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The Effectiveness of Rabies Hunter Game Application on Dog Bite Prevention Among School-Aged Children in Southern Region of Sarawak, Malaysia

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Abstract

Educational intervention is beneficial in preventing future dog bite. Most dog bite cases involved children aged below 15 years old. In view of most children in this technology era play computer, web, portable or console games using computers, cell phones or handheld organizers, we developed Rabies Hunter mobile game application as a novel educational intervention to prevent dog bite among children. *Aims and Objectives:* This study aimed to assess the effectiveness of Rabies Hunter game application on safety knowledge on dog's behaviour, perceived vulnerability towards dog, precautionary behaviour around dog and help-seeking behaviour following dog bite. *Methodology:* A quasi-experimental study was conducted with control group (N = 188) and intervention group (N = 222). Questionnaires were administered to respondents during three different sessions. *Results and Findings:* Safety knowledge on dog's behaviour was more significantly improved in intervention [$F(2,442) = 30.66$, $p < 0.001$] than control [$F(1.91,357.47) = 5.14$, $p = 0.007$] groups. Perception on vulnerability towards dog in control and intervention groups improved significantly with $F(1.88,352.40) = 9.26$, $p <$

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0.001 and F(1.83,404.54) = 146.57, $p < 0.001$ respectively. Significant difference in precautionary behaviour around dog was higher in control [F(1.93,361.30) = 5.47, $p = 0.005$] than intervention group [F(2,442) = 3.86, $p = 0.022$]. Changes in help-seeking behaviour following dog bite was only observed in intervention group [F(1.95,429.91) = 5.10, $p = 0.007$]. Significant difference between groups after final post-intervention was observed in perception on vulnerability towards dog [t(355.56) = (-4.47), $p < 0.001$] only. Thus, exposure to Rabies Hunter game application is potentially effective in preventing dog bite incidence.

Keywords: *Dog bite prevention, Safety knowledge, Perceived vulnerability, Precautionary behaviour, Help-seeking behaviour*

INTRODUCTION

Sarawak, Malaysia is in the midst of rabies outbreak and had resulted in 24 cases with 23 mortalities from July 2017 until 18th July 2020 (Jawatankuasa Pengurusan Bencana Negeri Sarawak, 2020). The origin source of rabies outbreak in Sarawak is suspected to come from neighbouring West Kalimantan in Indonesia through dogs that freely moving across the border between both countries (Navanithakumar et al., 2019). Geographically, Sarawak, the largest state in Malaysia (Sarawak Government, 2017), has a distinct border with the state of Sabah, Brunei and Kalimantan in Indonesia.

Dog bite is associated with high morbidity and mortality including physical injuries (Chhabra et al., 2015), mental and emotional injuries (Dolman, 2015) and infection particularly rabies (World Health Organization, 2017). It remains major public health (Ogundare et al., 2017) and clinical problem worldwide and occurs in all continents except Antarctica (World Health Organization, 2017). Children are the most common dog bite victims (Abubakar and Bakari, 2012) especially male children aged below 15 years old (Ghosh et al., 2016). The majority of dog bite incidence among young children involved family pet dog that is familiar to them (Reisner et al., 2011; Davis et al., 2012) as compared to stray and unfamiliar dogs (Seligsohn, 2014).

Regrettably, most children have lower awareness and substandard knowledge in safe behaviour around dogs (Jakasania et al., 2017; Chlopčíková and Mojžíšová, 2010) and perceived their pet dog as not harmful and will not bite them (Shen et al., 2013). This may lead them to be more impulsive in communicating with dogs (Resiner (2016) especially the familiar ones such as playing, yelling, grabbing and having eye contact with the dogs (Venkatesan et al., 2017). Furthermore, the majority of dog bite victims are aware that asymptomatic rabies is a 100% vaccine-preventable disease but they tend to do not seek treatment (Shah et al., 2012). This is further worsened by poor access to appropriate post-exposure prophylaxis treatment as well as inadequate availability of the medical resource for dog bite cases which might also be inferior and expensive or does not exist in certain locality that contributed to the high number of mortality rate (Zaidi et al., 2013).

Therefore, the World Health Organization (WHO) had emphasized the importance of educational intervention, public awareness and access to mass vaccination of dogs besides community participation and access to post-bite treatment. These were delineated as the main components in the three pillars of a successful rabies control programme (World Health Organisation, 2017). Children should be competently educated on dog's behaviour (Asghar et al. (2017) and safe behaviour around dogs (Dwyer et al., 2007) in order to prevent future dog bite among them besides animal control, environmental modifications and optimizing adult supervision (Schwebel et al., 2016). Wu e al. (2016) also stated that educational intervention is beneficial for improving knowledge, attitude and practice on rabies among people. However, this intervention should cover wider scope that encompasses awareness of dog's behaviour to prevent dog bite as well as appropriate response and good help-seeking behaviour following dog bite.

