

Spacing Effect-based Educational Interventional Strategy to Improve Asthma Knowledge among Biomedical Students in a Private Malaysian University

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ABSTRACT

Background: Asthma is a serious non-communicable disorder where the inflammation of the airways passages occurs and cause narrowing of the airways. Statistic shows approximately two millions asthmatic patients in Malaysia. So, it is important to test the knowledge of asthma among Malaysian particularly biomedical students. As biomedical students can increase the knowledge of public by educate patient and solves medical related trouble in the foreseeable future. Interventional strategies are used in this study to improve knowledge of asthma patients by providing knowledge via brochure. **Objectives:** To assess the potential for asthma knowledge improvement among the respondents by means of the spacing effect-based educational interventional tool. **Methodology:** An interventional, descriptive and longitudinal study was conducted among biomedical students. 250 eligible respondents participated in the study. Initially, a self-administered questionnaire related to asthma knowledge was used to assess students' knowledge towards asthma (baseline study). Interventional tool (brochure) was distributed 1 week after collecting the returned questionnaire. In phase-2, the same questionnaire was distributed again one week after the distribution of brochure. Data collected from the respondents was analysed and interpreted. **Results:** The scores grade of the respondent showed 'poor' grade during the baseline study and 'moderate' grade during the second phase study. Hence, the score grade proved that asthma knowledge among the sample improved from baseline study to phase-2 study. **Conclusion:** The knowledge, perception, practice of asthma will be improved with the interventional tool and the spacing effect.

Key words: Asthma, Knowledge, Spacing Effect, Quality of Life, Interventional tool, Wilcoxon Signed Ranks test.

INTRODUCTION

Asthma has been prevalent for many years. It is derived from the Greek word 'azēin' (meaning 'breathing hard'). Hippocrates had utilized this word to describe the condition of episodic shortness of breath more than 2,000 years ago.¹ According to The National Institutes of Health and National Education and Prevention Program (NAEPP), asthma had been defined as 'a chronic inflammatory disease which is caused by many cells and cellular elements in the airways especially mast cells, macrophages, neutrophils, eosinophil's, T-lymphocytes and epithelial cells'. With these cellular

elements, inflammation occurs and leads to many symptoms, with the possibility of getting bronchial hyper responsiveness to a variety of triggers will increase.² Asthma is a serious non-communicable disorder where the inflammation of the airways passages occurs and cause narrowing of the airways. This leads to coughing, episodic wheezing, breathlessness and chest tightness specifically early in the morning or at night. An asthma attack can result in respiratory failure and death. Thus, asthma is commonly known as a disease which has a high morbidity and mortality rates.³

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There are several asthmatic triggers:

- Viral pathogens (rhinovirus adenovirus, influenza virus, coronavirus virus);
- Allergens (dust mites, animal dander, cockroaches);
- Environmental triggers (cold air, nitrogen dioxide, tobacco smoke);
- Exercise (exercise-induced asthma);^{4,5}

There are approximately two million asthmatic patients in Malaysia, of which only 6% are under-control, implying that there are 1.8 million Malaysian asthmatic patients whose condition is either uncontrolled or partially controlled. According to the Respiratory Journal 2013, most asthma patients who take the quick reliever medication thrice a week, with asthma attacks occurring 3-4 times a year, usually consider their own asthma condition as well-controlled.⁶ In August 2017 the World Health Organization (WHO) stated that there are 235 million people affected with asthma worldwide. Malaysia was ranked 58th in the world with regard to asthma prevalence.⁷ It can be inferred that the awareness and knowledge about asthma is still low in Malaysia. Lack of asthma knowledge leads to poor control resulting in more frequent asthma episodes.⁸ In Malaysia, although there are present of advances in modern treatment of asthma, the prevalence of uncontrolled or poor controlled asthma patients are still increasing. Thus, ways to increase asthma knowledge are extremely vital.⁹ Despite numerous attempts in Malaysia to curb this issue, the numbers of poorly controlled asthma patients are still increasing. This presents a bleak picture of the Malaysian public's health status, with regard to asthma, as reported by the studies conducted in Malaysia. The need of the hour is for a national strategy to overcome contributors to excess asthma among Malaysians.^{10,11} As pharmacists have the pharmacotherapy knowledge and patient counselling skills, are readily accessible to the public, they are the prime candidates for improving the knowledge of asthma among the asthma patients and the general public. The pharmacist can educate recipients about the disease condition, medications and other therapeutic modalities.¹² Interventional strategies are used to improve knowledge of respondents by providing knowledge via brochure, among others. An effective intervention strategy in this context is the usage of pamphlets and/or brochures which can be given post-counselling in order to supplement or fortify the knowledge of asthma patients regarding their condition.^{13,14} The brochure can contain information such as asthma triggering factors, symptoms, medications, prevention methods, diagnostic methods, accurate way to use the inhalers and peak flow meter.

