FEATURE ARTICLE

Effect of Health Education via Mobile Application in Promoting Quality of Life Among Asthmatic Schoolchildren in Urban Malaysia During the COVID-19 Era

A Quasi-experimental Study

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Bronchial asthma among children is a common chronic disease that may impact quality of life. Health education is one of the strategies to improve knowledge and quality of life. This study aims to assess the effect of health education via a mobile application in promoting the quality of life among schoolchildren with asthma in urban Malaysia during the COVID-19 era. A quasi-experimental, pre- and post-intervention design was used in this study involving a total of 214 students, randomly assigned into two groups (an intervention group and a control group). The control group received face-to-face health education, whereas the experimental group received health education via a mobile application. The findings showed that the total score of quality of life improved from a mean total score at pre-intervention of 5.31 ± 1.27 to post-intervention of 5.66 ± 1.28 for the control group, compared with the experimental group with a mean total score of quality of life at pre-intervention of 5.01 ± 1.36 and post-intervention of 5.85 ± 1.29. A comparison between the experimental and control groups using an independent *t* test showed statistically significant differences in their mean quality of life scores. The effect of health education via a mobile application showed a statistically significant improvement in the mean quality of life score from pre- to post-intervention ($F_{1,288} = 57.46$, $P < .01$). As recommended, the use of mobile technology in health education improved the quality of life of schoolchildren with asthma as compared with the traditional methods of a face-to-face lecture and/or a handbook. Thus, educational modules using mobile applications do improve quality of life.

KEY WORDS: Asthma, COVID-19, Health education, Mobile application, QoL

Asthma is a chronic inflammatory disease of the airways caused by bronchial hyperresponsiveness to a variety of stimuli, which leads to the obstruction of airflow that can be reversible by self or by treatment.[1] It is one of the most chronic illnesses prevalent among adolescents in industrialized societies.[2] The global prevalence of asthma varies from one country to another and ranges from 5% to 20%, or even more.[3] Among asthmatic patients, 3% to 10% suffer from severe asthma. Moreover, 10% to 25% of asthmatic patients in a speciality clinic have severe asthma.[4] Asthma is gradually becoming a burden among children in Malaysia, and it has been categorized as one of the most influential factors affecting the quality of life of children and their parents.[5]

Poorly managed effects of asthma can affect a child's quality of life. Studies show that low quality of life increases future emergency room visits relating to asthma, which indicates inadequate control of asthma.[5–7] Asthma can affect quality of life because the disease or treatment process can change physical, psychological, and social functions.[8] These effects may lead children to have a high risk of school absenteeism.[9] In the United States, the National Interview Survey mentioned that kids with asthma have three times more school absenteeism and have more risk of learning disability compared with normal children.[10]

Education is the main key to improving patient knowledge, skill, and compliance, especially for patients with poor knowledge and compliance.[11] So, improving the knowledge of schoolchildren about asthma leads to reducing distress and severity and thus improving their quality of life, and

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Written consent was obtained from the participants, and they were informed that refusal to participate would not result in negative consequences.

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learning from this, the nursing staff will have guidance in developing a better health service to improve the quality of life of children.[12]

In the recent COVID-19 pandemic, research has found that both children and adults with asthma tended to be more vulnerable to the disease, although there was no major sex disparity.[13] The existing literature agrees on the wide range of impact of school closure, ranging from not beneficial to transmission declines to more significant consequences. School closure incurs the economic damage, and there is widespread agreement among economists that it will have severe negative impacts on the economy.[14] At the same time, being indoors could make children more vulnerable to indoor conditions that may worsen asthma, including secondary sensitivity to cigarette smoke and occupational allergens such as molds, rodents, and roaches.[15] Despite the lack of evidence, experts strongly agree that all children and adolescents with asthma stay on their asthma treatment plan throughout the COVID-19 outbreak.[16]

Smartphones are used by about 50% of adolescents aged 12-17 years old and 75% of adults aged 30-49 years old. Hence, an intervention via mobile health applications is a great alternative during this time, directed at assisting adolescents with chronic asthma as they shift to take on more responsibility for their asthma treatment.[17] Unfortunately, the literature on the usage of smartphone technology for schoolchildren with asthma is lacking. Most healthcare application users focus on monitoring their condition rather than improving their knowledge or management of the disease.[2,18–21] However, there are several studies available evaluating the effectiveness of smartphone usage in children's health education and how health education can improve their Quality of Life (QoL).[22–24]

The present study is part of a research project titled "Developing Children Asthma Program (CAP)" that promotes health outcomes among schoolchildren in Malaysia. This study aims to assess the effect of health education via a mobile application in promoting quality of life among asthmatic schoolchildren in urban Malaysia during the COVID-19 period.

