Research Article

Knowledge, attitude, and drug resistance preventive behaviors of high school students in Bangkok

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ABSTRACT

Background: In recent years, the problem of drug resistance has significantly increased especially resistance to antibiotics. However, many people are still unaware of the drug resistance problem and preventive behavior of drug resistance. This will lead to overuse and misuse of antimicrobials which are the major factors that cause drug resistance. Objectives: To assess knowledge, attitude, and preventive behavior of drug resistance of high school students and to study factors that affect drug resistance preventive behaviors. **Materials and Methods:** In July 2021, all grade 10–12 students from Suksanari School were invited to participate in completing an online questionnaire. A total of 322 students participated. Knowledge about drug resistance, attitudes toward drug resistance preventive behavior, and drug resistance preventive behaviors were assessed. Differences between outcomes and sociodemographics were analyzed through independent t-tests and the ANOVA. **Results:** Students revealed moderate knowledge about drug resistance, correctly answering 10.66 (standard deviation [SD] = 1.68) questions in a total of 15 and showed a good score of attitude toward drug resistance preventive behaviors (M = 41.72, S = 4.78). Students reported a moderate level of drug resistance preventive behavior, on average, 47.70 (SD = 5.99) of the 60 behaviors full scores. Grade 11 students presented higher levels of knowledge, more positive attitudes than other class levels. However, grade 12 students engaged in more preventive behaviors than other class levels. Attitude toward preventive behavior (Beta = 0.520, $P < 0.01$) and class level (Beta = 0.128, $P < 0.01$) predicted the adoption of those preventive behaviors. **Conclusion:** Participants showed a moderate level of drug resistance knowledge, good attitude toward preventive behavior, and moderate level of drug resistance preventive behaviors. Attitude toward drug resistance preventive behavior and class level were predictive factors for drug resistance preventive behavior adoption. From the study, it was recommended to promote the right attitude toward drug resistance preventive behaviors among this group of students to improve preventive behaviors.

KEY WORDS: Drug Resistance; Antibiotics; Preventive Behavior; Anti-drug Resistance

INTRODUCTION

Drug resistance is the reduction in the efficacy of medicine such as antimicrobial medicine that includes antibiotics, antivirals, antifungals, and antiparasitics to remedy a disease or condition.[1,2] Infections become drug-resistant when the microbes change themselves to defeat and no longer respond to the medicines that design to kill them.[3] These microbes are sometimes called "Superbugs." Drugs are necessary medical equipment that are used to prevent and treat infections, so without effective drugs, infections that were once easily treatable are becoming untreatable, or patients need to stay longer in hospital.[4] One of the most common types of drug resistance is antibiotics resistance, which occurs when bacteria become resistant to antibiotics, whereas antimicrobial resistance (AMC) occurs in bacteria, viruses, fungi, and parasites.[1,5] Multidrug resistance is AMC

