

ORIGINAL ARTICLE

The Effect of Antimicrobial Resistance (AMR) Educational Module on Knowledge and Attitude Among Primary School Students in Kota Belud, Sabah, Malaysia

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ABSTRACT

Introduction: Antimicrobial resistance (AMR) is a burgeoning problem worldwide. The trend of AMR has increased over the past decade. Health education and interventions with the goal of raising awareness and knowledge about AMR should be conducted to create a community that uses antimicrobial prudently and to slowdown the spread of resistance. **Methods:** This study used a quasi-experimental research design with pre-test and post-test. Primary school students (standard 4-6) in Kota Belud, Sabah were divided into control and intervention group. Paired t-test was used to compare knowledge and attitude level between pre-test and post-test scores in each group. Independent sample t-test was used to compare two groups and to assess the effect of the AMR Module. **Results:** After AMR education, the intervention group showed a significant increase in knowledge level from the pre-test (mean=17.48, SD=3.73) to post-test (mean=21.71, SD=4.50) compared to control group's pre-test (mean=13.76, SD=5.66) to post-test (mean=14.33, SD=4.75). Significant increase in attitude level was also reported from the pre-test (mean=27.90, SD=5.25) to post-test (mean=32.13, SD=5.16) compared to control group's pre-test (mean=27.73, SD=5.31) to post-test (mean=27.75, SD=4.19). A significant difference was also recorded in the intervention and control group's knowledge level ($p<0.001$) and attitude level ($p<0.001$) in pre-test and post-test respectively. **Conclusion:** Improvements in primary school students' knowledge and attitude on AMR demonstrate that AMR Module was an effective tool for teaching AMR topic. Adopting AMR education interventions as part of public health school intervention can build positive knowledge and attitudes on AMR among primary school students.

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INTRODUCTION

Antimicrobial Resistance (AMR) is one of the greatest threats to human health globally that contributed to an estimated 1.27 million death in 2019 (1). Antimicrobials are widely used not only in human medicine, veterinary and agricultural practices (2). AMR happens when microbes such as bacteria, viruses, fungi and parasites are no longer responding to the antimicrobial designed to kill them causing the antimicrobial to become ineffective to the microbes (1).

The increasing rate of AMR is fuelled by excessive and inappropriate use of antimicrobials (3). Other factors increasing AMR include overpopulation and excessive self-purchasing of antibiotics without a prescription for self-limiting conditions including upper respiratory tract infections, traveling, water pollution and a lack of hygiene and water sanitation (4). In general, the emergence of AMR affects aspects such as the healthcare system, public health, food security, and economy with the major impacts include higher medical costs, prolonged hospital stays, and increased mortality (5).

The World Health Organization (WHO) has been at the forefront of global AMR education initiatives. WHO launched the Global Action Plan on Antimicrobial

Resistance in 2015 with the aims was to improve awareness, knowledge and understanding of AMR through effective education, training and communication (6). Apart from that, WHO had initiated World AMR Awareness Week (WAAW) to raise awareness on AMR and encourage best practices among the public, health workers and policymakers (7).

Malaysia developed the Malaysian Action Plan on AMR (MyAP-AMR) which was the national action plan that outlined a variety of strategies to combat AMR by enhancing infection prevention and control measures, encouraging responsible use of antibiotics in the veterinary and healthcare sectors, and strengthening surveillance systems to monitor antibiotic resistance and usage (8). The Ministry of Health Malaysia (MOH) and Ministry of Education (MOE) Malaysia have been working together to incorporate AMR education into the primary and secondary school curriculum to enhance understanding and awareness (9).

The overall knowledge and attitude on AMR show varied results across countries, necessitating public health intervention programs to be implemented on the use of antimicrobials (10). The creation of targeted educational resources is essential to address inadequate educational resources on AMR (11). These materials can give students the fundamental knowledge they need to comprehend AMR and its consequences (12). Targeted education also emphasizes interactive and practical learning methods, such as game-based learning and visual aids have been shown to enhance critical thinking and reinforce retention among primary school students (13, 14).

Students with better education have the potential to be change agents, educating their friends and family (15). Health education and interventions for AMR should be conducted through physicians, mass media, and community approaches where the contents should include the basic concepts of antimicrobials, the appropriate use and the impact of misuse (16). Schools and universities are integrating AMR education into their curricula, ensuring that future healthcare providers are well-informed about antimicrobial resistance (7).