The awareness and knowledge of asthma in Malaysia is generally low. This was reported in numerous studies.^{15,16} The poor knowledge levels can result in poor outcomes with regard to treatment and adherence, ultimately resulting in an upsurge in proportion and severity of asthma cases.¹⁷ The levels of asthma knowledge are relatively poor among school and university students also.¹⁸ Based on the literature survey, several studies were conducted worldwide to evaluate asthma knowledge among the population. However, asthma knowledge-based studies were conducted relatively lesser in Malaysia during the last five years. Unfortunately, the asthma patients' numbers in Malaysia is significantly increasing. Hence, this study was conducted in Malaysia to access the asthma knowledge among biomedical students. This study utilized interventional tools (pre-validated questionnaire and brochure), coupled with spacing effect to evaluate asthma knowledge improvement among the respondents. The study objectives are listed below:

1. To assess the potential for asthma knowledge and self-management improvement among the respondents by means of the interventional tool.
2. To determine the impact of spacing effect on asthma knowledge and practice among the respondents.

METHODOLOGY

Study design

This interventional, descriptive and longitudinal study comprised two phases: Baseline study (phase-I) and phase-II, with the variable(s) asthma knowledge being recorded during each phase. The dependent variable is knowledge; while the independent variables were the age, gender and educational status of the respondents. After obtaining the ethical approval (AUHAEC6/FOP/2014), convenience sampling technique was used to source the respondents. Once the required sample number was acquired, the same respondents were used for each subsequent phase (related group). Raosoft sample size calculator and PASS software's were used to calculate the sample size for this study.¹⁹ The estimated sample size was 200 (95% CI, 5% margin of error, 50% response distribution, 30% margin for drop-outs). The inclusion criteria were Malaysian asthmatic students in Kedah state who were able to comprehend, read and write English. The exclusion criteria were Malaysian non-asthmatic students; students who were not able to comprehend, read and write English; and expatriate residents.

During phase-I, the questionnaires were distributed to 300 respondents. Of the 300 respondents, the responses garnered from 250 respondents were considered

eligible mainly due to the completeness of the returned questionnaires (83.33% response rate). During the subsequent phase-II, the same 250 respondents participated in the study. Figure 1 depicts the study flow. The study was aimed at individuals who were studying biomedical courses (Pharmacy, Dentistry, MBBS and Physiotherapy). The study population were sourced from a private university located in Kedah.

Study Instrument

The 45-item customized questionnaire was developed by adapting the original source instruments²⁰⁻²⁵ to the current study requirements. The questionnaire contains items to assess asthma knowledge and consists of three sections:

- The initial segment consisting of respondents’ general information;
- Section A (asthma self-management): 16 survey items
- Section B (asthma knowledge): 29 survey items

Validation (face, content), reliability and readability tests were performed prior to commencing with the pilot test.