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that resists among a species of microorganisms at least one antimicrobial in three or more antimicrobial categories.[6] It has many factors that cause drug resistance. For instance, drug resistance can be caused by patients not finishing the full prescription of antimicrobials. In some countries, regulation on antimicrobial use is poorly enforced or does not have this control at all, so it makes many patients misunderstand about using antimicrobial and they buy it or suggest other people to buy it without a prescription from the doctor, so it causes medication overuse.[1,7] Some people do not know that anti-inflammatory drugs are not antibiotics and some people use it in the common cold (i.e. viral infection).[8] In healthcare workers, many doctors and pharmacists still have some misconceptions about antibiotics that it can cure only diseases caused by bacteria and it leads to over-prescription of antibiotics. The CDC researchers have found that of the estimated 154 million prescriptions for antibiotics in the USA written in doctor's offices and emergency departments each year, 30% are unnecessary; that was approximately 50 million and this finding creates a benchmark for improving outpatient antibiotic prescribing and use. Furthermore, About 44% of outpatient antibiotic prescriptions are written to treat patients with acute respiratory conditions, such as sinus infections, middle ear infections, pharyngitis, viral upper respiratory infections (i.e., the common cold), bronchitis, bronchiolitis, asthma, allergies, influenza, and pneumonia. An estimated half of these outpatient prescriptions are unnecessary.[9] Moreover, antimicrobials are also used in animals. Many farmers add antimicrobial to animal feeds to treat and prevent infection. They can therefore carry antimicrobial-resistant with animals and can spread when we eat or have direct contact with them.[10,11] When we use animal manure as fertilizer in vegetables, antimicrobial-resistant bacteria that are contaminated with animal manure will spread to the humans when they eat those vegetables, and antimicrobials are also used to treat plant diseases such as citrus greening.[12] Drug resistance can spread from the patient to other people via direct contact with patients or patients' staff. People may receive drug-resistant pathogens from the hospital. Then, they come home and spread it to other people.[3,13] AMC causes approximately 700,000 deaths worldwide each year, and every country is potentially affected. If not properly controlled, the number could grow to 10 million per year by 2050. The highest impact is likely to be found in Asia and Africa, accounting for 4.7 and 4.2 million deaths and causing an economic impact of approximately 3500 trillion baht or 100 trillion USD.[14] Drug resistance can be prevented by learning the right ways to use antimicrobials, preparing food hygienically and choosing foods that have been produced without the use of antimicrobials, regularly washing hands to prevent infection, avoiding close contact with sick people, practicing safer sex, and keeping vaccinations up to date. Health professionals should only prescribe and dispense antimicrobials when they are needed, prevent infections by ensuring your hands, instruments, and environment are clean, give information to patients about how to take antimicrobials correctly, AMC, the dangers of misuse, and how to preventing infections. Farmers should only give antimicrobials to animals under veterinary supervision and should not use antimicrobials for growth promotion or to prevent diseases in healthy animals.[7,10]

The number of cases in Thailand is approximately 88,000 cases each year and 38,000 cases were fatal. It leads to longer hospital stays, a higher chance of death, and economic losses of more than 40 billion baht.[14] In Thailand, resistant gram-negative bacteria is a major problem in nosocomial infection, for example, infections with Acinetobacter spp. and Pseudomonas spp., are major causes of mortality in hospitals. In the community, the main causes are *Escherichia coli* (*E. coli*), Klebsiella spp., and *Neisseria gonorrhoeae* (*N. gonorrhoeae*). *E. coli*, Campylobacter spp., and Salmonella spp are major threats in livestock and food production. Nowadays, Thailand has the National Strategic Plan on AMC 2017-2021 (NSP-AMR) that has been planned since 2014. The Ministry of Public Health undertook a consultation with stakeholders in all concerned sectors to assess the national status of AMR management in 2014. The result is that Thailand lacked a specific policy on AMR and affected suboptimal coordination and unclear goals and objectives. In 2015, the Ministry of Public Health appointed a Coordinating and Integrating Committee on AMR. This strategic plan was completed in 2015 with the vision of reducing the morbidity, mortality, and economic burden caused by AMR. Its goals are that by the year 2021, morbidity caused by AMR will reduce by 50%; antimicrobial consumption in humans and animals will reduce by 20% and 30%, respectively; public knowledge on AMR and awareness on the appropriate use of antimicrobials will increase by 20%, and Capacity of the national AMR management system will be improved to level 4. To achieve this goal, the NSP-AMR has to be based on three principles and six strategies with strategies 1–5 aim at resolving different aspects of AMR in an integrated manner whereas strategy 6 aims at developing structures and mechanisms to implement NSP-AMR. The challenges of this strategic plan are that Thailand has a large number of databases that have specific purposes and complications and also has essential information that does not have national databases on it.[15] The Half-plan Progress of NSP-AMR has reported the results of the first survey about knowledge and the use of antimicrobials in 2017 on 27,729 people who have aged more than 15 years old. The result was 3% of Thai people have an accurate fundamental knowledge of AMR, while 22% have no background knowledge at all, and most Thai people (75%) do not have enough knowledge of AMR. In addition, hospitals are the most places that people can assess the use of antimicrobials and the second place in the pharmacy. It was found that knowledge about the use of antimicrobials in raising animals for food is quite limited and most people are unaware of the use of antimicrobials in animals that will become their food. Therefore, it leads to incorrect antimicrobial behavior and causes of drug resistance.[16]

Currently, Thai people do not have enough information about drug resistance and Thailand has an insufficient analysis of the risk or impact of widespread use of antimicrobials.[15] This study aimed to assess the knowledge about drug resistance, attitudes toward drug resistance preventive behavior, and drug resistance preventive behavior in high school students, and study factors that affect anti-drug resistance behavior, and promote the participant to have accurate anti-drug resistance behavior of using antimicrobials to help and resolve the problem.

