

ORIGINAL ARTICLE

Awareness of Antibiotic Usage and Antibiotic Resistance: A Case Study in Selangor, Malaysia

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ABSTRACT

Introduction: Adequate knowledge of antibiotics usage among users is one of the key factors preventing the spread of antibiotic-resistant strains' infections. This study is conducted to determine the level of awareness on antibiotic usage and antibiotic resistance among the residents in Selangor, Malaysia. **Methods:** This study is a cross-sectional, questionnaire-based study that consisted of three parts: socio-demographic profile, antibiotic use awareness, and antibiotic resistance awareness. The questionnaire was distributed online using the snowball sampling method from January to March 2021. **Results:** A total of 239 respondents have participated in this study. The majority of the respondents involved were among the Malay youth residents in Selangor. Results showed that most residents in Selangor (65%) misunderstand that antibiotics can treat cold and flu. More than 44% of respondents also thought that antibiotic resistance could only occur to individuals who frequently take antibiotics and could not be spread to other people. Findings also showed associations ($p < 0.05$) between the level of awareness on antibiotic resistance and the respondents' socio-demographic profile (education level, household income and settlement category). A significant positive correlation was also observed between the level of awareness of antibiotic use and antibiotic resistance ($r = 0.42$, $p < 0.05$). **Conclusion:** In conclusion, the Selangor respondents' antibiotic usage and antibiotic resistance level of awareness are moderate to high. However, there is still a need to increase awareness of antibiotic resistance and correct the misunderstandings among the public to help curb the antibiotic resistance issue from rapidly increasing in the future.

Keywords: Antibiotic resistance, Awareness, Antibiotic use, Residents, Selangor

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INTRODUCTION

Antibiotic resistance is a global issue that threatens the treatment of infectious diseases. Antibiotic resistance occurs due to mutation or transfer of resistance genes in infectious microorganisms, causing the ineffectiveness of antibiotics commonly used to treat the disease (1). A pathogenic microorganism is not only capable of becoming resistant to one type of antibiotics, but there is also an increasing emergence of bacterial strains such as *Acinetobacter baumannii*, various Enterobacteriaceae strains and *Staphylococcus aureus* that has been reported to show resistance towards multiple class of antibiotics (2, 3). The list of infectious diseases becoming harder to treat (eg. pneumonia, tuberculosis, gonorrhoea etc.) is consistently growing as new antibiotic resistance emerges and spread globally (4).

The excessive use and misuse of antibiotics have led to an increase in the emergence and spread of resistant strains. According to CDC (5), about 2 800 000 antibiotic-resistant bacterial infections cases, with more than 35 000 deaths reported in the United States yearly. A study by Klien et al. (6) also reported that between the year 2000-2015, there was a 65% increase in global antibiotic defined daily dose (DDD) and a 39% increase in global antibiotic consumption rate by the low- and middle-income countries. This uprising trend could also be seen as an indicator of the increased number of bacterial infectious diseases among the global population, including signs of increased antibiotic-resistant bacterial strains. The higher burden of infectious diseases, especially in low- and middle-income countries, would lead to the change of prescriptions from the first-line antibiotics to the third- and fourth-line antibiotics in treating the diseases. Another study by Boeckel et al. (7) also reported an increase in carbapenem and polymyxin; two antibiotics are commonly used as a final resort for disease treatments, indicating the rise of multiple antibiotic-resistant bacteria. In Malaysia,

increased resistance rates towards antibiotics other than penicillin were also observed, as reported in the National Antibiotic Resistance Surveillance Report 2019 (8). For example, the report has established that the resistance rate was increased for the majority of the antibiotics tested for *Acinetobacter baumannii* and *Pseudomonas aeruginosa*, which include ceftazidime, imipenem, meropenem, gentamicin and amikacin.

Developing and implementing strategies to combat antibiotic resistance issues is a global challenge for public health (9). In accordance with the WHO Global Actions Plan on Antimicrobial Resistance (4), several strategies have been implemented to curb the spread and overcome problems related to antibiotic resistance to human health in Malaysia. These strategies include the establishment of the Protocol on Antimicrobial Stewardship Program in Healthcare Facilities (10), National Medical Care Statistics (NMCS) 2014 (11), National Antibiotic Guideline (12) as well as the Malaysian Action Plan on Antimicrobial Resistance (MyAp - AMR) 2017-2021 (13). Actions such as practising good antimicrobial stewardship to patients (eg. promotion of the optimal antimicrobial drug, route of administration, correct dose and duration), enhancing surveillance of antibiotic usage and increasing knowledge and awareness on the proper use of antibiotics are emphasized in these implemented strategies.