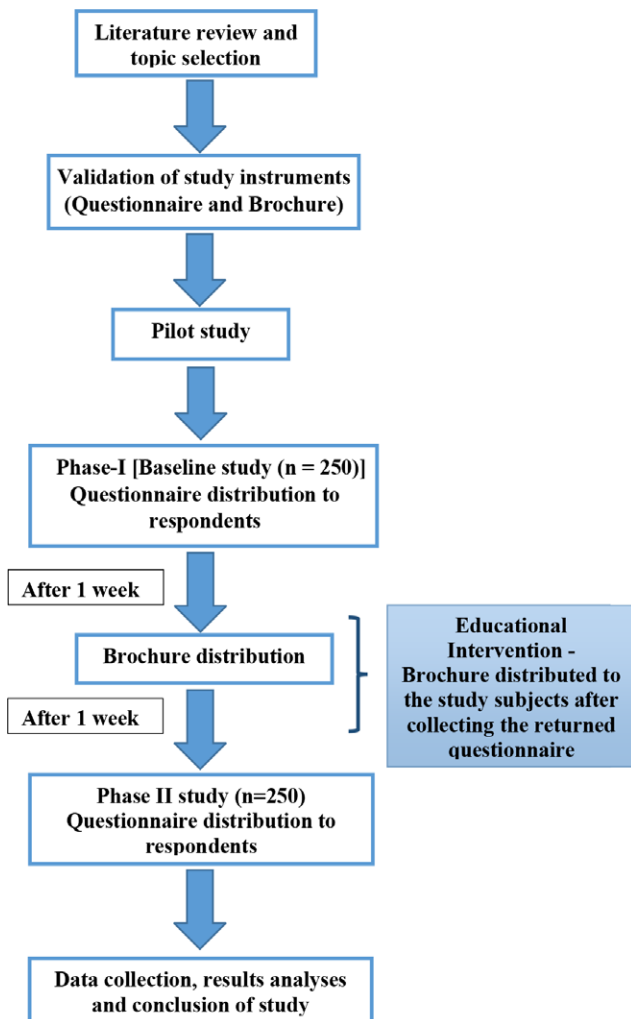


Figure 1: Study flow during the two phases.

The internal reliability of the instrument as assessed by the Cronbach alpha test had a value of 0.72, indicating that it was acceptable to be used in this study. The score ranges attributed to each domain based on the type of questions and the total score range for the questionnaire is depicted in Table 1.

Interventional Tool (Educational brochure)

The educational brochure was prepared with utmost care, so that the most important information regarding the concepts of asthma (triggers, signs, symptoms, diagnosis and treatment) were displayed in a simple and easy to understand manner. The brochure was subjected to validation (face, content) and readability tests, prior to the pilot study.

Table 2 depicts the total score range for each of the two sections and the total score range. The scoring grades attributed to each domain and overall were adopted from Bloom’s cut-off points for grading participants’ scores. The grades were: good (80-100%); moderate (60-79%); poor (< 60%).²⁶ The score grading template specific to this study (as per original Bloom’s Original cut-off points) is displayed in Table 3.

Statistical Analyses

Non-parametric tests were employed for data analyses

Table 1: Score ranges (for each domain and total) based on question type.

Section	Question Type (n)		Score range		Score range for each domain	Total Score Range
	Close-ended	Likert-based	Close-ended	Likert-based		
A	16	-	0 – 16	-	0 – 16	0 – 45
B	29	-	0 – 29	-	0 – 29	

Table 2: Score ranges for each domain and the total score.

Sec-A score range	Sec-B score range	Total Score
0 – 16	0 – 29	0 – 45

Table 3: Score grading template as per original Bloom’s Original cut-off points.

Grades	Percentage (%)	Section A (score)	Section B (score)	Total Score
Poor	0 – 59	0 – 9	0 – 17	0 – 27
Moderate	60 – 79	10 – 13	18 – 23	28 – 36
Good	≥ 80	14 – 16	24 – 29	37 – 45

as the sample was not normally distributed. The median was used to describe the scores from the questionnaire. The Wilcoxon Signed Rank Test was used to compare the score differences (median) between each phase for the individual domain and the overall or total score (i.e., Sec.A P1 vs Sec.A P2; Sec.B P1 vs Sec.B P2; and total score P1 vs total score P2). The ad hoc Wilcoxon Signed Ranks test was performed to negate the type-I errors.

RESULTS

The median scores were utilized for the statistical analyses as the data was non-parametric. An increase in the median scores for both the domains of asthma self-management (section-A) and asthma knowledge (section-B) were observed during phase-II when compared to phase 1. The section-A scores increased from 6 to 10, while section-B scores increased from 16 to 21, denoting a marked improvement in the asthma self-management and knowledge among the respondents. The overall score also improved from 22 to 31 from phase-I to phase 2. The score grades also increased from 'poor' in phase-I to 'moderate' in phase-II (Table 4). The statistical significance implies that the improvement in the scores and score grades were due to the interventional strategy employed in this study. Comparison of phase-1 and 2 of sections A, B and total scores are highly significant (Table 5). The Wilcoxon signed rank test for sections-A, B and total score (A+B) is displayed in Table 5.