There are many types of educational intervention for dog bite prevention among children such as testimonial-based intervention (Shen et al., 2016), interactive website using special software that was adopted into a program named The Blue Dog (Schwebel et al., 2016) and Short Message Service (SMS) (Wu et al., 2016) besides conventional method and techniques such as classroom-based instruction with live dogs and video-based training in laboratories, classrooms, and hospital settings (Shen et al., 2017). There were also a few programs with the same intention had been initiated by some parties such as BARK (Be Aware, Responsible, and Kind) Dog Bite Prevention Program (Schwebel et al., 2015), Delta DogSafe program (Lakestani and Donaldson, 2015) and Prevent-A-Bite (Chapman et al., 2000). Although some studies had shown a short term effect of the educational intervention on the behaviour of school children towards dogs, many other studies had found that the benefit outweighed the disadvantage.

Nevertheless, the importance of educational intervention should not be belittled (Lakestani and Donaldson, 2015) and yet it should be continuously upheld as a noteworthy and friendly approach particularly for the children. Furthermore, a study by Dixon et al. (2012) had discovered that merely less than one-third of children who received formal dog bite prevention education have poor awareness and knowledge on dog bite prevention as well as their awareness towards management of dog bite cases and appropriate help-seeking behaviour. Thus, this study developed Rabies Hunter mobile game application as a novel educational intervention to prevent dog bite among children. This is based on the fact that computer, web, portable or console games are played by 97% of teenagers aged 12 to 17 years old with 48% of them play games using cell phones or handheld organizers (Lenhart et al., 2008).

The objective of this study is to assess the effectiveness of Rabies Hunter game application towards safety knowledge on dog's behaviour, perceived vulnerability towards dog, precautionary behaviour around dog and help-seeking behaviour following dog bite among school-aged children.

MATERIALS AND METHODS

Study design and sampling procedure

This was a non-randomised quasi-experimental study involving two schools (one school from Serian and one school from Bau, Kuching were assigned for control and intervention group respectively) that were selected by using two-stage cluster sampling. These schools were selected because they are located within the declared rabies outbreak area (Jawatankuasa Pengurusan Bencana Negeri Sarawak, 2017). The calculated total sample size was 209 samples. However, the number of respondents who participated in this study was 188 and 222 from control and intervention groups.

Development of Rabies Hunter Game Application

This innovative educational intervention is a competitive game that was developed by researchers. Its content was designed based on Octalysis-Gamification Framework (Chou, 2017) and using the One Health approach by considering input from experts namely public health physician, preventive scientist, veterinarian as well as social science and humanities expert. Focus Group Discussion involving five boys and four girls aged between 13 to 14 years old was conducted to assess the needs and refine the game content by identifying the children preferences on the type of game application. The participants were provided with mobile tablets to allow them to play different types of game and later commented on all the games. This is crucial to ensure that the to-be-developed game application is useful and able to capture the interest of children and subsequently contribute towards the effectiveness of its use to achieve the objective of this study.

This interactive 3-dimensional (3D) game application contains values of safety knowledge in recognizing dog's behaviour, perceived vulnerability towards dog, precautionary behaviour around dog and help-seeking behaviour following dog bite. The development process took about nine months to be completely developed before being tested and assessed for its compatibility and usability involving seven children aged 11 to 14 years old. The copyright was obtained from Intellectual Property Corporation of Malaysia (MyIPO).

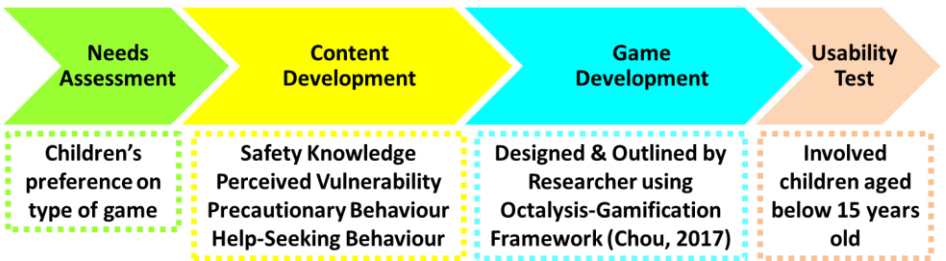


Figure1 Development of Rabies Hunter Game Application

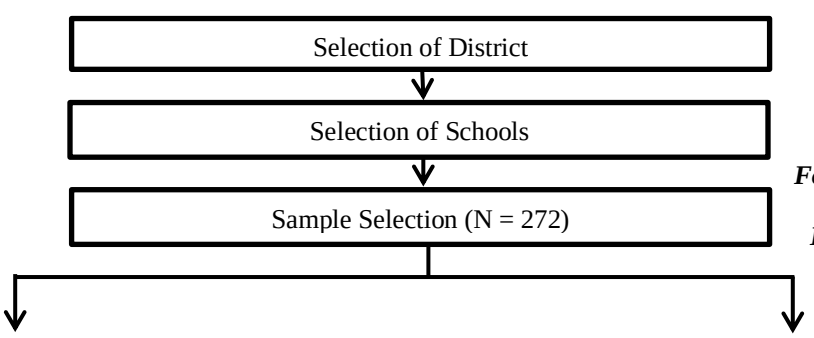
Intervention Procedure and Process Evaluation

