression analysis was carried out to determine the variables that influenced SMA because the scale of measurement on the independent and dependent variables was categorical. The variables from the bivariate test that had $p < 0.25$ were age, marital status, employment status, and knowledge of antibiotics (Q1, Q3, Q9, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q20) were tested using multivariate logistic regression (Dahlan, 2017). The results of the multivariate logistic regression test are shown in Table 5.

The results of multivariate logistic regression imply that age, marital status, employment status, knowledge of access to antibiotics (Q9–Q10), and knowledge of antibiotics misuse effect (Q12 and Q15) had a significant effect on high SMA practice ($p < 0.05$). Respondents aged <30 and >50 years had a prevalence of practicing SMA 1.7 times higher than respondents aged 30–50 years. Those single respondents had the possibility of committing SMA nearly two times more often, and widows/widowers/divorcees had the chance of practicing SMA 2.8 times more often than married respondents. Furthermore, unemployed respondents were likely to practice SMA 1.5 times more often than employed ones. Respondents who answered incorrectly in the antibiotic access question domain (Q9–Q10) and the knowledge on antibiotic misuse effect domain (Q12) were more likely to perform SMA approximately 1.5–1.8 times more frequently than those who answered correctly. Yet, in contrast to the question in Q15, respondents who answered incorrectly appeared to commit SMA 0.6 times more than those who answered correctly on the question.

DISCUSSION

The results of this study indicate that 16% (154 of 961) of the respondents practiced SMA. This prevalence is smaller than the results of studies in several other countries such as Malaysia, the Philippines, Africa, the United Arab Emirates, the Kingdom of

Table 3. Respondent knowledge of antibiotics and their relationship with SMA ($n = 961$).

Domain	Statement	Respondents' answer *N* (%)		*p*-value*
		Correct	Incorrect	
Identification of antibiotics	Q1. Amoxicillin is an antibiotic.	713 (74.2)	246 (25.8)	0.221
	Q2. Tetracycline is an antibiotic.	567 (59)	394 (41)	0.957
	Q3. Paracetamol is antibiotic.	439 (45.7)	522 (54.7)	0.001
Knowledge of the role of antibiotics	Q4. Antibiotics are used to kill bacteria.	858 (89.3)	103 (10.7)	0.450
	Q5. Antibiotics can be used to treat infections due to viruses.	151 (15.7)	810 (84.3)	0.595
	Q6. Colds and flu can be cured without antibiotics.	690 (71.8)	271 (28.2)	0.505
	Q7. Antibiotics can reduce fever.	258 (26.8)	703 (73.2)	0.642
Knowledge of antibiotics access	Q8. Antibiotics can be bought online.	365 (37.9)	596 (62.1)	0.251
	Q9. Antibiotics from other people may be taken.	631 (65.7)	330 (34.3)	0.001
	Q10. Amoxicillin can be purchased at a pharmacy without a doctor's prescription.	319 (33.2)	642 (66.8)	0.001
	Q11. Antibiotics can be purchased at the grocery shop.	631 (65.7)	330 (34.3)	0.097
Knowledge of antibiotics misuse effect	Q12. Inappropriate use of antibiotics will cause ABR.	624 (64.9)	337 (35.1)	0.001
	Q13. Inappropriate use of antibiotics will cause these antibiotics to not be used later.	482 (50.2)	479 (49.8)	0.076
	Q14. Inappropriate use of antibiotics can cause more severe illness.	580 (60.4)	381 (39.6)	0.223
	Q15. Inappropriate use of antibiotics increases costs.	483 (50.3)	478 (49.7)	0.172
Knowledge of side effects of antibiotics	Q16. Antibiotics can cause allergic reactions such as redness of the skin.	603 (62.7)	358 (37.3)	0.009
	Q17. Antibiotics can kill good bacteria in the intestines.	446 (46.4)	515 (53.6)	0.030
Knowledge of antibiotic use	Q18. Antibiotics need to be stored in case of illness in the future.	403 (41.9)	558 (58.1)	0.001
	Q19. Antibiotics leftover can be used again if sick.	584 (60.8)	377 (39.2)	0.001
	Q20. Antibiotics can be stopped if the ill has improved.	351 (36.5)	610 (63.5)	0.001

*Chi-square test.

Table 4. The relationship of sociodemographic characteristics of participants and SMA (n = 961).