METHODS

Design

This is a quantitative study in the form of a quasi-experimental, pre-test and post-test, nonequivalent control group design. The quasi-experimental study is a research design used to evaluate interventions that do not involve randomization.[25] The researcher chose this design because of the inability to manipulate or control the environment and the use of nonrandomized subjects. Randomization is difficult in educational studies; since this study took place in a group environment that included schoolchildren in classrooms, the samples could not be individually monitored by the researcher.[26] This study design would also assess the differences between the pre-test results of the experimental and control groups, variations between pre-test and post-test results, and variations between the post-test results of the experimental and control groups that are compatible with the particular objectives of the current study.

The inclusion criteria were schoolchildren diagnosed with asthma in the age group of 13 to 16 years old who had manifested asthmatic symptoms in the last 12 months, those with smartphones, and students who spoke either English or Malay. The exclusion criteria were students with significant comorbidities and those who refused to participate.

We randomly chose six schools located in the city of Petaling Jaya in the state of Selangor, Malaysia. The participants from the randomly selected schools were then randomly assigned to one of two groups: three schools for the experimental group and three schools for the control group, from which we recruited schoolchildren who met the inclusion criteria. According to Brydges,[27] the sample size required for group differences research to achieve 80% statistical power using a power analysis with $\alpha = .05$ (two-tailed) is 107 per group; hence, a total of 214 schoolchildren were involved in this study. So we randomly selected 107 for each group for data analysis. In this stage, the researcher put random code numbers on all students in an Excel file and arranged them in sequence in two separate groups and then used the randomize tool to select 107 participants from each group to include them in data analysis. The schoolchildren in the experimental group were from different schools than those in the control group. In this study, the control group used only traditional methods of education (face-to-face), whereas the experimental group received education via a mobile application. In addition, a control population with similar characteristics to the study population were expected to undergo similar changes that occurred to the study population.[28] The outcome measures were assessed after 3 months, post-intervention, for both groups.

Research Phases

This research was conducted in four phases. The first phase was constructing the health education program about bronchial asthma, "Asthma Care Program®," and developing the mobile application "MemahamiAsma®" that began with an extensive literature review. The second phase was conducting a quasi-experimental study that first used a survey to identify eligible participants according to the inclusion criteria, followed by a pre-intervention assessment. In the third phase, the control group attended face-to-face health education regarding asthma and the experimental group attended online learning for 1 hour, followed by mobile application-based learning over the next 3 months. The last phase was the follow-up 3 months after the health education interventions for the control and experimental groups using a self-administered questionnaire, similar to that at the pre-health education intervention, to assess the schoolchildren's QoL.

Study Instruments

Demographic Data

This instrument was developed by the researcher based on previous studies.[29–31] This data consists of the schoolchildren's general information, and their status, sex, age, race, and family history of asthma. This questionnaire aims to evaluate the correlation between demographic factors and QoL level among asthmatic schoolchildren.

Quality of Life Questionnaire

The questionnaire used to measure the quality of life of the schoolchildren was adopted from the Pediatric Asthma Quality of Life Questionnaire, which was designed and validated by Juniper et al.[32] Pediatric Asthma Quality of Life Questionnaire's measuring properties and validity were tested in various countries in more than 40 various languages including Malay.[32–34] This instrument contains 23 questions in three domains (symptoms, activity limitations, and emotional function). The schoolchildren were asked to recall their experiences during the previous week and to respond to each question on a 7-point scale. The researcher in this study based the questionnaire on the instruction of the original questionnaire's author[32] to classify the quality of life level into three degrees of impairment. A score of 6 or 7 was categorized as 1 (minimum or no impairment); a score of 3, 4, or 5 was categorized as 2 (moderate impairment); and a score of 1 or 2 was categorized as 3 (severe impairment).