There were four Rabies Hunter game sessions conducted in the school computer laboratory weekly and completed within one month from 5th April 2019 to 26th April 2019. The respondents were briefed about the game application for 10 minutes during 1st game session before they played it for 30 minutes. A computer was shared by 2 students and they played alternately in different sessions to ensure equal exposure to the game. The research team members assisted respondents to troubleshoot problems with games such as loading issues. These procedures were repeated for the next game sessions except briefing. For the purpose of process evaluation, respondents' attendance was taken in each session. The 1st session attendance had recorded 232 with no absentees during the 2nd session. However, two and five respondents were absent on the 3rd and 4th session respectively. Thus, the dropout rate for the game session was only 2.2%. Their feedback on the gaming experience and satisfaction was obtained verbally whereby a longer game session was requested. However, this request is beyond the researcher's control unless it is conducted during the non-schooling day. Overall feedback for this intervention activity was good.

Data collection instrument and procedure

A questionnaire was developed that consists of questions assessing knowledge on dog's behaviour which was created based on information from Coren and Hodgson (2007) and The United States Department of Homeland Security (2016). The questions to measure perceived vulnerability towards dog, precautionary behaviour around dog and help-seeking behaviour following dog bite were adapted from Shen et al. (2016). Content Validation was performed by a Public Health Specialist, Social Science and Humanities Expert and Preventive Scientist. It underwent back-to-back translation from English language to Malay language version before pilot tested. The reliability and validity of this questionnaire were acceptable (Halim et al., 2020).

The respondents underwent three consecutive scheduled questionnaire answering sessions. They were briefed for about 15 minutes to introduce the research including its objectives and the task given to them during pre-intervention. Subsequently, they were required to answer the questionnaire. For the intervention group, the pre-intervention and 1st post-intervention sessions were proceeded with game session after the questionnaire answering session. Figure 2 summarised the flow of data collection. Overall drop-out rate was 19% and 4.3% in control and intervention group respectively.



