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Research Paper

Causal relationships among self-management behaviors, symptom control, health-related quality of life and the influencing factors among Thai adolescents with asthma

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ABSTRACT

Objective: To examine causal relationships among asthma self-management behaviors, asthma symptom control, health-related quality of life and the influencing factors among Thai adolescents.**Methods:** A cross-sectional study was conducted using convenience sampling. A total of 240 adolescent-caregiver dyads from three tertiary hospitals in Bangkok, Thailand was ultimately included. Interviews and self-administered questionnaires assessing health-related quality of life, asthma symptom control, asthma self-management behaviors, health literacy, depression, comorbidities, family support, peer support, home environmental management, and relationships with health care providers were administered between November 2020 and July 2021. A hypothesized model based on the revised self- and family-management framework was proposed. Data were analyzed using descriptive statistics and path analysis.**Results:** It was shown that the proposed model was a good fit for the empirical data and accounted for 67.2% of the variance in health-related quality of life. Depression and asthma symptom control directly affected quality of life ($\beta = -0.132, P < 0.05$; and $\beta = 0.740, P < 0.05$, respectively), while asthma self-management behaviors did not. Both depression and asthma self-management behaviors had indirect effects on the quality of life through asthma symptom control ($\beta = -0.382, P < 0.05$; and $\beta = 0.225, P < 0.05$, respectively). Health literacy ($\beta = 0.343, P < 0.05$), family support ($\beta = 0.167, P < 0.05$), peer support ($\beta = 0.163, P < 0.05$), and relationships with health care providers ($\beta = 0.181, P < 0.05$) also showed direct effects on asthma self-management behaviors.**Conclusion:** The findings confirmed the causal relationships among asthma symptom control, self-management behaviors, depression and health-related quality of life. Health literacy, support from family and peers, and relationships with health care providers were also found to influence asthma self-management behaviors. To achieve effective asthma control and good quality of life, a nursing intervention promoting asthma self-management for Thai adolescents should be developed. Early detection and intervention of depressive symptoms are also suggested.© 2023 The authors. Published by Elsevier B.V. on behalf of the Chinese Nursing Association. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

What is known?

- The serious signs and symptoms of asthma have substantial impacts on physical, psychological, and social functions among adolescents, resulting in poor health-related quality of life.

- Asthma self-management is an effective approach to improving health outcomes, including asthma control and quality of life.
- Knowledge of correlational and predicting factors of asthma self-management, asthma symptom control, and health-related quality of life have been well established, but causal relationships among them cannot be drawn, especially in the Thai context.

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What is new?

- Asthma self-management behaviors do not directly affect Thai adolescents' health-related quality of life, but those who perform good self-management achieve control of their asthma symptoms, consequently leading to the improvement of their health-related quality of life.
- Depression could affect Thai adolescents' health-related quality of life both directly and indirectly by working through asthma symptom control.
- Thai adolescents with asthma who have adequate health literacy, sufficient support from family and peers, and trustworthy relationships with health care providers would self-manage their asthma well, leading to effective asthma symptom control.

1. Introduction

Asthma is a long-term inflammation of the airways caused by hyperresponsiveness that results in swollen cells lining the airways, bronchospasm, and airway obstruction. Even though asthma is a controllable disease, recurrent symptoms may occur when encountering with triggering factors. During an asthma exacerbation, patients have difficulty breathing due to wheezing, coughing, breathlessness, and chest tightness [1].

The serious signs and symptoms of asthma could have substantial impacts on physical, psychological, and social functions among children and adolescents. Coughing, shortness of breath, wheezing, and chest tightness interfere with the daily activities of affected adolescents by causing them to reduce physical activity or outdoor activities to avoid exacerbating symptoms [2]. They also report missing school days due to asthma attacks and urgent visits to an emergency room [3], resulting in lower academic performance with respect to mental process, comprehension, and learning ability in subjects [4]. Moreover, many adolescents with asthma feel different from their peers and isolate themselves, as they feel embarrassed when using inhalers in public and anxious about avoiding asthma triggers [5–7]. Thus, effective symptom control is the key component of asthma treatment and management, which can lead to good health-related quality of life.