The researcher distributed and read the questionnaire, explained any unclear questions to the schoolchildren, and then requested them to answer the questionnaire. Participants had to complete a short demographic questionnaire (ie, sex, occupation, age, etc) before a facilitator guided them through the evaluation process and study instructions. The evaluation was conducted in a quiet environment with no distractions. During the evaluation, the facilitator sat next to the participants to clarify any questions and recorded users' interaction with each interface, comments, and errors.

Educational Pamphlet "Asthma Care Program®"

Asthma Care Program® is a children's asthma pamphlet developed by the researcher in both English and Malay based on the literature review and the evaluation by a panel of experts. This tool was designed to be colorful, entertaining, educational, and developmentally appropriate as well as diverse regarding sex, race, and culture. The content of the pamphlet includes the anatomy and physiology of the lungs and the management and prevention of asthma. This pamphlet was distributed to the control group.

Mobile Application "MemahamiAsma®"

The asthma mobile application called MemahamiAsma® was developed by an Android developer in cooperation with the research team in both English and Malay to support children with asthma in their daily care needs. The mobile application is an electronic alternative for the pamphlet and contains all data on asthma.

Application Design Process

The design process of MemahamiAsma® is based on the goal-directed design[35] and Health Literacy Online's six main strategies.[36] To simplify the process of the design, modifications were made to both aforementioned methods by dividing the design process into four stages covering the two phases of development and deployment. Figure 1 depicts the design process of MemahamiAsma®.

User Manual

"Understanding Asthma" or MemahamiAsma® is a simple-to-use and straight-to-the-point Android application for high school students in Malaysia. The application is developed in both English and Malay, as shown in Figure 2.

On the first page, the user will see the login page. They have to enter their login ID and password. The user then has to choose their preferred language, either English or Malay. After choosing their language, the user will be greeted by a tabbed page, populated with INFO tabs (information on asthma) and FAQ tabs (frequently asked questions about asthma).

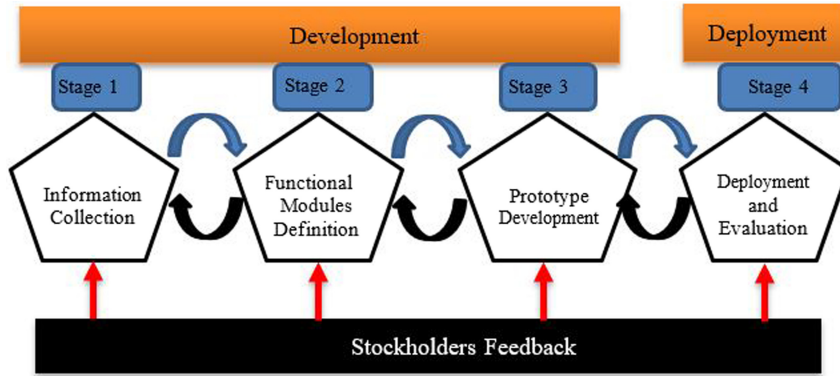

FIGURE 1. Design process of asthma mobile app, MemahamiAsma® .