In accordance with the MyAP-AMR, a comprehensive educational and awareness plans are recommended actions that are able to increase knowledge on AMR among students (10). Therefore, educating about the threats of AMR is an important step in controlling the emergence of AMR. As there is a wide cross-national

difference in the antimicrobial usage as well as knowledge level regarding AMR, it is crucial to regularly assess knowledge, attitude and practices concerning AMR to tailor intervention strategies to tackle this issue (17).

MATERIALS AND METHODS

Study Design and Location

A quasi-experimental research approach which uses a pre-test and post-test questionnaire with control and intervention groups was conducted at four primary schools in Kota Belud, Sabah, Malaysia.

Study Population and Sampling Method

The study population consisted of standard four to six school children from four selected primary schools in Kota Belud district, Sabah. A cluster sampling was used to select four schools in Kota Belud. From 57 primary schools in Kota Belud listed, four schools were randomly selected. Of the four schools, the first and third school were assigned as the control group (Sekolah Kebangsaan Taun Gusi and Sekolah Kebangsaan Tamu Darat) and the second and forth school were used as an intervention group (Sekolah Kebangsaan Pekan and Sekolah Kebangsaan Piasau). A simple random sampling was used to select the students. A list of students was obtained from the four selected schools. From the list, we draw a random sample to choose the students. Students were gathered at the same time to complete the questionnaire given.

Sample Size Calculation

The sample size was calculated using the two independent mean formula. The expected mean knowledge score of the intervention group was 0.53, whereas the expected level of knowledge of the control group was 0.13 (18). With a test power of 90% and a significance level at 5%, the required minimal sample for this study is 240. Correction for drop out was set at 10% such that a sample size of approximately 260 was considered appropriate (19).

Study Flowchart

Students were divided into control and intervention group and were given pre-test questionnaire. Students in intervention group received AMR Module by using peer-led approach where the peer-led was trained prior to the intervention session. A post-test questionnaire was given after two weeks of intervention study. The flow of the study is shown in Figure 1.

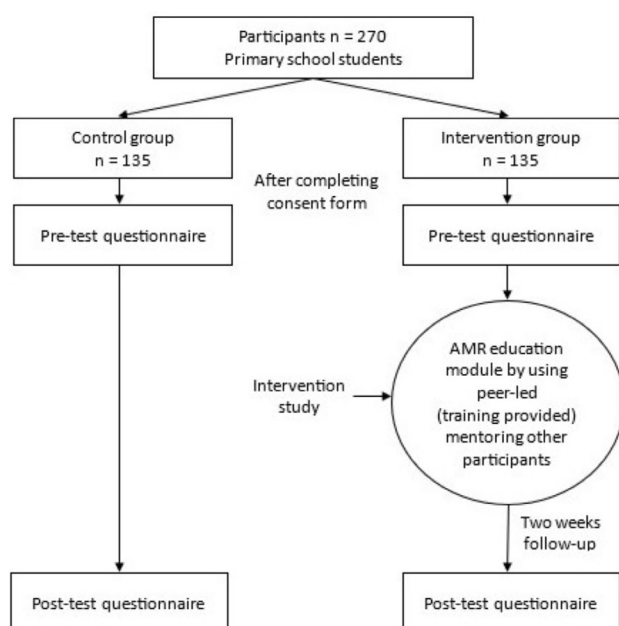


Figure 1: Study flowchart to assess the knowledge and attitude on AMR in control and intervention group

Study Instruments

a) Questionnaire

A self-administered questionnaire was used to collect the data. This research used a close-ended questionnaire, adapted and modified from previous studies (20, 21). The questionnaire was translated into Bahasa Melayu. The questionnaire comprised three sections: sociodemographic information, knowledge of AMR and attitude towards AMR. A pilot study was conducted among 50 primary school students. The reliability for knowledge section was 0.71 and attitude section was 0.74. The results demonstrated that the questionnaire was reliable.

b) AMR Module

A total of 20 students in the intervention group were chosen as peer-led where each of them mentoring 10 students. The peer-led mentors underwent two days training program by research team prior to mentoring their group of 10 students. The intervention study was held for two days, during which students in the intervention group received the full programme of AMR Module including game-based learning, group discussion, group activity and role play, whereas the control group did not receive any intervention. The main assessments were conducted both before and after the intervention session to both groups.

Data Collection Methods

The questionnaire was distributed via self-administered. Participants were given a hardcopy questionnaire. Participants were briefed and informed on the purpose of this study, and all their information and answers will be treated with the strictest confidentiality and used for this study purpose only. The questionnaire took approximately 15 minutes to complete. The completed questionnaire was collected by the investigator as soon as participants had completed the questionnaire.