MATERIALS AND METHODS

Participants and Procedure

This was a cross-sectional observational study. An online questionnaire was purposely developed and made available through Google From between July 14, 2021 and August 01, 2021. All Suksanari high school students were eligible and were invited to participate in the study. The invitation was sent to the school social media groups. The grade 10–12 students have access to the school social media groups, so they all receive an invitation. In this invitation, information about the objectives of the study as well as the ethical guarantee of confidentiality and anonymity in the data collected as stated in the informed consent were explained. Participation was completely free and voluntary, and no personal data was collected from any participant. Of the 1644 students, a total of 322 students participated in the study (response rate: 19.59%).

Instrument

The questionnaire was developed based on a literature review including (1) antimicrobial, antibiotics, drug resistance from WHO, CDC (2) studies performed on the same topic where several common items were used to assess each of the dimensions analyzed in this study. The proposed items were then grouped and redundant items were removed.

A preliminary version of the instrument was reviewed by three experts to validate its content. A pretest was then performed with a small sample of high school students to test for comprehension and difficulty. All the questions remained without modifications. The psychometric characteristics of the questionnaire were tested, as described in the statistical analysis subsection.

The final version of the questionnaire contained 42 questions; five about sociodemographic data (class level, study program, target faculty in college, parent occupation, and household income) and 37 items divided into three sections.

Knowledge about drug resistance

This scale consisted of 15 statements related to drug resistance; cause of drug resistance, drug resistance behavior, drug resistance transmission, current situation of drug resistance, correct antibiotics use, antibiotics use in livestock, antibiotics use in healthcare workers. The participants were asked to choose the correct answer from choices of two. One point was assigned to each correct answer while providing an incorrect answer received zero points. The sum of all items was made hence higher scores corresponded to a higher level of knowledge.

Attitude toward drug resistance preventive behavior

This scale was composed of 10 items, and response categories consisted of a five-point Likert scale (from 1-strongly disagree, to 5 agree) with the highest score corresponding to more positive attitudes toward drug resistance preventive behaviors. Some items on the scale were inverted for the analysis. A sum of all the items was made to obtain a score. The "Attitude toward preventive behavior" factor consisted of 10 items and varied from 10 to 50 and the higher values corresponded to a more positive attitude toward preventive behavior.

Drug resistance preventive behavior

This scale referred to the number of preventive behaviors adopted and included 12 items (antibiotics use, hygiene, hand washing, and personal protective equipment). The data analysis reports 12 items. Each item was answered using a five-point scale (From 1-Never to 5-Always), with one point assigned to each behavior that was always practiced. The number of behaviors practiced was added up. A high score on this scale indicated good preventive behaviors, ranging from 12 to 60.

Statistical Analysis

The analysis was performed using SPSS for Windows, version 26. To analyze psychometric characteristics of the scales, an exploratory factor analysis, using principal component analysis with varimax rotation, was carried out. Reliability was analyzed through the calculation of item-total correlation coefficients and Cronbach's alpha (α) for the scales of the questionnaire. The descriptive analyses were presented in absolute (n) and relative (%) frequencies, mean (M), and standard deviations (SD). To assess the differences between the outcome variables (Knowledge, attitudes, and drug resistance preventive behavior) and the sociodemographic characteristics, considering the sample size, independent t-test and the ANOVA were used as appropriate. The correlations between the outcomes of the study were calculated by Pearson's correlation. Finally, a generalized linear model was calculated to determine the predictive variables of the preventive behaviors. Exp (β) and the respective 95% confidence intervals (95% IC) were presented. Statistical significance was defined as $P < 0.05$.

Ethical Considerations

This research uses an anonymous data collection method to collect data from grade 10 to 12 Students of Suksanari School, Bangkok, Thailand, by using Google form. The invitation was sent to the school social media groups. In these invitations, information about the study's objectives and the ethical guarantee of confidentiality and anonymity in the data collected as stated in the informed consent was explained. Participation was completely free and voluntary, and no personal data was collected from any participant.