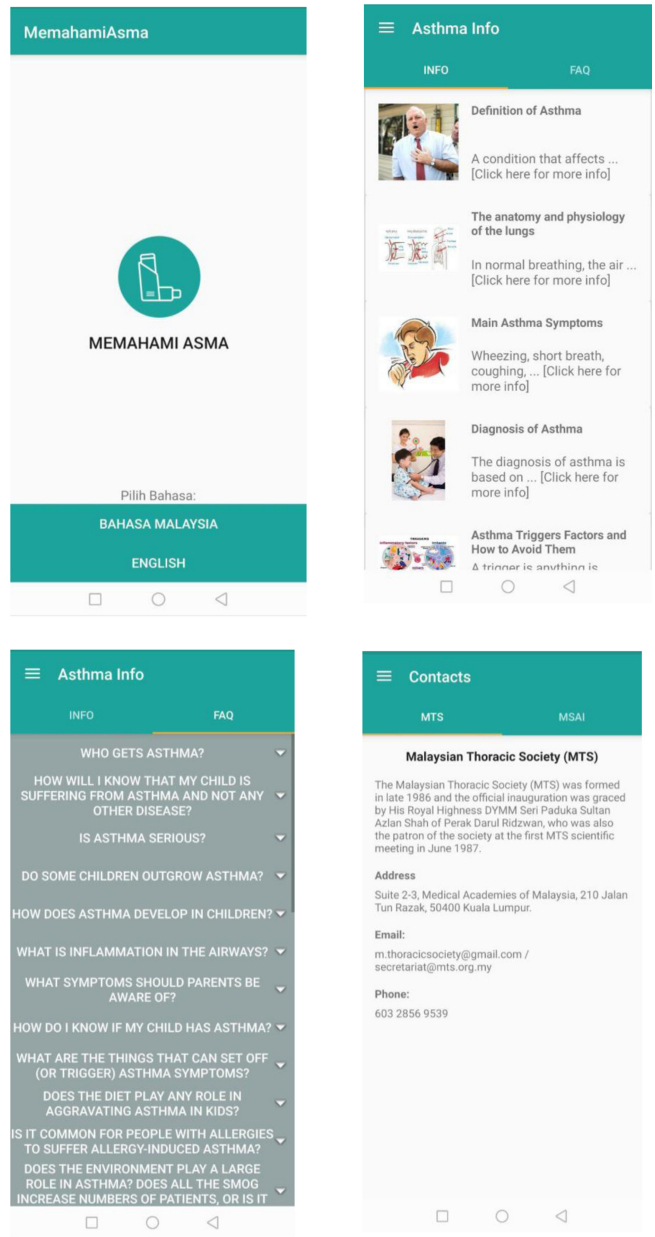

FIGURE 2. Screenshots of asthma mobile app, MemahamiAsma® .

The last page is the contacts page; if advanced knowledge and information regarding asthma or asthma research or any other related events or activities are needed, this page provides the user with the contacts to societies related to asthma, which are the Malaysian Thoracic Society and the Malaysian Society of Allergy and Immunology.

The Validity of Health Education Contents

Three experts evaluated the tools used in this analysis to evaluate the content's significance and determine the degree of satisfaction with the evaluation module. The three experts comprised of a professor in the Department of Pediatrics, University of Malaya; a senior lecturer in the Department of Nursing Science, University of Malaya; and the head of the Department of Nursing, Irbid National University, Jordan. To ensure appropriateness and accuracy, the content of the health education tool was sent electronically to the experts with the cover letter attachment and the evaluation guidance. The experts carried out an independent evaluation of the quality of the content using an ordinal 4-point scale: 1 = amateur, 2 = acceptable, 3 = admirable, and 4 = exceptional. The content validity index was determined

based on the experts' assessments, proving excellent content validity where content validity of individual items was 1.00 and content validity of the overall scale average was 1.00.

Data Collection

Data collection was carried out for both groups separately to avoid contamination of data. The samples were randomly divided into two groups, the experimental group and the control group.

During the pre-health education intervention, the researcher distributed and read the QoL questionnaire, explained any unclear questions to the schoolchildren, and then requested them to answer the questionnaire. Meanwhile, the researchers' team sat next to the participants to clarify any questions and recorded users' interaction with each interface, comments, and errors.

During the health education intervention stage, the control group attended a face-to-face lecture about asthma and received Asthma Care Program®, the educational pamphlet. The experimental group first attended online learning for 1 hour, followed by mobile app–based learning over the next 3 months. The frequency and duration of use of the mobile application were flexible and according to the user's preference.

During the 3 months after the health education intervention, the students in both groups had the flexibility to use the mobile app or the education handbook at their desired duration and frequency. Then, after 3 months, the researcher visited the schools again, distributed the same self-administered questionnaire (pre–health education intervention) to the experimental and control groups, and then asked the schoolchildren to answer the questionnaire. Upon completion, the researchers collected the questionnaires after ensuring that all questions were answered to prevent any missing data. The questionnaire in post–health education was carried out on 214 schoolchildren.

Ethical Consideration

The information sheet included basic details on the intent of the analysis, the effects of participating, and the amount of time required to answer the questionnaire. Participants were advised that their comments would remain private and confidential and that involvement in the study was voluntary. To ensure equal interference, participants were told that they were to be handled equally without the study being threatened, discriminated against, and harassed. The researcher followed study protocols closely, and no experiments were carried out, which had not obtained clearance. For reasons specifically relevant to the study question, each participant was chosen equally and not for individual gain.