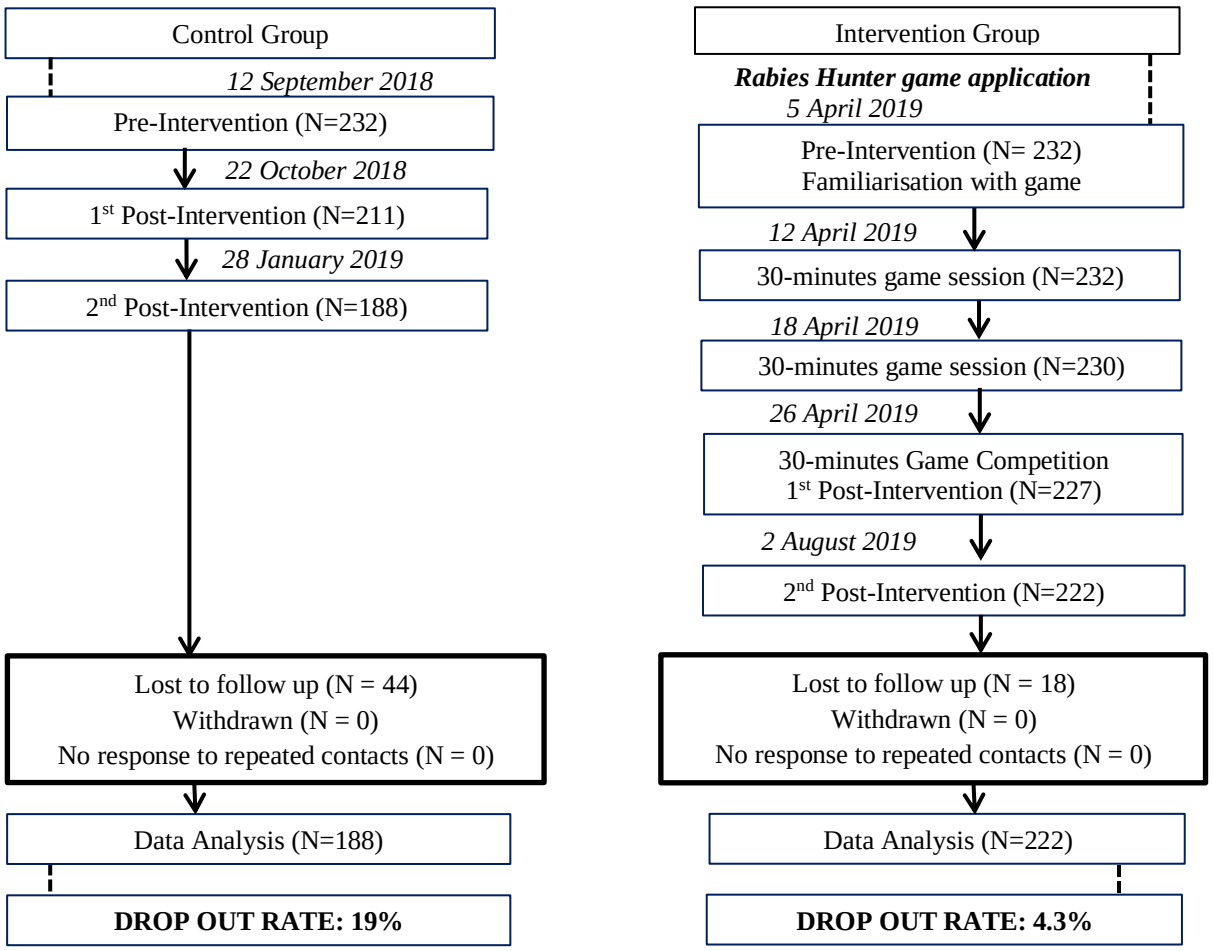


Figure 2 The flow chart of sampling and data collection

Data entry and analysis

The data collected was coded, checked manually for any inconsistencies, duplications or missing values and analysed using Statistical Package for Social Science (SPSS), version 21.0. Statistical assumptions were tested prior to Descriptive analysis, Repeated Measures ANOVA (Analysis of Variance) and Independent t-test. Data was presented in both tabular and figure forms.

Ethical considerations

This study was approved by the Medical Research and Ethics Committee (MREC) of Malaysian Ministry of Health [KKM/NIHSEC/P18-978(11)] and the Ethical Committee of Universiti Malaysia Sarawak (UNIMAS) [UNIMAS/NC-21.02/03-02 Jld.2 (122)]. Permission from Malaysian Ministry of Education [KPM.600-3/23-eras(466)] and Sarawak State Educational Department [JPNSW.SKPP.LAT.600-1/1/1 (89)] was obtained prior to the study. The participants were briefed about the purpose of data

collection and their voluntary participation was sought. They were also assured of data confidentiality. Written consent was obtained from respondents and their parents before the research was conducted.

RESULTS

Demographic data

Respondents in both groups have similar characteristics as shown in Table 1. They are mostly female, aged 13 and 14 years old and the majority of them lived in village. More than half of them were from Bidayuh ethnic.

Table 1 Socio-demographic characteristics in control and intervention groups

Characteristics	Control (n=188)		Intervention (n=222)	
	Frequency	Percentage	Frequency	Percentage
Age in Years				
13 years old	98	52.1	112	50.5
14 years old	90	47.9	110	49.5
Mean Age (SD)	13.48 (0.50) years		13.50 (0.50) years	
Gender				
Male	71	37.8	101	45.5
Female	117	62.2	121	54.5
Place of Living				
Village	149	79.3	179	80.6
Housing area	33	17.6	33	14.9
City	6	3.2	10	4.5
Ethnicity				
Bidayuh	102	54.3	161	72.5
Malay	37	19.7	32	14.4
Chinese	24	12.8	13	5.9
Iban	19	10.1	10	4.5
Others	6	3.2	6	2.7

Safety knowledge on dog's behaviour

There was significant improvement in safety knowledge on dog's behaviour among respondents from both control and intervention groups. However, higher significance was observed in the latter with F (2, 442) = 30.66 and $p = 0.000$ ($p < 0.001$) as compared to F (1.91, 357.47) = 5.14, $p = 0.007$ ($p < 0.05$) in the former. The significant improvement in control group was observed mainly from pre-intervention with mean (SD) of 0.83 (0.18) to 1st post-intervention with mean (SD) of 0.86 (0.16), $p = 0.047$ ($p < 0.05$) as well as from pre-intervention to 2nd post-intervention with mean (SD) of 0.87 (0.16), $p = 0.013$ ($p < 0.05$). Meanwhile, the improvement in intervention group was significant from pre-intervention with mean (SD) of 0.81 (0.16) to 1st post-intervention with mean (SD) of 0.88 (0.15), $p = 0.000$ ($p < 0.001$) as well as from pre-intervention and 2nd post-

intervention with mean (SD) of 0.89 (0.14), $p = 0.000$ ($p < 0.05$). Nevertheless, there was no significant difference between control (mean = 0.83, SD = 0.18) and intervention (mean = 0.81, SD = 0.16) groups in pre-intervention with t (408) = 1.31, $p = 0.192$ ($p > 0.05$). Similarly, the difference in 2nd post-intervention between control (mean = 0.87, SD = 0.16) and intervention (mean = 0.89, SD = 0.14) groups was also not significant with t (372.29) = (- 1.65), $p = 0.100$ ($p > 0.05$). Figure 3 below summarises these findings.