Self-management behavior is an important strategy for success in asthma symptom control and good health-related quality of life [8]. During the transitional phase between childhood and adulthood, the responsibility of asthma care is transferred from parents to adolescents themselves. However, adolescents still require parental supervision and guidance. This transition and gradual independence may lead to difficulty with respect to self-management behaviors [9]. Qualitative studies have shown that adolescents with asthma often overlook and underreport symptoms to parents and health care providers [5,10]. Moreover, they do not perform symptom monitoring and management behaviors due to negative relationships and poor communication with health care providers [6,11]. Thus, adolescents are particularly at risk of poor asthma self-management.

Influencing factors of asthma self-management among adolescents include health literacy [12,13], psychological disorders [6,14], comorbidities [6], peer support [5], family support [5,6], environment management [15], and relationships and communication with health care providers/teachers/peers [5,11]. Systematic reviews also reported the positive effects of asthma self-management programs on asthma symptom control and patient health-related quality of life [8,16].

While there is a large body of published research on the factors influencing asthma self-management behaviors, asthma symptom control, and health-related quality of life, certain gaps of knowledge still exist. First, most previous studies used an individual-level theory as their study framework. Few studies have focused on family involvement and the health care system in adolescents' asthma management, while, in pediatrics, self-management includes shared management roles between adolescents and families [9]. Furthermore, health care systems can affect the capacity of individuals and families to manage long-term illness [17]. Second, previous studies conducted in Thailand used correlational study designs to predict the outcome variables. Such designs only describe direct relationships among the study variables but do not clearly illustrate the complex relationships among multiple factors that contribute to the outcomes. Third, the previous findings cannot be generalized to the Thai context due to the differences in geography and sociocultural aspects. Allergic fungi are commonly found in Asian countries located in tropical zone, where fungi grow easily and spread a large number of spores in the air [18]. Such environmental conditions could affect asthmatic symptoms. In addition, sociocultural beliefs have been found to have an effect on asthma self-management behaviors. Patients and their families have their own unique beliefs and experiences regarding the use of complementary and alternative medicines for asthma, which are widely used in Asia [19]. Moreover, Thai child-rearing culture might affect the asthma self-management behaviors of adolescents, as adolescents in Thai families are expected to obey and respect their parents [20]; thus, compared to the Western context, Thai adolescents may be less independent and less likely to perform self-management behaviors.

To bridge these gaps of knowledge, the current study used the Revised Self- and Family Management framework, which proposes facilitators and barriers at the individual, family, and health care levels and identifies the process of self- and family management, as well as health outcomes [17], as the study framework. The aim of this study was to examine the pattern of causal relationships among asthma self-management behaviors, asthma symptom control, and health-related quality of life as well as their influencing factors among Thai adolescents, as proposed in Fig. 1. Fully understanding the comprehensive relationships among the study factors would enable the development of an appropriate nursing intervention to increase Thai adolescents' self-management behaviors, improve asthma control, and enhance their health-related quality of life.

2. Participants and methods

2.1. Study design

The study used a cross-sectional study design with path analysis. First, data regarding the study factors were collected; one month later, data regarding the study outcomes, including asthma control and health-related quality of life, were collected.

2.2. Settings and sample

The study was conducted at tertiary hospitals (having 1,000 beds or more) located in Bangkok, where allergy and immunology clinics were available to provide outpatient services to patients with asthma. Three hospitals granted permission to conduct this study between November 2020 and July 2021.