It is crucial to increase the awareness and understanding of antimicrobial resistance among the public, which is also included as one of the WHO Global Actions Plan on Antimicrobial Resistance strategic objectives (4). When the public has high awareness and knowledge, especially on the adverse effects of antimicrobial resistance towards global health, they could help combat this issue by changing their behaviour, especially in ensuring that they will only consume antibiotics as prescribed by the medical practitioners for them. Based on a study conducted by the WHO on 12 countries (14), the level of awareness on the appropriate use of antibiotics indicates a high level of misunderstanding. Similar studies had also been conducted in Malaysia, although fairly limited to certain populations such as in Penang (15), Cheras, Kuala Lumpur (16,17), Putrajaya (18), and Shah Alam (19), which also showed that the level of knowledge and attitude towards antibiotics usage is still low. Common misunderstanding identified includes the type of diseases that requires antibiotics as treatment, self-medicating by getting antibiotics without prescriptions and sharing prescribed antibiotics with other people. These misunderstandings, if it is not rectified, would lead to the increase of antimicrobial resistance development. It should also be noted that the previous local studies (15-19) only focused on awareness of antibiotic usage without exploring in an extensive manner of the targeted population awareness of the antibiotic resistance issues. Therefore, this study aimed to gain access to the awareness and understanding

level of antibiotic usage and explore the awareness and perceptions on antibiotic resistance among the residents in Selangor to help strategize interventions to prevent the antimicrobial resistance spread.

MATERIALS AND METHODS

Study design and sample selection

This study is a cross-sectional study using quantitative data analysis methods. The respondents' inclusion criteria for this study are Malaysian citizens residing in Selangor, 18 to 65 years old, fluent in Malay or English, and have access to the internet. Selangor has been chosen as the sampling location due to its high density of residents as compared to the other states in Malaysia (20). Sampling was conducted in January – March 2021. Ethical approval from the Universiti Kebangsaan Malaysia Research Ethics Committee was obtained before the commencement of this study [Ref. No: UKM/PPI/111/8/JEP-2021-021].

The sample size was determined by using Cochran sample size formula (21) based on the antibiotic prescription rate at primary health clinics for Malaysians (21.1%) as reported by the Ministry of Health, Malaysia (11). The level of confidence level was set at 95% and error margin of 0.05. Therefore, the required sample size was 255 respondents. The questionnaire was distributed via an online platform (Google form) using the snowball sampling method to the general population residing in Selangor. The sampling method enables the authors to reach out to the large required number of respondents with ease as the study period falls during the Movement Control Order, limiting sample collection activities. The confidentiality of information and anonymity of the respondents was maintained throughout this study.

Instrumentation

The questionnaire used was adopted on a previous study conducted by WHO (14) with some modifications according to the suitability of the sample population of this study. The questionnaire is divided into three parts, namely Sections A, B, and C. Section A is a socio-demographic section that contains questions related to the respondents' information such as gender, age, locality, housing area category, level of education, level of income and household composition. Next, Part B contains questions about their current practice of antibiotics usage and their awareness of antibiotics use, whereas Section C contains questions about antibiotic resistance.

The items in Section B and C contain multiple-answers questions that allow the respondent to choose only one correct answer from the list of answers given and also True/False type of questions. Section C also includes a 3-Likert scale type of questions to determine respondents' opinion on statements regarding antibiotic resistance given. Every correct answer from both sections

was scored as one, and the incorrect answer was scored as zero. The level of awareness for Sections B and C were graded based on percentage scores. The scores obtained were divided into 3 categories (low, moderate and high) according to the percentiles (22). Those who scored $\leq 33\%$ were considered to have a low level of awareness. Meanwhile, those who scored 34% to 66% and $>66\%$ were considered as having a moderate and high level of awareness, respectively.

Statistical analysis

All data from respondents that fulfilled the inclusion criteria of this study were analyzed using the IBM Statistical Package for the Social Sciences (SPSS) ver. 25.0 software (IBM Corp. Armonk, NY, US). Data were analyzed descriptively as well as using the Fisher exact test and Pearson's correlation coefficient. A p-value of <0.05 was considered as significant in this study.