Ethical approval was obtained from the research committee of the University of Malaya Medical Centre (MRECID no. 20161124501). Also, this study is registered with the Australian New Zealand Clinical Trials Registry under Trial ID ACTRN12614300582550. In addition, schoolchildren's parents were asked to sign a written, informed consent form before the schoolchildren started answering the questions.

Data Analysis

Data were analyzed using the IBM SPSS Statistics version 22 (IBM Inc., Armonk, NY, USA). Descriptive and inferential statistics were used to summarize the demographics of the schoolchildren and their level of QoL. Quantitative data included the calculation of mean and standard deviation. The associations between categories were determined using the chi-squared test, and the difference in mean at pre-test and post-test was analyzed using the split-plot analysis of variance. The statistical significance is fixed at $P < .05$.

RESULTS

Profile of the Sample

A total of 214 schoolchildren participated in this study, with 107 students in the control group and another 107 students in the experimental group. The data show that female students made up more than half of all students in both the control and experimental groups with n = 55 (51.4%) and n = 63 (58.9%), respectively. Also, there were more students aged 15-16 years old than 13-14 years old in the control group (n = 59, 55.1%) and the experimental group (n = 62, 57.9%). Regarding ethnicity, around two-thirds of the students were Malay, n = 73 (68.2%) in the control group and n = 72 (67.3%) in the experimental group; Indian, n = 25 (23.4%) in the control group and n = 18 (16.8%) in the experimental group; and Chinese, n = 9 (8.2%) in the control group and n = 17 (15.9%) in the experimental group.

In addition, the results showed that the age of more than half of the students in the control group (n = 60, 56%) and the experimental group (n = 55, 51%) when they had first been diagnosed with asthma was between 0 and 6 years old, whereas around half of them from both the control and experimental groups (n = 45 [42%] and n = 48 [45%], respectively) were diagnosed with asthma in a hospital (Table 1).

Relationship Between Demographic Characteristics and Quality of Life of the Control and Experimental Groups at Pre-intervention

The data in Table 2 show that the quality of life level of "No Impairment" was highest in the control group whereas "Moderate Impairment" was highest in the experimental group. In the control group, "No Impairment" was highest for the following factors: 15-16 years old (n = 34, 58.6%), Malay (n = 43, 58.9%), and male students (n = 35, 67.2%). Meanwhile, in the experimental group, "Moderate Impairment" was highest for the following factors: 14-15 years old (n = 29, 48.8%), Malay (n = 45, 62.5%), and female students (n = 39, 61.9%).

Table 1. Baseline Socio-demographic Characteristics (N = 290)

Variables	Control Group n (%)	Experimental Group n (%)	χ^2	*P*
Sex			0.086	.769
Male	52 (48.6)	44 (41.1)		
Female	55 (51.4)	63 (58.9)		
Age, y				
13–14	48 (44.9)	45 (42.1)	1.476	.478
15–16	59 (55.1)	62 (57.9)		
Ethnic			6.682	.083
Malay	73 (68.2)	72 (67.3)		
Indian	25 (23.4)	18 (16.8)		
Chinese	9 (8.2)	17 (15.9)		
Age at asthma diagnosis, y			5.454	.708
0–6	60 (56)	55 (51)		
6–13	47 (44)	52 (49)		
Where was your asthma first diagnosed?			264.981	<.001
Hospital	45 (42)	48 (45)		
Clinic	36 (33)	48 (45)		
Nonspecific	27 (25)	11 (10)		
Total	107 (100)	107 (100)		

However, there was no statistically significant difference ($P < .05$) in the quality of life level throughout, so univariate logistic model analysis was not conducted in this situation. Thus, the demographic variables do not influence the dependent variable, QoL.

Total Quality of Life Level and Quality of Life Domains

As can be seen from Table 3, data show a slight increase in the mean total quality of life score in the control group from pre-intervention (5.31 ± 1.27) to post-intervention (5.66 ± 1.28). Meanwhile, the experimental group experienced a significant increase in the mean total quality of life score from pre-intervention (5.01 ± 1.36) to post-intervention (5.85 ± 1.29). Regarding the QoL domains, in the control group, symptoms functioning had the highest score at pre-intervention (4.99 ± 1.39) and post-intervention (5.92 ± 1.09), whereas activity limitation had the lowest score at pre-intervention (5.19 ± 1.33) and emotional functioning at post-intervention (5.48 ± 1.39). Furthermore, in the experimental group, symptoms functioning had the highest score at pre- and post-intervention (5.13 ± 1.53