Populations in this study included Thai adolescents with asthma

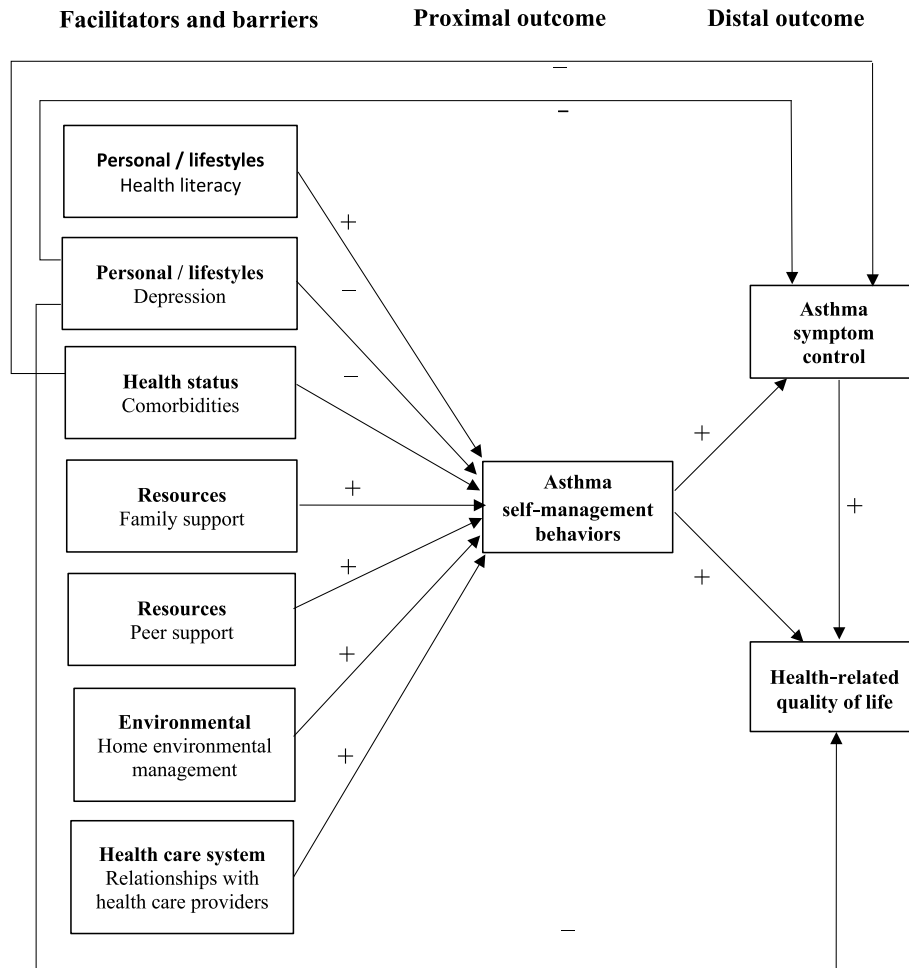


Fig. 1. A hypothesized model of the causal relationships among asthma self-management behaviors, asthma symptom control, health-related quality of life and the influencing factors among Thai adolescents.

and their caregivers. The study sample was recruited by convenience sampling. The inclusion criteria for adolescents were as follows: 1) between 12 and 18 years of age, 2) diagnosed with asthma (at any degree of severity) for at least 6 months, 3) taking at least one type of asthma medication, and 4) able to read and write Thai independently. The inclusion criteria for caregivers were as follows: 1) 18 years of age or older, 2) a parent or relative of adolescent patients who lived in the same house, and 3) able to read and write Thai independently. Adolescents with developmental disability affecting their cognitive function were excluded from the study. Kline recommends a minimum of 10 participants per estimated parameter for an optimal model fit [21]. The hypothesized model in this study consists of 23 estimated parameters that include 13 paths and 10 error terms (see Fig. 1). Therefore, the sample size in this study should be at least 230 [21]. To account for the potential loss of subjects during data collection, 240 adolescent-caregiver dyads were ultimately recruited.

2.3. Research instruments

2.3.1. Personal information questionnaire

The personal information questionnaire developed by the researchers consists of 1) adolescent and caregiver interviews to collect demographic information and 2) a clinical information recoding form to collect histories of asthma and comorbidities as well as to collect current medication from medical records,

including asthma controller medication (used to reduce airway inflammation and control symptoms) and asthma reliever medications (used for as-needed relief of worsening asthma).

2.3.2. The Functional, Communicative and Critical Health Literacy – Thai version

The Functional, Communicative and Critical Health Literacy (FCC-HL) [22] – Thai version [23] consists of 14 items and three domains: functional, communicative, and critical health literacy. Each item was evaluated on a 4-point rating scale ranging from 1 (never) to 4 (always). Higher scores indicate a greater level of health literacy. The psychometric properties of this questionnaire were tested among patients with chronic illness in the United States. The results showed good reliability for each subscale (ranging from 0.79 to 0.89), and confirmatory factor analysis yielded a three-factor model consistent with the original construct [24].

2.3.3. The Center for Epidemiologic Studies Depression Scale -Thai version

The Center for Epidemiologic Studies Depression Scale (CES-D) [25] -Thai version [26], a 20-item scale, was used to assess sorrowful feelings, positive emotions, somatic and retarded activity, and social interactions of the adolescents. The response options for each item include seldom or never (0), sometimes (1), often (2), and always (3). Scores of 16 or above indicate that the respondent is at risk for depression. The internal consistency of the scale was 0.85.

The criterion validity was assessed; the correlation between the CES-D and the Hamilton Clinician's Rating scale was moderate (0.44) [26].