RESULTS

Socio-demographic characteristics of respondents

A total of 239 respondents participated in this study, and their socio-demographic characteristics were shown in Table I. The majority of the respondents were female (72%), while only 28% were males. Most of them are within the age groups of 18-24 years old (24%), and the respondents' education mainly was Bachelor's degree (54%). About 53% of the respondents live in Klang and Petaling districts, with 39% and 46% of the total respondents reporting living in the urban and suburban areas, respectively. Almost all of the respondents who participated in this study were Malay (230, 96%), with most of them have low (\leq RM5000) (47%) and middle level of income (RM5001-RM11 000) (37%).

Current practice and level of awareness about antibiotic use

The majority of the respondents (75%) reported that they still remember when they had previously taken antibiotics, while 5% reported that they had never taken any antibiotics before. Among the respondents who have taken antibiotics previously, $\geq 90\%$ reported that the antibiotics received were prescribed by their doctors, obtained from hospitals and clinics, and advised how to take them (data not shown). Table II showed the respondents' responses towards statements regarding antibiotic use. About 88% of the respondents have correctly answered that they should stop taking antibiotics when they have taken all of the antibiotics as directed. The majority (85%) also know that antibiotics should not be shared with friends or family members. However, it should be noted that there was about 34% of respondents believed that it is okay to purchase or request antibiotics from their doctors when they are having the same symptoms as their previous illness. A high level of misunderstanding among respondents was also observed on conditions that could be treated with antibiotics such as cold and flu (60%), fever (71%) and

Table I. Sociodemographic characteristics of the respondents (N=239).

Characteristics	Frequency (N= 239)	Percentage (%)
Gender		
Male	67	28
Female	172	72
Age		
18-24	104	44
25-34	39	16
35-44	56	23
45-65	40	17
Districts		
Sabak Bernam	12	5
Kuala Selangor	15	6
Hulu Selangor	9	4
Gombak	22	9
Petaling	51	21
Klang	76	32
Hulu Langat	34	14
Sepang	15	6
Kuala Langat	5	2
Ethnicity		
Malay	230	96
Chinese	5	2
Indian	1	0.4
Others	3	1.3
Settlement category		
Urban (within city)	93	39
Suburban (suburb of a city)	100	46
Rural (outside of a city, e.g.village / countryside /farming area)	37	16
Education level		
SPM	23	10
STPM / Pre-Uni / Matriculation	31	13
Diploma	32	13
Bachelor's Degree	129	54
Masters/ Professional Certificate	19	8
Doctorate	5	2
Monthly income		
\leq RM5000 (Low)	113	47
RM5001 – RM 11000 (Middle)	89	37
$>$ RM11000 (High)	37	16

sore throat (60%) (Fig. 1). Overall, 51% of respondents obtained moderate-, 39% scored high- and 11% scored low-level awareness on antibiotic use based on their total scores for this section.

Level of awareness about antibiotic resistance

In general, 59% of the respondents scored moderate-, 37% scored high, while only 4% scored low-level understanding and awareness of antibiotic resistance. The three most common terms concerning antibiotic resistance that is familiar to the respondents were "antibiotic resistance" (68%), "drug resistance" (66%),

Table II: Respondents' correct/incorrect responses towards statements regarding antibiotic use (N = 239).

Statement	Correct (%)	Incorrect (%)
If you need to take antibiotics, when do you think you should stop taking antibiotics once you have begun treatment?	210 (88)	29 (12)
It is okay to use antibiotics that were given to a friend of family member, as long as they were used to treat the same illness.	202 (85)	37 (16)
It is okay to buy the same antibiotics, or request these from a doctor if you are sick and they helped you get better when you had the same symptoms before.	158 (66)	81 (34)

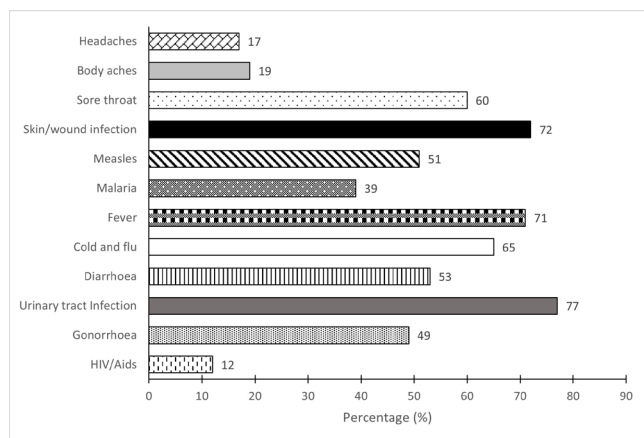


Figure 1: Respondents' response on conditions that can be treated with antibiotics.

and "antibiotic-resistant bacteria" (62%) and followed by "antimicrobial resistance (48%), "superbugs" (31%) and lastly "AMR" (28%). The most common sources of information regarding antibiotic resistance obtained by respondents were from their education institution (42%) (Fig. 2).