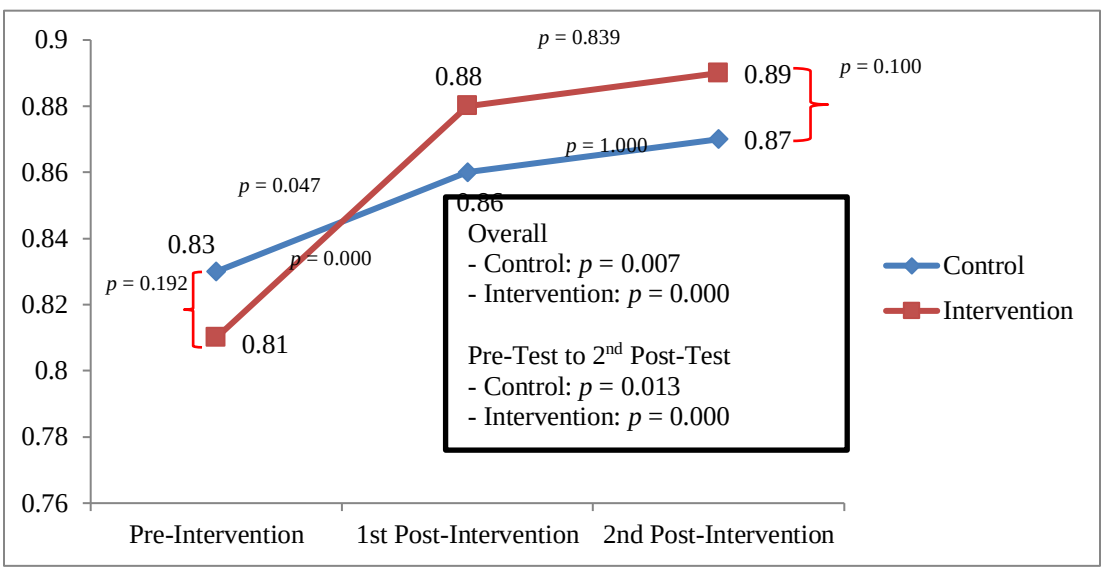


Figure 3 **Profile Plot for safety knowledge on dog's behaviour between control and intervention groups**

Perceived vulnerability towards dog

The perceived vulnerability towards dogs among respondents in both control and intervention groups had shown significant improvement with F (1.88, 352.40) = 9.26, $p = 0.000$ ($p < 0.001$) and F (1.83, 404.54) = 146.57, $p = 0.000$ ($p < 0.001$) respectively. The improvement in control group was significant from pre-intervention to 1st post-intervention with mean (SD) of 3.52 (0.51) and 3.60 (0.52) respectively, $p = 0.027$ ($p < 0.05$) and from pre-intervention to 2nd post-intervention [mean (SD) of 3.68 (0.55)], $p = 0.000$ ($p < 0.001$). Similarly, the intervention group had shown significant improvement from pre-intervention to 1st post-intervention with mean (SD) of 3.45 (0.53) and 3.91 (0.51) respectively, $p = 0.000$ ($p < 0.001$) as well as from pre-intervention to the 2nd post-intervention [mean (SD) of 3.90 (0.44)], $p = 0.000$ ($p < 0.001$). However, there was no significant difference between control (mean = 3.52, SD = 0.51) and intervention (mean = 3.45, SD = 0.53) groups in pre-intervention with t (408) = 1.24, $p = 0.215$ ($p > 0.05$). On contrary, significant difference was observed in 2nd post-intervention between control

(mean = 3.68, SD = 0.55) and intervention (mean = 3.90, SD = 0.44) groups with t (355.56) = (- 4.47), $p = 0.000$ ($p < 0.001$). Figure 4 summarises these findings.

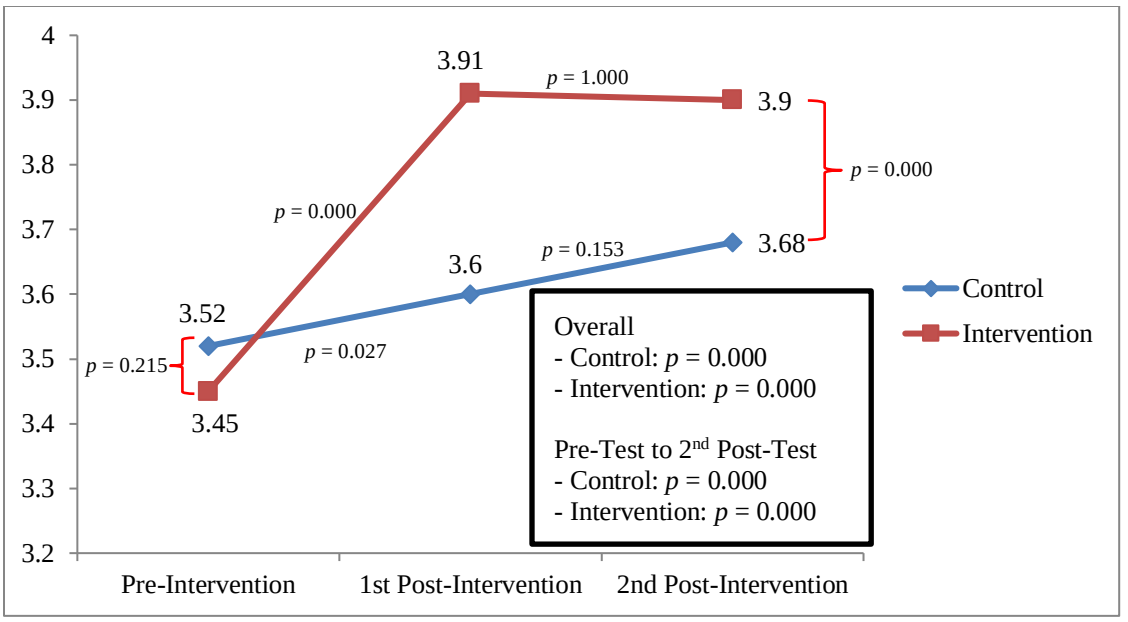


Figure 4 **Profile Plot for perceived vulnerability towards dog between control and intervention groups**