DISCUSSION

The cohort's median knowledge and self-management scores increased from 16 to 21 and 6 to 10 respectively, indicating improvement from 'poor' to 'moderate'. Intervention was Educating respondents by customized asthma-specific brochure. The respondents were encouraged to read the brochure regularly prior to next phase. Regularly reading the brochure improved respondents' asthma-specific knowledge impacting practices towards asthma. The short time duration between phases could have resulted in better memory retention by the respondents.

Iraj Poureslami *et al.* (2012) investigated effect of information presentations by community educational videos and illustrated pamphlet on asthma patients' self-management. The education that patients received on asthma self-management through the interventional tools contained asthma-specific information. Asthma knowledge increased drastically post-intervention, proving that short, simple and appropriate intervention improve respondents' asthma knowledge and practices.²⁷ Bandana Saini *et al.* (2011) evaluated knowledge improvement post-customized interventional education program provided by pharmacists and measured the sustainability of improvements and patients' asthma perception due to knowledge alteration. It was conducted at 3-4 points over a period of six months. At the start

Table 4: Scores and associated scores grades for each domain and total scores.

Sections	Phase-1 (score)	Grade	Phase-2 (score)	Grade	p-value
A	6.00	Poor	10.00	Moderate	< 0.001*
B	16.00	Poor	21.00	Moderate	
A+B	22.00	Poor	31.00	Moderate	

(*Wilcoxon Signed Ranks test)

Table 5: Wilcoxon signed Rank test for Sections-A, B and the total score.

Particulars	Phases-1 and 2	N	Mean Rank	Sum of rank	p-value
P1_A	1	249	191.90	47782.00	< 0.001*
	2	250	307.87	76968.00	
P2_A	1	249	191.90	47782.00	
	2	250	307.87	76968.00	
P1_B	1	248	182.99	45382.50	
	2	249	314.74	78370.50	
P2_B	1	248	182.99	45382.50	
	2	249	314.74	78370.50	
P1_A+B	1	247	178.29	44036.50	
	2	249	318.15	79219.50	
P2_A+B	1	247	178.29	44036.50	
	2	249	318.15	79219.50	

(P1 = Phase-1; P2 = Phase-2) (*Wilcoxon Signed Rank Test)

and end of the service, asthma knowledge was evaluated. The asthma knowledge improved significantly due to the service provided, which was sustained for 12 months post-service. Customized educational intervention did improve and sustained asthma knowledge. Pharmacists who delivered educational intervention manage to promote asthma knowledge.²⁸ A review conducted by Australian Association of Health Promotion Professionals to determine printed materials' efficacy in altering health-related knowledge, behavior and attitudes revealed that with use of brochure, knowledge, attitudes and behavior of health-related disease can be effectively increased. They concluded that practitioners have to continue using brochures for patients and public education.²⁹ A single-blind, parallel design, randomized-controlled trial by Dianne Goeman *et al.* (2013) utilized educational intervention by Patient Asthma Concern Tools (PACT) to improve asthma control and adherences to medications for patients. Patient-centric education significantly increases asthma outcomes. The use of PACT to assess patients' concerns and requirements would aid health professionals to improve asthma knowledge and practice.³⁰ Lais Souza Barretto Cardosa *et al.* (2016) systematically reviewed 17 clinical trials literature regarding effects of asthma education intervention in schools. 29% of interventions had reduced asthma symptoms, 35% decrease frequency of hospitalization, 29% showed reduced absenteeism in school and 41% increase in individuals' QoL. They concluded that educational intervention carried can increase the asthma awareness and decrease the effect of morbidity indicators.³¹

With time, people lose their ability to recall information. Amount of information retained per gradually reduces. Spacing effect refers to increased retention following learning instances spaced out in time. Spaced learning is affected by previous learning as it affects memory and attention processes that are crucial to spacing effect.³² Spacing effect (or spaced repetition) is the repeated provision of same information at regularly spaced time intervals to reinforce key concepts.³³