RESULTS

This study comprised a total of 322 students. The sociodemographic characteristics of the sample are presented in Table 1. Most participants were in grade 11 (n = 131, 40.7%) followed by grade 12 (n = 102, 31.7) and grade 10 (n = 89, 27.6%), respectively. 190 (59%) of the participants studied in the science program while the rest studied in the non-science program (n = 132, 41%). Most of the participants had a target faculty in college to go to the faculty of medicine (n = 124, 38.5%) followed by the other faculty (n = 63, 19.6%), faculty of art (n = 56, 17.4%), faculty of architecture and faculty of engineering (n = 47, 14.6%) and faculty of communication (n = 32, 9.9%) respectively. Most parent occupations of the participants were self-employed (n = 107, 33.2%) followed by company employees (104, 32.3%), freelance and other (n = 67, 20.8%), and government officer and healthcare worker (n = 44, 13.7%), respectively. Most participants had household income below 50,000 baht (n = 139, 43.2%) followed by 50,001–100,000 baht (n = 126, 39.1) and more than 100,000 baht (n = 57, 17.7%), respectively.

Regarding knowledge about drug resistance, participants revealed moderate knowledge about drug resistance, correctly answering the mean of 10.66 (SD = 1.68) questions in a total of 15. Participants that were in grade 11 showed the highest drug resistance knowledge score (M = 10.40, SD = 1.64). Participants who study in science programs showed higher drug resistance knowledge scores (M = 10.86, SD = 1.70) than participants who study in non-science programs (M = 10.37, SD = 1.60). Participants who had a target faculty in college to go to the faculty of medicine showed the highest drug resistance knowledge with a mean score of 11.03 (SD = 1.61). Participants whose parent occupations were government

Table 1: Differences in outcomes according to the sociodemographic characteristics of participants (n=322)

Sociodemographic characteristics	*n* (%)	Knowledge about drug resistance (Range 0–15) M (SD)	Attitude toward drug resistance preventive behavior (Range 10–50) M (SD)	Drug resistance Preventive behavior (Range 12–60) M (SD)
Class level				
Grade 10	89 (27.6)	10.40 (1.68)	40.55 (5.09)	45.69 (6.95)
Grade 11	131 (40.7)	11.02 (1.64)	42.37 (4.52)	48.40 (5.18)
Grade 12	102 (31.7)	10.42 (1.66)	41.91 (4.68)	48.57 (5.69)
Study program				
Science	190 (59)	10.86 (1.70)	42.08 (4.69)	48.25 (5.70)
Non-Science	132 (41)	10.37 (1.60)	41.20 (4.88)	46.91 (6.31)
Target faculty in college				
Faculty of medicine	124 (38.5)	11.03 (1.61)	42.52 (4.69)	49.02 (5.78)
Faculty of architecture/Faculty of engineering	47 (14.6)	10.51 (1.92)	41.85 (4.72)	47.19 (5.47)
Faculty of art	56 (17.4)	10.27 (1.59)	41.86 (4.79)	47.20 (6.14)
Faculty of communication	32 (9.9)	10.31 (1.47)	39.66 (5.45)	46.63 (6.07)
Other	63 (19.6)	10.57 (1.69)	40.98 (4.34)	46.48 (6.26)
Parent occupation				
Government officer/Healthcare worker	44 (13.7)	11.02 (1.52)	42.89 (4.62)	48.30 (6.29)
Company employee	104 (32.3)	10.66 (1.67)	41.59 (4.45)	47.35 (6.30)
Self-employed	107 (33.2)	10.46 (1.65)	41.72 (4.88)	47.85 (5.83)
Freelance/Other	67 (20.8)	10.75 (1.82)	41.16 (5.17)	47.63 (5.61)
Household income				
<50,000 baht	139 (43.2)	10.80 (1.62)	41.86 (4.69)	47.58 (5.63)
50,001–100,000 baht	126 (39.1)	10.59 (1.64)	41.75 (5.04)	47.79 (6.46)
>100,000 baht	57 (17.7)	10.49 (1.88)	41.30 (4.42)	47.82 (5.84)
Total	322 (100)	10.66 (1.68)	41.72 (4.78)	47.70 (5.99)

officer and healthcare worker had the highest drug resistance knowledge score (M = 11.02, SD = 1.52). For the household income group, participants who earn less than 50,000 baht had the highest drug resistance knowledge score (M = 10.80, SD = 1.62).