The percentage of respondents (correct/incorrect) responses regarding antibiotic resistance statements were shown in Table III. Overall, respondents have given the correct response for most statements given. However, while the statement "antibiotic resistance occurs when your body becomes resistant to antibiotics and they no longer work as well" is false, about 93% of the respondents believed that the statement is true.

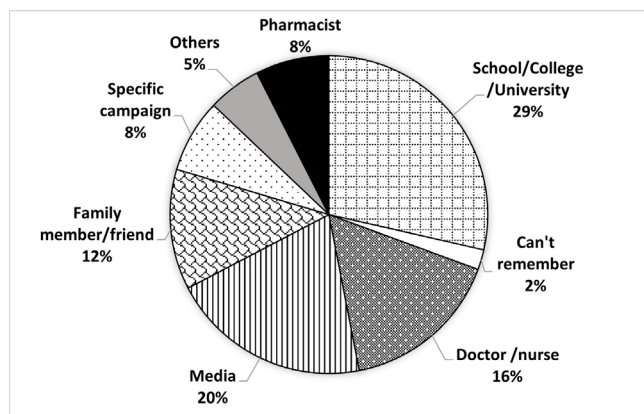


Figure 2: Common source of information regarding antibiotic resistance

Table III: Respondents' correct/incorrect responses towards statements regarding antibiotic resistance (N = 239)

Statement	Correct (%)	Incorrect (%)
Antibiotic resistance occurs when your body cannot be treated by antibiotics and they no longer work as well.	16 (7)	223 (93)
Many infections are becoming increasingly resistant to treatment by antibiotics.	190 (80)	49 (21)
If bacteria are resistant to antibiotics, it can be very difficult or impossible to treat the infections they cause	215 (90)	21 (10)
Antibiotic resistance is an issue that could affect me or my family.	205 (86)	34 (14)
Antibiotic resistance is an issue in other countries but not here.	194 (81)	45 (19)
Antibiotic resistance is only a problem for people who take antibiotics regularly.	114 (48)	125 (52)
Bacteria which are resistant to antibiotics can be spread from person to person.	134 (56)	105 (44)
Antibiotic-resistant infections could make medical procedures like surgery, organ transplants and cancer treatment much more dangerous.	189 (79)	50 (21)

Other than that, about 52% and 44% of respondents also answered incorrectly for the "antibiotic resistance is only a problem for people who take antibiotics regularly" and the "bacteria which are resistant to antibiotics can be spread from person to person" statements, respectively. A range of 74 – 97% of respondents agrees to the 7 out of 8 actions that could help address the problem of antibiotic resistance listed (Table IV(a)). However, only 49% of respondents agree that farmers should give fewer antibiotics to food-producing animals, while 13% disagree, and 38% responded as "neutral" on this action. On statements relating to the respondents' opinion on the scale of impact of antibiotic-resistant issues (Table IV(b)), 75% of respondents agree that antibiotic resistance is one of the biggest problems the world faces. About 86% are worried about antibiotics resistance's impact on their health, but 65% of the respondents believed they are not at risk of getting an antibiotic-resistant infection as long as they take the antibiotics correctly. A total of 96% of respondents believe that everyone needs to take responsibility for using antibiotics responsibly. However, 57% of respondents believed, while 26% are not sure if they can contribute to stopping the antibiotic resistance issue. Moreover, about 75% of respondents believed that medical experts would solve the antibiotic resistance problem before becoming too serious.