Data Analysis

All data collected were analysed by using Statistical Package for Social Sciences (SPSS) software version 29.0 for Windows. Descriptive statistic was conducted to analyse the distribution of categorical variables such as demographic data, knowledge and attitude on AMR among control and intervention groups. Paired t-test was used to compare knowledge and attitude level between pre-test and post-test scores in each group. Independent t-test was used to compare difference in knowledge and attitude level on AMR in control and intervention groups. A value of $p < 0.05$ was considered statistically significant.

ETHICAL CLEARANCE

This study was ethically approved by Universiti Malaysia Sabah Research Ethics Committee (Ref No: UMS/FPSK6.9/100-6-1-95) and Jabatan Pendidikan Negeri Sabah (JPNS) (Ref No: JPNSBH.SPS.600-11/2/1 Jld.20(18)).

RESULTS

Demographic Characteristics

The sociodemographic data of the respondents were summarized in a table according to their gender, age, standard, ethnicity and religion. Female respondents dominated this study ($n=152$) compared to male respondents, where most of the students were in standard 5. Respondents represented various ethnicities; most were Bajau ($n=127$), followed by Kadazandusun, Malay and other ethnicities including Irianun, Murut, Bajau, Suluk and Chinese. In addition, most of the respondents were Muslim ($n=182$). The demographic characteristics and distribution of students in the control group and intervention group are shown in Table I.

Table I: Sociodemographic characteristics for all students in control and intervention groups (n=270)

Characteristics	Total n (%)	Intervention group n (%)	Mean (SD)	Control group n (%)	Mean (SD)
Gender					
Male	118 (43.7)	54 (40.0)		64 (47.4)	
Female	152 (56.3)	81 (60.0)		71 (52.6)	
Age (years)			10.94 (0.78)		11.14 (0.81)
Standard					
4	81 (30.0)	45 (33.3)		36 (26.7)	
5	97 (35.9)	53 (39.3)		44 (32.6)	
6	92 (34.1)	37 (27.4)		55 (40.7)	
Ethnicity					
Kadazandusun	109 (40.4)	40 (29.6)		69 (51.1)	
Bajau	127 (47.0)	76 (56.3)		51 (37.8)	
Malay	20 (7.4)	15 (11.1)		5 (3.7)	
Others	14 (5.2)	4 (3.0)		10 (7.4)	
Religion					
Muslim	182 (67.4)	105 (77.8)		77 (57.0)	
Non-Muslim	88 (32.6)	30 (22.2)		58 (43.0)	

*Abbreviation: SD, standard deviation

Knowledge on AMR

The intervention group showed a significant increase in knowledge level from the pre-test (mean=17.48, SD=3.73) to post-test (mean=21.71, SD=4.50) compared to control group's pre-test (mean=13.76, SD=5.66) to post-test (mean=14.33, SD=4.75). A significant difference was found between the knowledge level of the intervention group ($p<0.001$) compared to the control group ($p=0.157$) (Table II).

Table II: Result for the comparison of pre-test and post-test knowledge level on AMR in intervention and control group

Group	Pre-test Mean (SD)	Post-test Mean (SD)	p-value ^a
Intervention (n = 135)	17.48 ± 3.73	21.71 ± 4.50	< 0.001 *
Control (n = 135)	13.76 ± 5.66	14.33 ± 4.75	0.157

^ap-value by using paired-t test, * $p < 0.05$

Abbreviation: SD, standard deviation

The result also presented that there were significant differences in the intervention and control group's knowledge level in pre-test and post-test ($p<0.001$) with the mean value is higher in intervention group compared to the control group (Table III).

Table III: Result for difference of knowledge level on AMR in intervention and control group

Group	Difference in knowledge level on post-test and pre-test Mean (SD)	p-value ^a
Intervention (n = 135)	4.23 ± 5.14	< 0.001 *
Control (n = 135)	0.58 ± 4.72	

^ap-value by using independent sample t test, * $p < 0.05$
Abbreviation: SD, standard deviation

Attitude on AMR

The intervention group showed a significant increase in attitude level from the pre-test (mean=27.90, SD=5.25) to post-test (mean=32.13, SD=5.16) compared to control group's pre-test (mean=27.73, SD=5.31) to post-test (mean=27.75, SD=4.19). A significant difference was found between the attitude level of the intervention group ($p<0.001$) compared to the control group ($p=0.955$) (Table IV).