Participants showed a good level of attitude toward drug resistance preventive behavior with the average score of 41.72 (SD = 4.78) from 50 full scores. Participants that were in grade 11 had the highest score of attitude toward drug resistance preventive behavior (M = 42.37, SD = 4.52). Participants who study in science programs showed higher scores of attitude toward drug resistance preventive behavior (M = 42.08, SD = 4.69) than participants who study in non-science programs (M = 41.20, SD = 4.88). Participants who had a target faculty in college to go to the faculty of medicine showed the highest attitude toward drug resistance preventive behavior score (M = 42.52, SD = 4.69). Government officers and healthcare workers that were parent occupations of the participants showed the highest attitude toward drug resistance preventive behavior with a mean score of 42.89 (SD = 4.62). Participants who had household income less than 50,000 baht showed the highest score of attitude toward drug resistance preventive behavior (M = 41.86, SD = 4.69).

Participants revealed a moderate level of drug resistance preventive behavior with a mean score of 47.70 (SD = 5.99) out of 60. Participants that were in grade 12 showed the highest score of drug resistance preventive behavior (M = 48.57, SD = 5.69). Participants who study in science programs showed higher drug resistance preventive behavior scores (M = 48.25, SD = 5.70) than participants who study in non-science programs (M = 46.91, SD = 6.31). For target faculty in college, the highest score of drug resistance preventive behavior was shown by participants that aimed to go to the faculty of medicine (M = 49.02, SD = 5.78). Participants whose parent occupations were government officers and healthcare workers showed the highest drug resistance preventive behavior score of 48.30 (SD = 6.29). Participants that had household income more than 100,000 baht had the highest score of drug resistance preventive behavior (M = 47.82, SD = 5.84).

The analysis of the correlations between the outcomes of the study-knowledge, attitudes, and preventive behavior -revealed the existence of positive and statistically significant correlation between the attitudes toward drug resistance preventive behavior (r = 0.549**, $P < 0.01$), the drug resistance preventive behaviors and knowledge about drug resistance (r = 0.132*, $P < 0.05$) [Table 2].

Results from the generalized linear model indicated that the attitude toward drug resistance preventive behavior (Beta = 0.520, $P < 0.01$), class level (Beta = 0.128, $P < 0.01$) had a statistically significant effect on the drug resistance preventive behavior adoption [Table 3].

DISCUSSION

The result from this study showed that high school students of Suksanari school, Bangkok, Thailand Students revealed moderate knowledge about drug resistance, correctly answering 10.66 (SD = 1.68) questions in a total of 15 and showed a good score of attitude toward drug resistance preventive behaviors (M = 41.72, SD = 4.78). Students reported a moderate level of drug resistance preventive behavior, on average, 47.70 (SD = 5.99) of the 60 behaviors

Table 2: Pearson's correlation coefficient between the study outcomes

Variables	Knowledge about drug resistance	Attitude toward drug resistance preventive behavior	Drug resistance preventive behavior
Knowledge about drug resistance	1		
Attitude toward drug resistance preventive behavior	0.153**	1	
Drug resistance preventive Behavior	0.132*	0.549**	1

**Correlation is Significant at the 0.01. *Correlation is Significant at the 0.05

Table 3: Generalized linear model predicting preventive behaviors of drug resistance