Association between the socio-demographic profile with the level of awareness on antibiotic resistance

The association between socio-demographic profile with the level of awareness on antibiotic resistance were shown in Table V. The level of awareness on antibiotic resistance were observed to be significantly associated with housing area category, level of income and education level (p<0.05), but showed no significant association with other socio-demographic profile. Most respondents (52%) living in the urban area showed a higher level of awareness of antibiotic resistance as compared to respondents living in the rural (30%)

Table IV. Percent of respondents' responses towards (a) actions that could help address antibiotic resistance and (b) impact of antibiotic resistance

Statements	Agree (%)	Neutral (%)	Disagree (%)
(a) Actions that could help address antibiotic resistance			
People should use antibiotics only when they are prescribed by a doctor.	97	1	2
People should not keep antibiotics and use them later for other illnesses.	87	5	8
Parents should make sure all of their children's vaccinations are up-to date.	95	3	2
People should wash their hands regularly.	94	3	3
Doctors should only prescribe antibiotics when they are needed.	96	2	2
Governments should reward the development of new antibiotics.	78	19	3
Pharmaceutical companies should develop new antibiotics.	74	21	5
Farmers should give fewer antibiotics to food-producing animals	49	38	13
(b) Impact of antibiotic resistance			
Antibiotic resistance is one of the biggest problems the world faces.	75	22	3
Medical experts will solve the problem of antibiotic resistance before it becomes too serious.	75	20	5
Everyone needs to take responsibility for using antibiotics responsibly.	96	3	1
There is not much people like me can do to stop antibiotic resistance.	57	26	17
I am worried about the impact that antibiotic resistance will have on my health, and that of my family.	86	11	3
I am not at risk of getting an antibiotic-resistant infection, as long as I take my antibiotics correctly.	65	19	16

and suburban (27%) areas. Although the percentage of respondents with low income with a high level of antibiotic resistance awareness was found to be lower (27%) than respondents with high (46%) and middle (46%) income, it should be noted that the majority of the low-income respondents have a moderate level of awareness (69%). It is also noted that respondents with a higher level of education (Masters/Professional Certificate and Doctorate) mostly scored a high level of awareness.

Correlation between the level of awareness on antibiotic use and the level of awareness on antibiotic resistance

Pearson's correlation coefficient test showed a significant, positive, and moderate correlation between the level of awareness of antibiotic use and antibiotic resistance ($r = 0.42$; $p < 0.05$).

Table V: Association between respondents' sociodemographic profile with the level of awareness on antibiotic resistance (N = 239)

Variable	Level of awareness			p-value
	Low (%)	Moderate (%)	High (%)	
Gender				
Male	4 (6)	37 (55)	26 (39)	0.455
Female	5 (3)	105 (61)	62 (36)	
Age				
18-24	6 (6)	63 (61)	65 (34)	0.13
25-34	0 (0)	18 (46)	21 (54)	
35-44	2 (4)	32 (57)	22 (39)	
45-65	1 (3)	29 (73)	10 (25)	
Districts				
Sabak Bernam	0 (0)	6 (50)	6 (50)	0.205
Kuala Selangor	0 (0)	9 (60)	6 (40)	
Hulu Selangor	1 (11)	3 (33)	5 (56)	
Gombak	0 (0)	10 (46)	12 (55)	
Petaling	2 (4)	27 (53)	22 (43)	
Klang	4 (5)	55 (72)	17 (22)	
Hulu Langat	2 (6)	20 (59)	12 (35)	
Selangor	0 (0)	10 (67)	15 (33)	
Kuala Langat	0 (0)	2 (40)	3 (60)	
Ethnicity				
Malay	9 (4)	139 (60)	82 (36)	0.305
Chinese	0 (0)	1 (20)	4 (80)	
Indian	0 (0)	0 (0)	1 (100)	
Others	0 (0)	2 (67)	1 (33)	
Settlement category				
Urban	5 (5)	40 (43)	48 (52)	0.001
Suburban	3 (3)	77 (71)	29 (27)	
Rural	1 (3)	25 (68)	11 (30)	
Education level				
SPM	2 (9)	18 (78)	3 (13)	0.025
STPM / Pre-Uni / Matriculation	1 (3)	23 (74)	7 (23)	
Diploma	2 (6)	13 (41)	17 (53)	
Bachelor's Degree	4 (3)	77 (60)	48 (37)	
Masters/ Professional Certificate	0 (0)	9 (47)	10 (53)	
Doctorate	0 (0)	2 (40)	3 (60)	
Monthly income				
≤ RM5000 (Low)	5 (4)	78 (69)	30 (27)	0.006
RM5001 – RM 11000 (Middle)	1 (1)	47 (53)	41 (46)	
> RM11000 (High)	3 (8)	17 (46)	17 (46)	