Variables	SMA		*p*-value*
	Yes (%)	No (%)	
Gender			
Male	76 (16.9)	375 (83.1)	0.511
Female	78 (15.3)	432 (84.7)	
Age			
<30	65 (21.1)	243 (78.9)	0.002
30–50	64 (12.3)	457 (87.7)	
>50	25 (18.9)	107 (81.1)	
Marital status			
Married	94 (13.2)	619 (86.8)	0.001
Single	50 (23.3)	165 (76.7)	
Widow/widower/divorcee	10 (30.3)	23 (69.7)	
Background Education			
No formal education and elementary school	22 (12.6)	152 (87.4)	0.390
Junior high school	34 (17.4)	161 (82.6)	
Senior high school	77 (17.3)	368 (82.7)	
Diploma	1 (5.0)	19 (95.0)	
Bachelor and higher	20 (15.7)	107 (84.3)	
Area residence			
Rural	89 (16.6)	447 (83.4)	0.526
Urban	64 (15.1)	360 (84.9)	
Employment status			
Unemployed	72 (20.3)	283 (79.7)	0.006
Employed	82 (13.5)	524 (86.5)	
Family monthly income (IDR)			
<1,600,000	114 (16.4)	580 (83.6)	0.661
1,600,000–1,900,000	29 (17.0)	142 (83.0)	
>1,900,000	10 (12.7)	69 (87.3)	

*Chi-square test.

Saudi Arabia, and Ethiopia (Abduelkarem *et al*., 2019; Al Rasheed *et al*., 2016; Ateshim *et al*., 2019; Bilal, 2016; Bogale *et al*., 2019; Bulario *et al*., 2018; Haque *et al*., 2019). This prevalence is also relatively lower than a similar study in Manado, Indonesia, in 2015, which suggested that 180 (45%) respondents had practiced self-medication (Kurniawan *et al*., 2017). This relatively small prevalence may be due to the GeMa CerMat program (Gerakan Masyarakat Cerdas Menggunakan Obat or People's Movement to Use Medicines Smartly), which has been implemented in Indonesia since 2015. Based on the Decree of the Minister of Health of the Republic of Indonesia Number HK.02.02/MENKES/427/2015, GeMa CerMat is the government and community's efforts through a series of activities to create vigilance, awareness, understanding, and skills among the community in using drugs appropriately and correctly, including antibiotics. The purpose of this program is to enhance public understanding and awareness about the importance of using drugs correctly, increase independence and change the public's behavior toward using drugs properly, and improve the rational use of drugs, including antibiotics. As per regulations in Indonesia, antibiotics can only be obtained in pharmacies with a doctor's prescription (Kepmenkes, 2015, 2020).

Respondents using antibiotics for SMA purchased them from pharmacies without a doctor's prescription, bought them at a shop, used leftover antibiotics from previous treatment, or obtained them from friends or relatives. The results of this study correspond to other studies. Previous studies mentioned that community pharmacies and other healthcare centers, relatives or friends, leftover drugs, and patent medicine stores were the primary sources of respondents in obtaining antibiotics for SMA (Abduelkarem *et al*., 2019; Aslam *et al*., 2021; Bulario *et al*., 2018; Mohanna, 2010; Nepal and Bhatta, 2018). In addition, patients used the previous prescription or an empty package to obtain antibiotics (Mohanna, 2010; Torres *et al*., 2019). Previous research revealed that 42% (58 out of 138) of shops surveyed in Indonesia sold antibiotics such as tetracycline, penicillin, amoxicillin, and ampicillin (Karuniawati *et al*., 2021a). In this study, the most frequently used antibiotics in SMA were amoxicillin (50%), tetracycline (33%), and ampicillin (6.5%). This is in line with the results of several previous studies and reviews, which revealed that penicillin (amoxicillin) was the most frequently used antibiotic for SMA (Abduelkarem *et al*., 2019; Alhomoud *et al*., 2017; Al Rasheed *et al*., 2016; Ateshim *et al*., 2019;

Table 5. The association between sociodemographic and knowledge variables and SMA practice and its odds ratio (ORs).