Precautionary behaviour around dog

There was significant improvement in precautionary behaviour around dog among respondents from both control and intervention groups with F (1.93, 361.30) = 5.47, $p = 0.005$ ($p < 0.05$) and F (2, 442) = 3.86, $p = 0.022$ ($p < 0.05$) respectively. The control group had shown significant poorer behaviour from pre-intervention to 1st post-intervention with mean (SD) of 4.26 (0.62) and 4.18 (0.64) respectively, $p = 0.037$ ($p < 0.05$) but subsequently improved significantly from 1st post-intervention to 2nd post-intervention [mean (SD) of 4.29 (0.62)], $p = 0.004$ ($p < 0.05$). Meanwhile, significant initial improvement was observed in intervention group from pre-intervention to the 1st post-intervention with mean (SD) of 4.11 (0.57) and 4.20 (0.57) respectively, $p = 0.028$ ($p < 0.05$). There was significant difference between control (mean = 4.26, SD = 0.62) and intervention (mean = 4.11, SD = 0.57) groups with t (408) = 2.55, $p = 0.011$ ($p < 0.05$) in pre-intervention. However, no significant difference between control (mean = 4.29, SD = 0.62) and intervention (mean = 4.18, SD = 0.52) groups was observed in 2nd post-intervention with t (367.47) = 1.94, $p = 0.053$ ($p > 0.05$). Figure 5 summarised these findings.

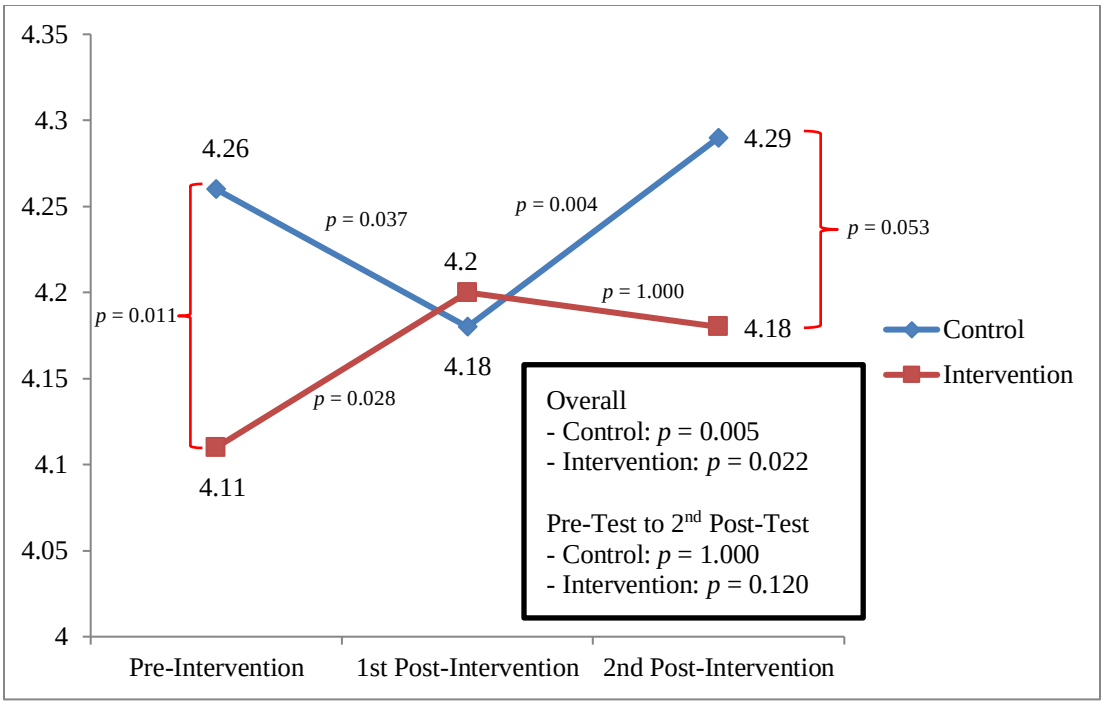


Figure 5 **Profile Plot for precautionary behaviour around dog between control and intervention groups**