2.3.4. *The Perceived Social Support from Family and Friends questionnaires*

The Perceived Social Support from Family (PSS-Fa) and Friends (PSS-Fr) questionnaires [27] were used to assess an individual's perception of how well family and friends meet one's need for support. Each questionnaire includes 20 items. The response options for each item include Yes (1), No (0), and Don't know (not scored). Higher scores indicate higher perceived support provided by family and friends. Cronbach's α coefficients for the PSS-Fa and PSS-Fr were 0.90 and 0.88, respectively, and confirmatory factor analysis indicated that each questionnaire comprised a single factor, as expected from the method of final item selection [27].

2.3.5. *The Caregiver Home Environmental Management Questionnaire*

The Caregiver Home Environmental Management Questionnaire [28] contains 37 questions assessing Thai caregivers' management of allergens and triggers such as dust mites, cockroaches, animal dander, mold, pollen, cigarette smoke, and other respiratory irritants. Response options for each item range from 0 to 4, and higher scores indicate more effective home environment management. As this questionnaire asks for factual information regarding the caregiver's practice, the reliability was not assessed by the developers. Content validity was checked and revised until the content validity index was 1.00 [28].

2.3.6. *The Patient-Doctor Relationship Questionnaire*

The Patient-Doctor Relationship Questionnaire (PDRQ-9) [29] is a 9-item scale, used to assess the extent to which patients view their primary care practitioner as a supportive and helpful health care professional. In the current study, the term 'primary care practitioner' was changed to 'health care providers,' which could include doctors, nurses, and pharmacists. Responses were provided on a 5-point Likert scale ranging from totally disagree (1) to totally agree (5). Higher scores indicate a stronger relationship. A Cronbach's α coefficient of 0.94 was reported among 165 patients; additionally, based on principal components analysis, the first factor (9 items) explaining 58% of the variance was selected, while the second factor explaining only 9% was deleted [29].

2.3.7. *The Asthma Self-Management Behaviors Questionnaire*

The Asthma Self-Management Behaviors Questionnaire (ASMB) was developed by the researchers based on a concept analysis by Mammen and Rhee [30]. This 25-item questionnaire assesses how often adolescents perform asthma self-management behaviors in terms of prevention management, symptom monitoring, attack management, and communication and seeking information with significant others. The response options range from never (1) to every time (4). Higher scores indicate more effective the self-management behaviors. The ASMB was examined for its content validity by 5 specialists who care for children with asthma. The I-CVI ranged from 0.6 to 1.00, and the S-CVI was 0.94.

2.3.8. *The Global Initiative for Asthma Assessment of Asthma Control*

The Global Initiative for Asthma (GINA) Assessment of Asthma Control is a 4-item screening questionnaire for patients with asthma to assess the presence of the following features in the past 4 weeks: daytime asthma symptoms more than twice/week, any night waking due to asthma, use of short-acting β -agonists (SABA) reliever for symptoms more than twice/week, and any activity

limitation due to asthma. The response options for each item included 'Yes' (1) or 'No' (0). Based on total scores, respondents are classified into 3 levels of asthma symptom control: controlled (reporting none of the features), partly controlled (reporting 1–2 of the features), and uncontrolled (reporting 3–4 of the features). In the data analysis of the current study, two categories (i.e., partly controlled and uncontrolled) were combined.

2.3.9. *The Standardized Pediatric Asthma Quality of Life Questionnaire - Thai version*

The Standardized Pediatric Asthma Quality of Life Questionnaire (PAQLQ) [31] - Thai version [32] is a 23-item questionnaire to assess three domains of health-related quality of life (activity restriction, asthma symptoms, and emotional function) in children with asthma by assessing physical and emotional problems they had in the past weeks. Response options for each item range from extremely bothered (1) to not bothered at all (7). Higher scores indicate better health-related quality of life. An interclass correlation coefficient of 0.95 was reported for the entire scale; for its construct validity, cross-sectional correlations between all the domains of the PAQLQ and clinical asthma control and β -agonist use showed moderate relationships, with Pearson correlation coefficients ranging from 0.30 to 0.60 [31].

Except for the ASMB, permissions for the use and translation of the questionnaires were obtained from the original tool developers and translators. The back-translation technique was used with every English questionnaire. The reliability of each questionnaire was tested with 30 adolescent-caregiver dyads who were matched to the study samples. The Cronbach's α coefficients were 0.84 for the FCC-HL, 0.85 for the CES-D, 0.76 for the PSS-Fa, 0.74 for the PSS-Fr, 0.93 for the PDRQ-9, 0.75 for the ASMB, and 0.93 for the PAQLQ.