DISCUSSION

Almost all respondents involved in this study have reported previous usage of antibiotics. This information is crucial in estimating the respondents' experience in handling and consumption of antibiotics. In general, respondents involved in this study showed a moderate to high awareness and knowledge regarding antibiotic use. Furthermore, it is pretty reassuring that most of these respondents have obtained their antibiotics from the

right sources with prescriptions and advice from their respective medical personnel. They were also aware that the antibiotics need to be taken as prescribed even though their symptoms have ceased, and they have felt better and not to share the antibiotics with others. These findings were also in concordance with the previous studies (15-19), indicating that Malaysians generally know the correct source to obtain their prescribed antibiotics and proper antibiotic consumption. This knowledge is essential in ensuring the public did not obtain their antibiotics without proper prescriptions. Taking the full course of the antibiotics as prescribed is crucial in preventing the spread of antibiotic resistance issues (23).

However, it is worth highlighting those major misunderstandings were observed among the respondents in this study, who thought antibiotics could treat conditions such as cold and flu, fever, and sore throat. These misunderstandings are also the worldwide common misunderstood conditions that could be treated by antibiotics, as reported by WHO (14). Similar confusion in identifying types of diseases that antibiotics could treat was also found in the baseline report of a recent local study (24). One of the reasons that contribute to this misunderstanding is the lack of knowledge among the public on the agents that causes the said health conditions. Thong et al. (24) observed a significant improvement of knowledge among respondents when interventions targeted on the education of bacterial-caused diseases versus viral infections were conducted. Therefore, interventions that focus on identifying diseases that antibiotics could treat should be emphasized in future antibiotic awareness campaigns. Some respondents also incorrectly thought that the same antibiotics they were previously prescribed could be purchased or requested from their doctors again when they have similar symptoms. This misunderstanding should be emphasized to educate the public that a thorough diagnosis and testing need to be conducted by medical professionals before choosing the correct type of antibiotics and course of administration needed by the patient to avoid mis-prescription of the antibiotics (25).

Our findings revealed that "Antibiotic resistance", "Drug resistance", and "Antibiotic resistance" are the terms that most respondents familiar with, similar to the findings from the WHO study (14). In the Malaysian context, this finding is probably due to the same terms used by the Malaysian Ministry of Health in their antibiotic resistance campaign and promotions via education delivered in the education institutions. However, the current finding contrasts with the findings by Hassali et al. (17), who has conducted a similar study on a different state in Malaysia. Based on that previous study, it was reported that respondents obtain the information regarding antibiotic resistance mostly from their friends and peers as opposed to the finding from the current

study, where respondents commonly obtain information on antibiotic resistance through educational institutions. Since most respondents in both studies were from the same age group, these differences between the common source of information may be due to the individual personal preferences in receiving and accepting the input regarding antibiotics. Socio-demographic might be a factor, too, as the basic concept of antibiotics is currently embedded in the Secondary School Standard Curriculum (Kurikulum Standard Sekolah Menengah) (26) for the Malaysian secondary school students who took the Science subject. Hence, multiple approaches in the promotion of antibiotic resistance awareness should be taken, such as emphasizing and enhancing the promotion activities through the educational institutions while at the same time electing public ambassadors to spread the awareness campaign among their peers.

Overall, respondents' level of awareness of antibiotic resistance were moderate. Items that the respondents incorrectly answered indicate misunderstandings and lack of knowledge, namely concerning how antibiotic resistance occurs and spread. One of the misunderstandings obtained from this study indicates that the respondent thought the body became resistant towards the antibiotics while in fact, the bacteria infecting them were the ones becoming resistant to the administered antibiotics. This also led to other misunderstandings where the respondents also thought that resistance could only occur to individuals who frequently take antibiotics and could not be spread to other people. Infection of antibiotic-resistant bacteria could occur to anybody regardless of their history of antibiotics consumption, and the infections can be transferred to another person, especially when proper hygiene is not in practice (27). It was also noted that there was also a lack of knowledge in antibiotic usage in food-producing animal among the respondents. Misuse of antibiotics in animal agriculture has been established as one of the contributing factors in the increase of resistant bacterial strains globally (28).