Help-seeking behaviour following dog bite

The help-seeking behaviour following dog bite among respondents from intervention group had significantly improved with F (1.95, 429.91) = 5.1 and p = 0.007 (p < 0.05). The improvement is mainly significant from pre-intervention with mean (SD) of 0.93 (0.12) to 2nd post-intervention with mean (SD) of 0.96 (0.09) only, p = 0.005 (p < 0.05). However, no significant improvement was observed in control group whereby F (1.80, 336.09) = 1.99, p = 0.144 (p > 0.05). Moreover, there was no significant difference between control (mean = 0.95, SD = 0.12) and intervention (mean = 0.93, SD = 0.12) groups with t (408) = 1.20, p = 0.23 (p > 0.05) in pre-intervention. Similarly, the difference in 2nd post-intervention for control (mean = 0.94, SD = 0.16) and intervention (mean = 0.96, SD = 0.09) groups was also not significant with t (286.78) = (- 1.24), p = 0.216 (p > 0.05). Figure 6 summarises these findings.

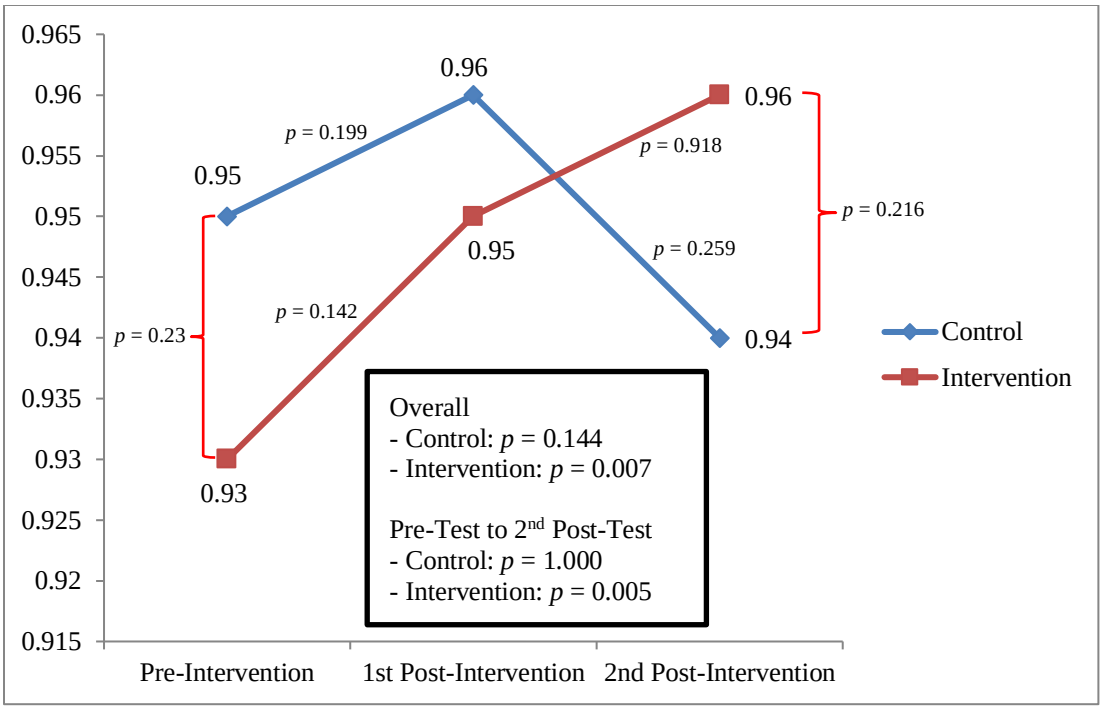


Figure 6 **Profile Plot for help-seeking behaviour following dog bite between control and intervention groups**

DISCUSSION

Intervention Effect on Safety Knowledge on Dog's Behaviour

There was a significant improvement of knowledge in both groups but more highly significant in the intervention group. This indicates more positive effect upon exposure to Rabies Hunter game application. Significant improvement in such knowledge was also found in a study by Rashid et al. (2018) involving Jahai villagers in Belum forest, Perak, Malaysia following exposure to intervention using discussion, comics, posters, slide presentation and video clips. Another study in Maryland, the United States of America by Spiegel (2000) on a program named "Be Aware, Responsible and Kind" (BARK) that consists of written materials and a video presented at school for 60 minutes, followed by class discussion and role-play had also discovered similar findings. Marked improvement in this current study indicates the needs of more innovative and creative health education approach to achieve successful rabies control by producing more sustainable knowledge in children. However, the difference in knowledge between control and intervention was not significant. This can be explained by lower knowledge during pre-intervention but higher at the end of study among respondents in the intervention group as compared to those in the control group. It is expected to be significantly different if exposure to Rabies Hunter game application is longer. A study by Meints et al. (2018) in Lincolnshire, United Kingdom had discovered that knowledge on dog's behaviour among children was improved and persistently significant at six months and one year later even though in the

meantime, the children were not exposed to the intervention modalities namely 16 short video-clips showing dogs with a full range of behavioural distress signals and audio stimuli.