2.4. *Ethical considerations*

This study was approved by the institutional review boards of the participating hospitals (COA No. Si917/2020, COA No. MURA2020/1767, and COA-NMD-REC 031/63).

2.5. *Data collection*

Registered nurses at each study location introduced the research study to eligible adolescents and their caregivers. If they showed interest in the study, the first researcher (JS) described the study objectives and procedure. Both eligible adolescents and their caregivers were asked to join the study voluntarily. Those who agreed to participate in this study were asked to sign an assent form (for adolescents) and informed consent form (for caregivers). Then, the first researcher conducted the data collection by obtaining personal information from the adolescents and their caregivers; distributing a set of self-administered questionnaires (including the FCC-HL, CES-D, PSS-Fa, PSS-Fr, PDRQ-9, and ASMB) to the adolescents; and administering the Caregiver Home Environmental Management Questionnaire to the caregivers. At this step, the questionnaires were distributed to 240 adolescent-caregiver dyads. Thirty days later, the researcher phoned the adolescents and interviewed them about asthma symptom control and asked them to complete the PAQLQ via Google Forms. The completed questionnaires were returned by all adolescents.

2.6. *Data analysis*

Descriptive statistics were used to describe the demographic characteristics of the participants and the study variables using the Statistical Package of the Social Science (SPSS) for Window version 18.0 (SPSS Inc., Chicago, IL, USA). The data were slightly

nonnormally distributed based on skewness and kurtosis analyses; path analysis with the maximum likelihood, which is robust for nonnormally distributed data [21], was used to investigate the direct and indirect effects of the study variables. Mplus program version 8.6 was used to conduct these analyses. The following fit indices were used to indicate a good model fit: 1) a nonsignificant chi-square (χ^2); 2) a ratio of chi-square (χ^2)/degree of freedom (*df*) less than two; 3) a root mean square error of approximation (RMSEA) less than 0.05; 4) a comparative fit index (CFI) greater than 0.95; 5) a Tucker–Lewis index (TLI) greater than 0.95; and 6) a standard root mean square residual (SRMR) less than 0.05.

3. Results

3.1. Characteristics of the participants and variable scores

In this study, 240 adolescents with asthma and their caregivers were recruited as study participants. The characteristics of adolescents and caregivers are presented in Tables 1 and 2, respectively.

Descriptive statistics in terms of range, median and interquartile range (IQR) of the variable scores are presented in Table 3. Notably, CES-D score of 74 (30.8%) adolescents reached at least 16, indicating a risk for depression.

3.2. Model testing

The proposed model was a good fit for the empirical data according to the goodness of fit indices, as shown in Fig. 2. The model accounted for 67.2% of the variance in health-related quality of life. As shown in Fig. 2 and Table 4, both asthma symptom control and depression directly affected quality of life. Depression also indirectly affected quality of life through asthma symptom control. Asthma self-management behaviors had a direct effect on asthma symptom control and an indirect effect on quality of life through asthma symptom control. Moreover, health literacy, family support, peer support, and relationships with health care providers had significant direct effects on asthma self-management behaviors.

Table 1
Characteristics of the adolescents with asthma (*n* = 240).

Characteristics	<i>n</i> (%)
Gender	
Male	165 (68.8)
Female	75 (31.2)
Age (years, Mean ± SD)	13.77 ± 1.86
Age of asthma onset (years, Mean ± SD)	3.52 ± 2.68
Emergency visit related to asthma exacerbation (during the past 12 months)	
Yes	15 (6.2)
No	225 (93.8)
Asthma controller medication	
Yes	214 (89.2)
No	26 (10.8)
Asthma reliever medications	
Yes	163 (67.9)
No	77 (32.1)
Number of comorbidity	
0	3 (1.3)
1 (Allergic rhinitis)	169 (70.4)
2–3 (Allergic rhinitis plus others)	68 (28.3)
Asthma symptom control	
Controlled	163 (67.9)
Partly controlled	76 (31.7)
Uncontrolled	1 (0.4)

Table 2
Characteristics of caregivers (*n* = 240).