Table 2. Relationship Between Demographics Characteristics and QoL Levels at Pre-intervention (N = 107)

Factors	Control Group				Chi-Square (χ^2) *P*	Experimental Group				Chi-Square (χ^2) *P*
	N = 107	QoL Level n (%)				N = 107	QoL Level n (%)			
		No Impairment	Moderate Impairment	Severe Impairment			No Impairment	Moderate Impairment	Severe Impairment	
Sex										.179
Male	52	35 (67.3)	16 (30.8)	1 (1.9)	.177	44	18 (40.9)	26 (59.1)	0 (0.0)	
Female	55	30 (54.5)	23 (41.9)	2 (3.6)		63	20 (31.7)	39 (61.9)	4 (6.3)	
Age, y										.597
13-14	48	31 (64.6)	15 (31.3)	2 (4.2)	.376	45	18 (40.0)	26 (57.8)	1 (2.2)	
15-16	59	34 (58.6)	24 (39.7)	1 (1.7)		62	20 (32.3)	39 (62.9)	3 (4.8)	
Ethnic										.717
Malay	73	43 (58.9)	27 (37)	3 (4.1)	.685	72	23 (31.9)	46 (63.9)	3 (4.2)	
Indian	25	17 (68)	8 (32)	0 (0.0)		18	8 (44.4)	10 (55.6)	0 (0.0)	
Chinese	9	5 (55.6)	4 (44.4)	0 (0.0)		17	7 (41.2)	9 (52.9)	1 (5.9)	

Significance level at $P < .05$.

Table 3. Descriptive Statistics of QoL Domains of the Experimental and Control Groups (N = 214)

Domains	Control Group (N = 107)				Experimental Group (N = 107)				Between Groups (Exp vs Con), *P*
	The Mean Total of QoL Mean (SD)		Diff. (Post-Pre)	Within Group	The Mean Total of QoL Mean (SD)		Diff. (Post-Pre)	Within Group	
	Pre–Health Education	Post–Health Education	Mean (SD)	Paired *t* Test, *P*	Pre–Health Education	Post–Health Education	Mean (SD)	Paired *t* Test, *P*	
Overall mean	5.31 (1.27)	5.66 (1.28)	0.35 (1.25)	<.001	5.01 (1.36)	5.85 (1.29)	0.84 (1.41)	<.001	<.001
Activity limitation	5.19 (1.33)	5.57 (1.43)	0.39 (1.25)	.03	5.03 (1.56)	5.81 (1.48)	0.78 (1.67)	<.001	<.001
Emotional function	4.99 (1.39)	5.48 (1.39)	0.49 (1.60)	<.001	4.9 (1.27)	5.57 (1.41)	0.67 (1.51)	<.001	<.001
Symptoms	5.44 (1.37)	5.92 (1.09)	0.49 (1.36)	<.001	5.13 (1.53)	6.09 (1.26)	0.97 (1.51)	<.001	<.001

Abbreviations: Con, control; Exp, experimental.

Within group: pre- and post-comparison within the experimental and control groups. Between group: comparison between the experimental and control groups.

and 6.09 ± 1.26, respectively), whereas emotional functioning had the lowest score at pre- and post-intervention (4.9 ± 1.27 and 5.57 ± 1.41, respectively).

A comparison between the experimental and control groups using an independent *t* test showed statistically significant differences in the mean quality of life scores between them.

Effectiveness of Health Education via Mobile Application

This research question was answered using inferential statistics. Generalized linear model, split-plot analysis of variance was used to examine the significant difference in the mean score of QoL (improvement) among the schoolchildren with asthma between the experimental and control groups.

Table 4 presents the summary of split-plot analysis of variance results that includes within-subjects effects (pre- and post-intervention score of QoL level) and between-subject effects (the experimental and control groups). The null hypothesis is rejected, and the effect of the mobile application is significantly effective in improving the QoL level of the students. The profile plot in Figure 3 indicates that the QoL level of the experimental group increased from pre-test to post-test.