Table IV: Result for the comparison of pre-test and post-test attitude level on AMR in intervention and control group

Group	Pre-test	Post-test	<i>p</i> -value ^a
	Mean (SD)	Mean (SD)	
Intervention (n = 135)	27.90 ± 5.25	32.13 ± 5.16	< 0.001 *
Control (n = 135)	27.73 ± 5.31	27.75 ± 4.19	0.955

^a *p*-value by using paired-t test, * $p < 0.05$

Abbreviation: SD, standard deviation

In addition, there were significant differences in the intervention and control group's attitude level in pre-test and post-test ($p<0.001$). It is demonstrated that the mean value is higher in intervention group compared to the control group (Table V).

Table V: Result for difference of attitude level on AMR in intervention and control group

Group	Difference in attitude level on post-test and pre-test	<i>p</i> -value ^a
	Mean (SD)	
Intervention (n = 135)	4.23 ± 5.70	< 0.001 *
Control (n = 135)	0.02 ± 4.57	

^a *p*-value by using independent sample t test, * $p < 0.05$

Abbreviation: SD, standard deviation

DISCUSSION

The aim of this study was to investigate the effect of AMR Module on knowledge and attitude on AMR among primary school students in Kota Belud, Sabah. The AMR education was delivered using trained interpersonal communication alongside interactive, playful education methods, which had been adapted to the local cultural context based on formative research.

The improvement in post-test scores confirms the effectiveness of targeted AMR education, suggesting that the intervention had a positive impact the participants' understanding of AMR. The results obtained were similar to local study conducted in Perak and Negeri Sembilan and international study in India and Egypt (22-25). Study in Perak did two weeks follow-up post-intervention and discovered that the knowledge was maintained (22). This suggests that a long-term approach for increasing knowledge about AMR could be educational intervention. Studies revealed that knowledge and attitude level significantly improved after the educational

intervention, demonstrating how effective educational interventions in raising understanding and awareness of AMR (22).

In the present study, the educational intervention with targeted education plays a crucial role in improving both knowledge and attitudes on AMR among students. By tailoring educational modules specifically to the needs and realities of primary school students, the effectiveness of AMR education was significantly enhanced (23). This approach takes into account age-appropriate language, cultural relevance and the local socio-economic context, ensuring the material resonates and can significantly impact students' understanding and attitudes towards education given (26).

In rural settings, where communities may have limited access to healthcare services, the risks of improper antibiotic use such as self-medication or misunderstanding the need for prescriptions are often higher, which highlights the need for educational interventions (27). By introducing information in a relevant way, these educational modules address specific misconceptions and foster a deeper understanding of AMR issues, thereby contributing to meaningful behavioural change (28). The module's game-based elements enhanced engagement and retention among students, while its interactive approaches promoted social and collaborative skills by encouraging students to work together and communicate about topics learned (29).

The intervention group's significantly increased understanding and awareness of AMR was probably facilitated by the focused educational techniques that were employed. According to both local and international research, targeted educational initiatives have proven quite successful in raising awareness of antimicrobial and AMR (18, 22). Conversely, the control group, which was not given the AMR Module, did not demonstrate significant increase in knowledge and attitude, supporting the idea that meaningful knowledge development cannot be produced in the absence of exposure to AMR education.

The findings show that comprehensive, interactive and well-structured modules were required to establish and sustain positive attitudes and understanding toward AMR. This highlights the necessity of continuous support and monitoring to ensure that these knowledge and attitudes able to be converted into effective and responsible actions in the battle against AMR (30).

Study strengths, limitations and recommendations

The strength of this study was the development of the AMR Module was specifically tailored for primary school students which underwent rigorous validation process. In addition, our findings support WHO and MyAP-AMR goals promoting AMR awareness through education.

Despite its strength, this study had a few limitations. The short duration of the study, which focused mostly on measuring changes in knowledge and attitude level in a short period of time after the intervention was one of the limitations. It would be beneficial for future research to undertake follow-up evaluations months or years following the intervention to see if the changes in attitude and knowledge have a lasting impact on students' antimicrobial use practices. Furthermore, the reliance on self-reporting data to measure changes in students' attitude may be disadvantage because it is susceptible to social desirability bias. Future studies could include objective measure of behaviour change such as monitoring the real usage of antimicrobials, with the contribution of parents or caretakers.

CONCLUSION

The AMR Module has shown to be a useful tool for increasing the intervention group's primary school students' understanding of AMR. Integrating educational interventions in primary schools has helped improve students' knowledge and attitude towards antimicrobial use and AMR has managed to help increase the percentage of students with good attitude and knowledge on AMR. This study argues in favour of these courses being used more widely in educational settings, particularly in rural areas where there is a lack of awareness about AMR.

Interventions such as the AMR Module, which focus on interactive and context-specific instructional strategies, can be very effective in preventing the misuse of antimicrobials and ultimately, in addressing the worldwide problem of AMR.

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