Characteristics	<i>n</i> (%)
Gender	
Male	22 (9.2)
Female	218 (90.8)
Age (years, Mean ± SD)	45.10 ± 6.16
Education	
Primary school	29 (12.1)
High school or equivalent	74 (30.8)
College/University degrees	137 (57.1)
Relationships with asthmatic patients	
Mother	209 (87.1)
Father	18 (7.5)
Grandfather/Grandmother	10 (4.2)
Relatives	3 (1.2)

4. Discussion

4.1. Factors influencing health-related quality of life and mediation of asthma symptom control

As expected, asthma symptom control had a direct effect on health-related quality of life with a strong magnitude of influence ($\beta = 0.740, P < 0.05$) among adolescents with asthma. Consistent with previous studies, a moderate correlation ($r = 0.6, P < 0.001$) was found between asthma control and quality of life among Indonesian children and adolescents [33]; another study from Palestine reported that children and adolescents with uncontrolled asthma had a 2.88 times poorer quality of life ($OR = 2.88, 95\% CI: 2.21, 3.41$) than their counterparts [34]. This is not surprising, as asthma symptoms impact adolescents' school performance and social life. A lack of concentration in school due to poor sleep quality when experiencing asthma symptoms at night and frequent school absences due to asthma symptoms and doctors' appointments could reduce their class or education involvement [35]. Moreover, in the case of poor asthma control, vigorous exercise could trigger asthma, which could keep adolescents from being physically active and lead them to adopt a sedentary lifestyle [2,36]. While adolescents with asthma withdraw from exercise as a coping strategy to address their fear of an asthma attack, healthy adolescents misinterpret such withdrawal as laziness or an excuse to avoid certain activities [35]. Such misperception would set the stage for teasing, resulting in a loss of self-esteem among those with asthma, which, in turn, will cause them to be more isolated. A qualitative study also reported that adolescents isolated themselves due to being embarrassed and bullied by having asthma attacks in public [5]. In contrast, if these adolescents could control their asthma symptoms very well, they would be able to be more involved in physical and social activities without the feeling of “being different”, thus resulting in good health-related quality of life.

The current study also confirmed a significant direct effect of depression on quality of life. Depression is a condition characterized by poor mood and aversion that may impair an individual's thinking, personality, and overall well-being. Thus, compared to adolescents with asthma who do not have depressive symptoms, those with depressive symptoms suffer greater impairments with respect to daily activities, interest in working or previously enjoyed activities, sleeping at night, and social life and relationships, all of which result in a poor health-related quality of life [37]. Depression also indirectly affected quality of life via asthma symptom control. This relationship can be explained by the fact that depression might enhance bronchial hyperactivity through mechanisms such as mast cell activation, mediator release, inflammation, and impairment of

Table 3
Description of the variable scores of the adolescents with asthma (n = 240).

Variables	Possible range	Actual range	Median (IQR)
Health literacy	14–56	27–54	45 (35–48)
Depressive symptom	0–60	0–30	10 (7–19.75)
Family support	0–20	3–20	14 (10–16)
Peer support	0–20	8–20	16 (12–19)
Home environment management	0–148	74–144	112 (106–122)
Relationships with health care providers	9–45	21–45	40 (31–41.75)
Asthma self-management behaviors	25–100	40–72	53 (47–58)
Asthma quality of life	7–161	100–161	148 (128–161)