DISCUSSION

The present study reveals that poor asthma control will affect the daily life of asthmatic schoolchildren and their adaptation to the illness in several aspects of life such as physical, emotional, psychological, and social during the COVID-19 period. During the recent COVID-19 pandemic, parents of children with asthma have voiced their worries regarding asthma management. They may have even paid more attention to the medicine given to their children.[15] In the United Kingdom, one research found a 76% decline in emergency visits for asthma of all severities during the COVID-19 pandemic. It is doubtful that this drop in hospital admissions can be explained solely by parents who treated mild attacks at home, but the reasons remain unclear for what is obviously a significant improvement. Lockdowns to avoid the spread of conventional respiratory viruses and diminished exposure to outdoor allergens may be factors.[37]

In our study, results showed that most schoolchildren in the control group at pre-intervention had no impairment in their quality of life whereas those in the experimental group had a moderate impairment. However, at post-intervention, the majority of schoolchildren in both the control and experimental groups had no QoL impairment. Regarding the QoL domains, the highest-scoring domain is symptoms functioning at pre- and post-intervention, whereas the lowest-scoring domain is emotional functioning at pre- and post-intervention.

In this study, the emotional sub-scale contributed the most to the schoolchildren's QoL impairment in both groups, and this is consistent with previous studies that revealed that adolescents with persistent asthma had common emotional symptoms related to asthma due to increased asthma morbidity, healthcare use, and school absenteeism. On the other hand, it would mean that adolescents with high morbidity from

Table 4. Split-Plot Analysis of Variance Results for Effectiveness of Health Education via Mobile App

	Sum of Squares	*df*	Mean Square	*F*	*P*
Within subjects					
Test	51.27	1	51.27	57.46	<.01
Test × Group	8.69	1	8.69	9.74	<.01
Error (Test)	257.01	288	257.01		
Between subjects					
Group	0.446	1	0.446	0.178	.673
Error	720.797	288	2.503		

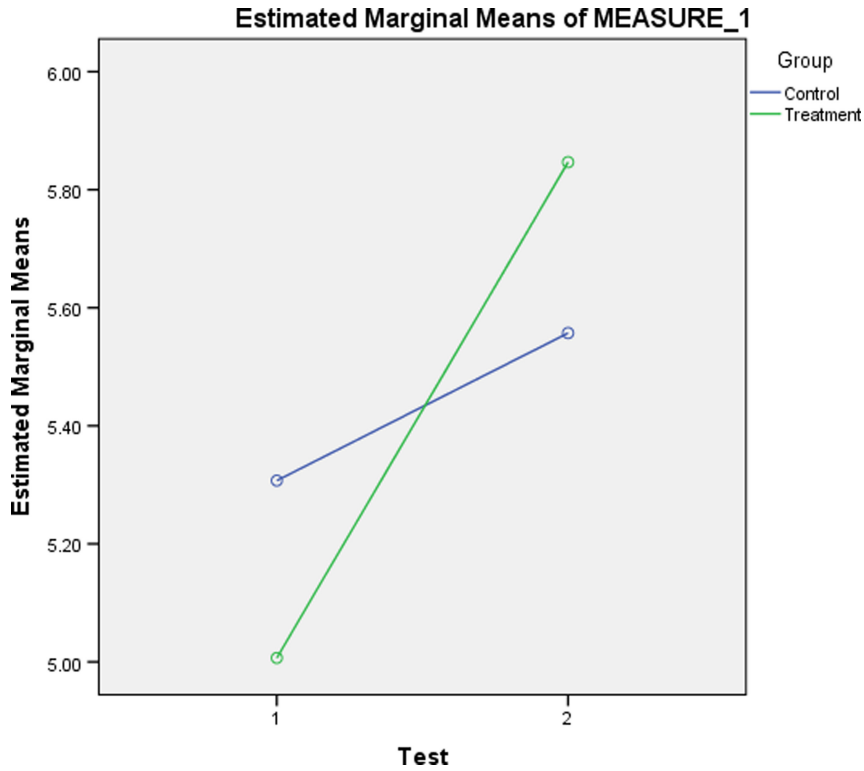

FIGURE 3. Split-plot analysis of variance graph plot of control and experimental groups at pre-intervention and post-intervention.