Intervention Effect on Perceived Vulnerability towards Dog

The exposure of respondents to Rabies Hunter game application resulted in significant improvement in their perceived vulnerability towards dog. A study by Shen et al. (2016) had also discovered a similar finding with significant improvement at three weeks after a group of children in rural Zhejiang Province in China was exposed to a video-based testimonial intervention. The interval of three weeks from pre-intervention to 1st post-intervention is similar to the current study. Another study by Schwebel et al. (2016) had also found that an interactive and entertaining website that was designed to train children in safety with dogs, is promising to alter their perceived vulnerability towards dog. An improvement in the children's perception is vital as it may lead to a positive change in their precautionary behaviour around dog (Shen et al., 2017). However, although both groups showed significant improvement, those from the intervention group who recorded poorer perception during pre-intervention had developed marked improvement towards better perception than those in the control group. In fact, the difference between these groups was significant at the end of the study. This indicates a faster and more sustainable positive effect upon exposure to this interventional approach. The initial poor perception is expected as most children have low perception of their vulnerability towards dog (Davis et al., 2012) by which appropriate intervention is required to improve this. Therefore, a good and appropriate perception is vital in reducing risk of dog bite among children. This is because of children tend to create stronger attachments to dogs that are responsive to their social communicative hint (Hall et al., 2016) that may lead to poor complications if no effective intervention is taken to correct and improve their perception of their vulnerability towards dog.

Intervention Effect on Precautionary Behaviour around Dog

The respondents in the intervention group had shown an initial improvement on precautionary behaviour around dog but were later poorer than those in the control group at the end of the study. This indicates immediate improvement in precautionary behaviour was achieved following exposure to Rabies Hunter game application but more frequent and continuous exposure to this intervention may be required to produce more sustainable improvement. The short term improvement was also observed in a study by Chapman et al. (2000) that was conducted in Sydney, Australia by exposing children to a real dog conducted by an accredited dog handler in an educational program named "Prevent-a-Bite". Similar findings were also found in studies by Shen et al. (2016), Schwebel et al. (2016) and Wu et al. (2016) who used testimonial-based intervention, dog safety website as well as the combination of rabies education information system (IS) and Short Messaging Service (SMS) caretaker respectively. However, a significant and insignificant difference in precautionary behaviour around dog between groups in the present study was observed during pre-intervention and 2nd post-intervention whereby both recorded poorer behaviour in the intervention group. This may be due to children

with poorer precautionary behaviour around dog tend to have poorer behaviour after intervention (Shen et al., 2016).

Intervention Effect on Help-Seeking Behaviour Following Dog Bite

The respondents from the intervention group showed significant marked improvement in help-seeking behaviour following dog bite despite poorer behaviour during pre-intervention as compared to those from the control group. This indicates a sustainable positive effect of exposure to Rabies Hunter game application among children which is crucial for preventing mortality through timely post-exposure prophylaxis (PEP) administration to the victim. This finding was similar to a study in Haiti by Etheart et al. (2017) whereby a counselling session in Integrated Bite Case Management (ICBM) program was conducted on their respondents. However, there was no significant difference in help-seeking behaviour between both groups in this current study. The difference may be significant if the duration of exposure to intervention is longer based on the sustainable improvement shown in this group.

Strength and Limitation

The main strength of this study is that this novel Rabies Hunter game application was solely and newly developed using content that was created based on One Health concept by researcher team members. This allows synchronization of game content with questionnaire to achieve study objectives. Rabies Hunter game application adopted gamification approach as in other popular mobile game applications. Lower drop-out rate in the intervention group (4.3%) as compared to 19% in the control group indicates better response towards intervention. However, this unequal rate will not always cause biasness (Bell et al., 2013).

The main limitation in this study was short duration of exposure to intervention for avoiding interruption to students' academic class time. It is expected that a longer duration of exposure may produce a better outcome. Secondly, respondents were gathered together in a large hall or computer room that may introduce bias because they might have spoken to or discuss with each other.

Recommendation

Rabies Hunter game application needs to be regularly reviewed and updated to continuously grab attraction from school-aged children for a more sustainable effect. Furthermore, this study can be expanded into larger communities in the future such as the whole of Malaysia or to other countries with similar risks but different cultures instead of merely in Sarawak. It may also be expanded to a wider range of developmental stages namely respondent's age such as younger children in primary school. Finally, policy makers worldwide in general and particularly in Malaysia may consider to adopt the use of this game application into their school co-curricular activity as a part of their effort to combat rabies.

CONCLUSION

Rabies Hunter game application is a novel educational intervention to prevent dog bite among children that had successfully proven to be effective in significantly improving perception of their vulnerability towards dog. The safety knowledge on dog's behaviour and help-seeking behaviour following dog bite was significantly improved and more sustainable. However, the improvement observed in precautionary behaviour around dog was not sustainable. Generally, this intervention has a good potential in contributing towards preventing dog bite and subsequently helps in avoiding future rabies infection among children. The intervention should be expanded to all age groups so that the effect can be assessed and the finding would then be more useful for policymakers in rabies control programs.

CONFLICTS OF INTEREST

This research has no conflicts of interests

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