Variables	SMA		*p*-value*	OR (95% CI)
	Yes (%)	No (%)		
Age				
<30	65 (21.1)	243 (78.9)	0.005	1.784 (1.186–2.683)
>50	25 (18.9)	107 (81.1)	0.046	1.726 (1.009–2.953)
30–50	64 (12.3)	457 (87.7)	Ref	
Marital status				
Married	94 (13.2)	619 (86.8)	Ref	
Single	50 (23.3)	165 (76.7)	0.001	1.995 (1.360–2.929)
Widow/widower/divorcee	10 (30.3)	23 (69.7)	0.008	2.863 (1.321–6.205)
Employment status				
Unemployed	72 (20.3)	283 (79.7)	0.034	1.498 (1.032–2.176)
Employed	82 (13.5)	524 (86.5)	Ref	
Q1. Amoxicillin is an antibiotic				
Wrong	46 (18.5)	203 (81.5)	0.843	1.043 (0.689–1.578)
Correct	108 (15.2)	604 (84.8)	Ref	
Q3. Paracetamol is an antibiotic				
Wrong	102 (19.5)	421 (80.5)	0.210	1.289 (0.867–1.917)
Correct	52 (11.9)	386 (88.1)	Ref	
Q9. Antibiotics from other people may be taken				
Wrong	77 (23.3)	254 (76.7)	0.030	1.564 (1.046–2.339)
Correct	77 (12.2)	553 (87.8)	Ref	
Q10. Amoxicillin can be purchased at a pharmacy without a doctor's prescription				
Wrong	121 (18.8)	522 (81.2)	0.011	1.805 (1.142–2.852)
Correct	33 (10.4)	285 (89.6)	Ref	
Q11. Antibiotics can be purchased at the grocery shop				
Wrong	62 (18.7)	269 (81.3)	0.893	1.028 (0.685–1.543)
Correct	92 (14.6)	538 (85.4)	Ref	
Q12. Inappropriate use of antibiotics will cause ABR				
Wrong	78 (23.1)	260 (76.9)	0.007	1.774 (1.173–2.684)
Correct	76 (12.2)	547 (87.8)	Ref	
Q13. Inappropriate use of antibiotics will cause these antibiotics not to be used later				
Wrong	87 (18.1)	393 (81.9)	0.327	0.807 (0.527–1.238)
Correct	67 (13.9)	414 (86.1)	Ref	
Q14. Inappropriate use of antibiotics can cause more severe illness				
Wrong	68 (17.8)	314 (82.2)	0.704	1.086 (0.708–1.667)
Correct	86 (14.9)	493 (85.1)	Ref	
Q15. Inappropriate use of antibiotics increases costs				
Wrong	69 (14.4)	410 (85.6)	0.045	0.663 (0.444–0.990)
Correct	85 (17.6)	397 (82.4)	Ref	
Q16. Antibiotics can cause allergic reactions such as redness of the skin				
Wrong	72 (20.1)	287 (79.9)	0.89	1.409 (0.949–2.092)
Correct	82 (13.6)	520 (86.4)	Ref	
Q17. Antibiotics can kill good bacteria in the intestines				
Wrong	95 (18.4)	421 (81.6)	0.806	1.052 (0.704–1.571)

Continued

Variables	SMA		*p*-value*	OR (95% CI)
	Yes (%)	No (%)		
Correct	59 (13.3)	386 (86.7)	Ref	
Q18. Antibiotics need to be stored in case of illness in the future				
Wrong	114 (20.4)	445 (79.6)	0.071	1.544 (0.949–2.092)
Correct	40 (10.0)	362 (90.0)	Ref	
Q19. Antibiotics leftover can be used again if sick				
Wrong	90 (23.8)	288 (76.2)	0.084	1.475 (0.949–2.293)
Correct	64 (11.0)	519 (89.0)	Ref	
Q20. Antibiotics can be stopped if the ill has improved				
Wrong	120 (19.6)	491 (80.4)	0.780	1.073 (0.653–1.763)
Correct	34 (9.7)	316 (90.3)	Ref	

*Multivariate logistic regression.

Bilal, 2016; Bulario *et al*., 2018; Horumpende *et al*., 2018; Jassim, 2010; Mohanna, 2010; Torres *et al*., 2020; Yeika *et al*., 2021).

According to the respondents, the practice of SMA was carried out because they had experience using antibiotics in previous illnesses with the same medicine treating the same disease and respondents already understood how to use antibiotics. Other reasons for practicing SMA are long queues for doctor's visits, saving money, a doctor's examination that does not include antibiotics, and antibiotics leftover. In addition, the previous studies revealed that the participants reported their previous successful experience with a similar illness with the antibiotic treatment; respondents thought that they could effectively diagnose and treat themselves every time they experienced the same symptoms and the illness was not serious enough to seek medical care. Other important factors included the following: economic reasons; suggestions from others; advertisements on television, radio, and print media; time-wasting and inconvenience to keep on visiting the physician (Abduelkarem *et al*., 2019; Ateshim *et al*., 2019; Bilal, 2016; Haque *et al*., 2019; Nepal and Bhatta, 2018; Rather *et al*., 2017).

In this study, the disease symptoms most often treated with antibiotics on their initiative were flu or the common cold, fever, diarrhea, cough, toothache, itching and skin infections, and sore throat. Previous research stated that nonprescription antibiotics were used to treat self-perceived sore throat, fever, pain, cough, vaginal discharge, eye problems, common influenza, urinary tract infections, gastrointestinal tract disease, respiratory tract infections, skin infections, ear infections, wounds, headache, diarrhea, and toothaches or gum symptoms (Haque *et al*., 2019; Horumpende *et al*., 2018; Grigoryan *et al*., 2007; Jassim, 2010; Mohanna, 2010; Nepal and Bhatta, 2018; Torres *et al*., 2020; Yeika, 2021). Of the 961 respondents, 76.3% reported never experiencing side effects of SMA, whereas 10.9% experienced itching, and approximately 5% experienced skin redness and diarrhea.