Second aim of this study was to determine spacing effect's impact on asthma knowledge, perception and practice after exposure to educational brochures. The spacing effect has been documented to involve adult participants who demonstrated benefits of spacing effect over relatively brief time intervals.³⁴ Cepeda *et al.* (2009) analysed spacing effect's impact on knowledge. The one-year, triphasic study comprised 150 subjects. First two sessions were learning sessions. The two study sessions were separated by a gap ranging from ten minutes to six months. All subjects underwent a memory test six months post-second learning session. The results revealed that

information recall success (for both facts and names) was best for a one-month gap, being much worse for shorter gaps and slightly poorer for longer ones.³⁵ Sobel *et al.* (2011) investigated spacing effect on 39 respondents by employing both massed and spaced learning techniques. After a week, the ability to recall vocabulary was tested. The spacing group showed superior long-term retention when compared to massed learning group, proving that spacing effect can be effectively generalized in applied settings.³⁶ Positive outcomes of spacing effect are widely and well-studied. Spacing effect is especially strong to free recall information that an individual was repetitively exposed to, where probability of recalling repeated information often improves due to spaced repetition.³⁷

The above corroborative studies strongly imply that the improvement in knowledge pertaining to the current research's focal point (asthma) is largely due to impact of the educational interventional tool. Spacing effect contributed to knowledge improvement by reinforcing information after an optimal gap between each phase.

Score grades were 'poor' in Phase-1 and 'moderate' in phase 2. The current study revealed that asthma knowledge improved from '0-59%' to '60-79%'. Score grades attained can be correlated with improvement in asthma knowledge domain. Wilcoxon signed Rank test, ($p < 0.001$) proved that knowledge and score grades improvement were significant, implying the impact produced by the combination of the educational interventional tool and spacing effect. This augments the relevance of utilizing spaced educational intervention to improve and sustain asthma knowledge, perception and practices.

STUDY LIMITATIONS

1. As the data is self-reported, it is prone to response bias. The study participants may not have been truthful all the time in their responses in apprehension of hurting the sentiments of the researcher and data collectors.
2. A longer study period with more phases would have been even more beneficial to assess even more precisely the impact of the educational brochure and spacing effect on the respondents. This study was not able to assess the knowledge domain beyond the stated study period, or to assess whether the intervention transformed into better and positive outcomes for the respondents in the longer term.

CONCLUSION

The current research study was an attempt to improve

the knowledge regarding various aspects of bronchial asthma among a cohort of biomedical students in a private university in Malaysia. This research utilized the ‘spacing effect’ as a component of the interventional strategy to positively improve the asthma knowledge and self-management amongst the cohort. A positive shift in the respondents’ knowledge was observed during the course of this study. This was evident in the improved results (scores) in each domain and the total score. The score grades also improved from ‘poor’ to ‘moderate’ implying a positive shift in the knowledge domain regarding asthma. The ‘spacing effect’ reinforced the same information to aid the knowledge retention and recall. Repeated reinforcement of the same information resulted in improved information retention and recall. As the prevalence of asthma is persistently high in Malaysia, it is vital that both private and government sectors collaborate to tackle this issue. Interventional strategies utilizing the spacing effect can improve the outcomes with regard to asthma knowledge, provided the healthcare personnel and others involved in the programme are persistent and determined to include the spacing effect. Increased involvement of public and education can be a focal point of future research works. Comprehensive and sustainable educational campaigns through ‘Spaced Repetition-Based Educational Intervention’ can be incorporated into health education targeting the asthma population, in order to increase their knowledge and recall capacity regarding asthma. Utilizing the spacing effect however, requires extra motivation for healthcare personnel to incorporate into the educational interventional programmes. The utilization of spacing effect in this context is novel because no other interventional studies in the country have utilized this strategy to improve the healthcare outcomes of asthmatic individuals. Studies with a longer duration and multiple follow-ups are needed to investigate the long-term outcomes and to use their findings for the development of future educational programs.

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CONFLICT OF INTEREST

The author and researchers involved in this study report no conflict of interest.

ABBREVIATIONS

PASS: Power and Sample Size; **CI:** Confidence Interval.

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