In this study, it was also found that the respondents seem to have contradicting beliefs. Although most respondents agree that antibiotic resistance is a crucial issue that needs to be addressed and everyone should take action, especially in using the antibiotics responsibly, they also felt that they are not sure if they can contribute in curbing this issue. Besides that, a high percentage of respondents believed they were not at risk of getting infected with resistant bacteria. Interventions should be strategized to increase awareness among the public that everyone is exposed to the risk of getting antibiotic-resistant bacterial infections. Hence, everyone, including the policymakers, medical professionals, livestock farmers, and the public, should address the issues. The public could take some actions by practising a high level of personal hygiene, which could help prevent them from getting any infections, practicing safe and hygienic food

handling, and using antibiotics only when needed and according to the specific prescription (27).

The level of education was found to influence the level of awareness of antibiotic resistance among the respondents, which is in accordance with the previous reports in Malaysia (15,18-19). However, it can be noted in our findings that the percentage of Bachelor's degree holders with a high level of awareness is lower than those with a moderate level of awareness. Besides, it is uncertain whether these respondents are from a science or non-science background; hence, it is impossible to pinpoint the exact factor contributing to this finding. It also further emphasizes our earlier suggestion that antibiotic resistance awareness should be targeted to educational institutions to strengthen the education on antibiotic usage and antibiotic resistance they received during their years of studies. The association between settlement area and level of awareness may be due to easy access to hospitals or clinics and medical advice, and high access to public transportation to the medical institutions among urban area residents. This also leads to better exposure to medical advice, especially knowledge regarding antibiotics among the urban residents as compared to the residents in other settlement categories (29). It is not surprising to note that level of income could also influence the level of awareness. With a higher level of income, they will be able to have higher education levels and access to better healthcare, which could help them gain more knowledge on antibiotic use and antibiotic resistance (30-31). A higher level of knowledge in antibiotic use would seem inevitable to cause an increase of awareness on antibiotic resistance. If a person was exposed to the knowledge of proper use of antibiotics and how the antibiotics kill the bacteria infecting them, it could help prevent misunderstandings and reduce antibiotic resistance issues.

A significant, moderate positive correlation between the level of awareness of antibiotic use and antibiotic resistance found in this study indicates that individuals who paid attention to the function and proper use of antibiotics will inevitably have increased their knowledge on antibiotic resistance either directly or indirectly. Certain common misunderstandings about antibiotic usage and antibiotic resistance among the respondents may have contributed to the moderate strength of this correlation. Better knowledge and understanding of the complication and misuse of antibiotics will increase the efficacy of the medication, thus reducing antibiotic resistance (32).

There are some limitations of this study that should be acknowledged. As the sampling technique employed in this study was the snowball sampling method, it might introduce some limitations in interpreting the findings from this study. Although this method allowed the authors to receive assistance from primary respondents

in recruiting more subjects, sampling bias might be introduced where the respondents involved might share the same characteristics, thus causing the samples' representativeness could not be guaranteed entirely (33). However, with the current vast use of various online social media platforms, the questionnaire was able to be distributed to bigger groups of the targeted population. The anonymousness of online questionnaire distributions also allowed minimization of subject hesitant, thus helping in attracting more respondents to participate in the study. It should also be highlighted that due to these limitations, the respondents in this study are mainly dominated by certain socio-demographic groups. The settlement categories were also based on the self-description of respondents based on the general description given in the questionnaire. Hence, the accuracy of this self-administered questionnaire's data depended on the understanding of the respondents. Thus, the findings from this study should be used with caution, especially in regards to its representativeness. Nonetheless, the obtained findings still serve beneficial reflection of awareness level in antibiotic usage and resistance, especially among the Malay youth population in Selangor.

CONCLUSION

In conclusion, the respondent's antibiotic usage and antibiotic resistance level of awareness, namely the Malay youth residents of Selangor, are moderate to high. However, it should be noted that there was still a high level of misunderstanding in diseases that is treatable with antibiotics among the respondents. In addition to that, most respondents were also not aware that antibiotic-resistant bacteria could be spread from one person to another. A significant, medium correlation ($r=0.42$, $p<0.05$) was found between the level of awareness in antibiotic usage and antibiotic resistance. It is vital to increase the awareness of antibiotic use and antibiotic resistance among the public. It can also be suggested that antibiotic awareness campaigns can be targeted to education institutions and using a peer ambassadors approach. Future studies on the awareness and perception on antibiotic resistance among youth and young adults in the tertiary institution could also help in determining the effectiveness of the campaigns conducted. By increasing the awareness and knowledge, it is hoped that public attitude towards the antibiotic resistance issue could be altered, leading to the change of their behaviour and contributing to reducing the emergence of resistant bacteria.

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