The results of multivariate logistic regression analysis showed that age, marital status, employment status, and knowledge of access to antibiotics (in the questions: Q9. Antibiotics from other people may be taken; Q10. Amoxicillin can be purchased at a pharmacy without a doctor's prescription), knowledge on antibiotics misuse effect (in the questions: Q12. Inappropriate use of antibiotics will cause ABR; Q15. Inappropriate use of antibiotics increases costs) significantly affected self-medication practice ($p < 0.05$). Respondents of <30 and >50 years were more prone to practice SMA 1.7 times more often than those aged 30–50. Similar findings were observed in a study conducted in Ethiopia, which revealed that SMA was significantly associated with age. Respondents aged 18–30 were 8.5 times more likely to commit SMA (Bogale *et al*., 2019). Another study affirmed that the younger the respondents are, the more likely they were to practice SMA: respondents aged <25 and 25–34 had 4.5 times and 2.7 times, respectively (Gebeyehu *et al*., 2015). Similar research examined in Manila involving mothers as respondents suggested that as the mother's age increases, the mother's tendency to self-medicate her child also increases ($p = 0.029$) (Bulario *et al*., 2018). Research in China also reported that older age was a risk factor for SMA ($p < 0.01$) (Pan *et al*., 2012). However, these findings contradict the study conducted in Saudi Arabia, which discovered that respondents aged 45 years were more likely to practice SMA 2.9 times more than those younger ($p = 0.010$) (Al Rasheed *et al*., 2016).

Previous studies conducted in Tanzania, Nigeria, and Ethiopia showed a significant effect between marital status and SMA practice (Afolabi, 2008; Kifle *et al*., 2021; Horumpende *et al*., 2018). It corresponds with this study where single and widows/widowers/divorcees intent to self-medicate with antibiotics was 1.99–2.86 times more frequent than that of married participants ($p = 0.001$). Nonetheless, this study does not align with research conducted in Iran and Iraq, where marital status is unrelated to SMA (Ahmed, 2016; Mousavi *et al*., 2020). Furthermore, in this study, respondents who were unemployed and had poor knowledge of antibiotics tended to practice SMA more often than those who worked. Again, this finding aligned with the previous studies (Ateshim *et al*., 2019; Haque *et al*., 2019; Kajeguka and Moses, 2017; Kurniawan *et al*., 2017).

Strengths and limitations

The strength of this study is that the respondents included those who live in urban and rural areas with varying ages, income levels, and education levels. Therefore, the results of this study

could represent the entire population. On the other hand, some respondents were not doing SMA at the time of data collection, so respondents tried to remember when the last SMA occurred, which might allow for a recall bias. To minimize bias, it is recommended in future studies that data collection be performed on patients who are currently taking antibiotics during the data collection.

CONCLUSION

During the study, 16% (n = 154) of the respondents practiced SMA. Sources of antibiotics for self-medication were pharmacy (46.8%), shop or stall (26.0%), leftovers (16.9%), and friends/relatives (10.3%). Age, marital status, employment status, and knowledge of antibiotics have a significant relationship with SMA practice ($p < 0.05$).

The results of this study can be used to evaluate the GeMa CerMat program implemented and be considered in designing further education to minimize SMA practice. Furthermore, these findings may provide an excellent foundation for future research into the areas that must be prioritized, the best educational resources, and the most effective teaching strategies for more focused, targeted interventions. Respondents were <30 and >50 years; single, widowers, divorcees, and unemployed can be considered the main targets in future interventions. Moreover, knowledge of antibiotic function, how to distinguish and obtain antibiotics according to regulations, and the effects of using irrational antibiotics can be priority material in future public education. Furthermore, it is necessary to strictly supervise the distribution of antibiotics so that they can only be obtained as per applicable laws and regulations.

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AUTHORS' CONTRIBUTIONS

HK initiated the study, conceptualization and design, data curation, and analysis, prepared the draft, and approved the final publishable manuscript. SS was responsible for the conceptualization and design, supervision, interpretation, critical review of the article, and approval of the final publishable manuscript. SASS contributed to the supervision, interpretation, critical review of the article, and approval of the final manuscript. TT was responsible for the analysis and interpretation of data, critical review manuscript, and approval of the final publishable manuscript. WHI was responsible for the analysis of data, drafting, and approval of the final publishable manuscript. MSH critically edited the manuscript, evaluated the scientific quality, and approved the final publishable manuscript.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ETHICAL APPROVALS

This study obtained ethical clearance from the Health Research Ethics Committee, Faculty of Medicine, Universitas Muhammadiyah Surakarta, No. 2063/B.1/KEPK-FKUMS/III/2019.

DATA AVAILABILITY

The research data is available upon a reasonable request to the corresponding author.

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