asthma have a high risk of poorer QoL. Therefore, emotional QoL should be included in the assessment of adolescents with asthma.[38] Another study conducted in Saudi Arabia assessed the influence of attitude on asthma severity and quality of life among asthmatic children. Their levels of quality of life also showed a higher score in the emotional domain compared with the physical domain.[39] In the United States, it was reported that there was slightly poorer emotional processing in Hispanic children in comparison with the non-Hispanic White and Black children. The emotional sub-scale explored how often children felt upset, anxious, worried, or distressed because of their asthma and how often they were frightened by an asthma attack.[40]

On the other hand, different studies have found that physical functioning and vitality are the typical measurements most impaired by asthma, which contradicts to our study that was conducted among schoolchildren with mild asthma, whereas other studies have been performed among those with moderate to extreme illness, where the study population had weak physical functioning.[41] Poor asthma control among children is an obvious public health problem. It causes respiratory health problems, limits physical activity, and leads to missed school days and also parental work absenteeism.[42] In the United States, the National Interview Survey mentioned that children with asthma have three times more school absenteeism and have more risk of learning disability compared with normal children.[10]

Generally, the present study reveals the effect of a mobile application in promoting quality of life among asthmatic schoolchildren. The result of this study is similar to a previous systemic review that aimed to assess the effect of a mobile application to support adult patients with asthma.[43] That result demonstrated that both patients with asthma and healthcare providers had an improved quality of life. Another study in the United States that assessed a mobile technology–based educational program on schoolchildren to improve asthma self-management and outcomes found that parents of the schoolchildren demonstrated significant improvements in their asthma caregiver-related quality of life.[21]

It is therefore concluded that the use of mobile technology in health education has a positive impact in improving the QoL of schoolchildren with asthma as compared with other traditional methods like a face-to-face lecture or a handbook. This finding agrees with that of other research that revealed that the mobile health initiatives have an impact on improving chronic disease conditions.[44] In another systemic review conducted by Majeed-Ariss et al,[45] it was explained that mobile applications have good benefits for adolescents since mobile technologies and software applications are now widely used by this age group either for social networking or for

gaming purposes. Hence, mobile applications could be used for healthcare educational purposes or as healthcare support.

As recommended, there is a need to assess efficacy and cost-effectiveness for using information technology to improve asthma treatment and knowledge, which must be reinforced by randomized trials.[46] The outcomes of such studies are urgently needed. The simplicity with which these strategies integrate into our everyday lives and the meaning of continuous chronic care indicate that these imaginative and innovative approaches may be a beneficial addition to successful clinical practice.

CONCLUSION

In this quasi-experimental research, the findings concluded that the use of mobile technology in health education improves the QoL levels of schoolchildren with asthma, compared with other traditional methods like a face-to-face lecture or a handbook, especially during the COVID-19 period.

LIMITATIONS AND RECOMMENDATIONS

The first limitation identified in this study is its quasi-experimental design. Due to the absence of randomization, there is likely the presence of selection bias. It is accepted that self-reported questionnaires can lead to a bias in the results of the study, as answers might not describe the true condition of the participants; they might rate higher or lower than the true condition. Other limitations include the probability that some participants failed to install the application, the reason for which is undetermined (this might have occurred during registration). Also, we do not know if any of the schoolchildren in the control group somehow accessed or downloaded the application. Similarly, we did not account for the use of other asthma mobile health software by the participants.

In this study, data on the patients' perception of illness, self-motivation, and approaches to self-management were not collected. Therefore, it is recommended for future research to investigate further regarding symptoms experienced by patients by gathering information on their illness perceptions, self-motivation, self-efficacy, and self-management strategies. Data retrieved can be integrated into psycho-educational programs to promote behavior change, hence improving the patients' self-management skills.

PRACTICAL VALUE

With sufficient basic knowledge regarding asthma, especially knowledge of adhering to proper medication, the QoL of asthmatic schoolchildren should eventually improve. Thus, it is important for school nurses to identify and implement different strategies regarding asthma medication/treatment.

Health education via mobile applications is considered a great innovation in asthmatic students' education or as a supplement to conventional learning methods. It is necessary to place health education via mobile applications as a prominent learning strategy for asthmatic students, with careful planning considering all aspects such as the age of the students, lecturers, learning facilitators, and technological use to achieve learning outcomes, which are to decrease symptoms and prevent complications. Therefore, health education via mobile applications is suggested as an effective learning strategy in promoting knowledge and QoL of asthmatic students within their existing education in schools throughout Malaysia.

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