Variables	B	SE	EXP (β)	Sig	95% CI	
					Lower	Upper
Class level	0.991	0.377	0.128	0.009	0.250	1.732
Study program	0.165	0.704	0.014	0.815	−1.220	1.549
Target Faculty in College	−0.349	0.221	−0.090	0.115	−0.784	0.086
Parent occupation	0.145	0.294	0.023	0.622	−0.433	0.723
Household income	0.467	0.379	0.058	0.219	−0.279	1.213
Knowledge about drug resistance	0.174	0.169	0.049	0.302	−0.158	0.507
Attitude toward drug resistance preventive behavior	0.652	0.060	0.520	0.000	0.534	0.769

full scores. Grade 11 students presented higher levels of knowledge, more positive attitudes than other class levels. However, grade 12 students engaged in more preventive behaviors than other class levels. The students studied in the science program, the participants that targeted faculty in college to go to the faculty of medicine, and the participants that had parents work as healthcare workers and government officers occupied the highest score in knowledge, attitude, and drug resistance preventive behavior. For household income, the participants that had household income lower than 50,000 baht had the highest scores in knowledge about drug resistance and attitude toward drug resistance preventive behavior. Nevertheless, the highest scores of preventive behavior was occupied by the participants that had household income more than 100,000 baht. The correlations' analysis revealed positive and statistically significant correlation between the attitudes toward drug resistance preventive behavior (r = 0.549**, $P < 0.01$), the drug resistance preventive behaviors, and knowledge about drug resistance (r = 0.132*, $P < 0.05$). Attitude toward preventive behavior (Beta = 0.520, $P < 0.01$) and class level (Beta = 0.128, $P < 0.01$) predicted the adoption of those preventive behaviors.

The fact that participants had a moderate score of knowledge about drug resistance was probably because they did not gain enough specific knowledge about drug resistance compared with research of Suttini Wattanakul which studied rational drug use literacy of village health volunteers. The result showed that after participants had been educated the mean level of rational drug use literacy among health volunteers increased significantly at 0.05 level.[17] The participants that studied in the science program revealed higher scores than the people that studied in the non-science program which corresponds to the basic knowledge and subject matter of the study because there are many questions that require basic knowledge of health science compared with research studying knowledge and awareness on rational use of antibiotics among first-year students of Mahidol University in the academic year 2011 found that students studied in health science revealed significantly higher mean score than student studying in other major subject.[18] The analysis of the correlations revealed positive and statistically significant correlation between knowledge about drug resistance and drug resistance preventive behaviors which was inconsistent with the research studying knowledge, believing, and behavior of village health volunteers at Tha Hat Yao, Phon Sai, Roi Et that the result showed that knowledge about antibiotics did not have correlation with behavior of antibiotics use.[19] However, it was consistent with the research studying antibiotics use behavior of patients in Srangsoke, Ban Mo District, Saraburi Province which the result showed that knowledge had a positive relationship with antibiotic usage behaviors (r = 0.215, $P < 0.05$).[20] Participants showed a good score of attitude toward preventive behavior and found that attitude toward drug resistance preventive behavior had a statistically significant effect on the drug resistance preventive behavior consistent with principles of preventive health behavior that some preventive health-related behaviors occur for reasons unrelated to health, for example,cultural traditions, attitudes, and beliefs can play an important role in the ways in which people behave.[21] compared with research studying factors related to the practice of antibiotic use for common cold in children among parents in Bangkok. This study found that the parent's attitudes toward antibiotics smart use in children was at moderate level and attitudes toward antibiotics smart use in children had high correlation with the intention to antibiotic usage in children with the correlation coefficient -0.759 ($P < 0.001$).[22]

The strength of this study was that the participants comprised a cross-section of the study's population and the data of this study could be very exact, consistent, and trustworthy. The study's limitation was that the survey was conducted during the COVID-19 pandemic and had to collect data from an online form. It, therefore, limited only participants that can use the Internet to access this survey and participants may search the internet for answers.

CONCLUSIONS

A total of 322 students participated in the study, most participants showed a moderate level of drug resistance knowledge (M=10.66, SD = 1.68). Regarding attitude toward drug resistance preventive behavior, most participants revealed a good level with the average score of 41.72 (SD = 4.78). Most participants showed a moderate level of drug resistance preventive behavior with a mean score of 47.70 (SD = 5.99). There were positive correlation between attitude toward drug resistance preventive behavior (r = 0.549**, $P < 0.01$), knowledge about drug resistance (r = 0.132*, $P < 0.05$) and drug resistance preventive behavior. Attitude toward drug resistance preventive behavior (Beta = 0.520, $P < 0.01$) and class level (Beta = 0.128, $P < 0.01$) were predictive factors for drug resistance preventive behavior adoption.

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