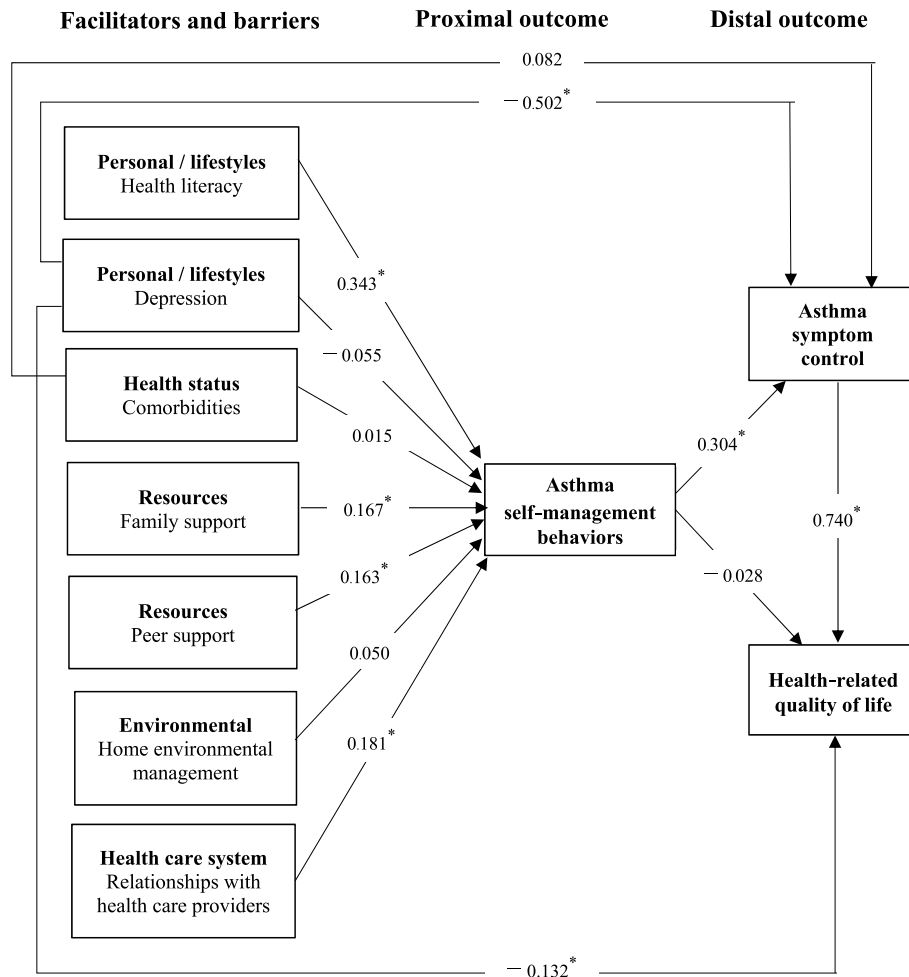


Fig. 2. A validated model of causal relationships among asthma self-management behaviors, asthma symptom control, health-related quality of life, and the influencing factors among Thai adolescents.

Note: * $P < 0.05$; $\chi^2 = 7.049$, $df = 11$, $P = 0.795$, $\chi^2/df = 0.640$, RMSEA = 0.000, CFI = 1.000, TLI = 1.000, and SRMR = 0.012.

respiratory tolerance, resulting in asthma exacerbation [38]. Furthermore, depressive symptoms also impair asthma control by decreasing adherence to their medical regimens [38], which would worsen the controllability of the symptoms and ultimately lead to poor quality of life.

In the current study, asthma self-management behaviors viewed as a multidimensional concept had an indirect effect on health-related quality of life through asthma symptom control. Previous studies using a similar framework of self-management to the current study showed that patients who underwent asthma self-management programs (consisting of activities such as trigger avoidance, self-assessment of symptoms, medication adherence,

use of peak-flow meters, communication with others) had better asthma symptom control [8,16] and a lower frequency of hospital admission and emergency visits [16]. Such findings confirm that once adolescents with asthma perform good self-management behaviors, they will be able to succeed in asthma symptom control, which would result in good health-related quality of life.

However, interestingly, a direct effect of self-management behaviors on health-related quality of life was not observed in this study ($\beta = -0.028$, $P > 0.05$), even though the variables were moderately correlated ($r = 0.541$, $P < 0.01$). According to a systematic review, school-based asthma self-management interventions probably improve children’s and adolescents’ health-

Table 4
Standardized direct effects, indirect effects, and total effects of the study variables on asthma self-management behaviors, asthma symptom control, and health-related quality of life among adolescents with asthma (n = 240).

Causal variables	Asthma self-management			Asthma symptom control			Health-related quality of life		
	DE	IE	TE	DE	IE	TE	DE	IE	TE
Health literacy	0.343*	–	0.343*	–	0.104*	0.104*	–	0.068*	0.068*
Depression	–0.055	–	–0.055	–0.502*	–0.017	–0.518*	–0.132*	–0.382*	–0.514*
Comorbidities	0.015	–	0.015	0.082	0.005	0.087	–	0.064	0.064
Family support	0.167*	–	0.167*	–	0.051*	0.051*	–	0.033*	0.033*
Peer support	0.163*	–	0.163*	–	0.050*	0.050*	–	0.032	0.032
Home environment management	0.050	–	0.050	–	0.015	0.015	–	0.010	0.010
Relationships with health care providers	0.181*	–	0.181*	–	0.055*	0.055*	–	0.036	0.036
Asthma self-management	–	–	–	0.304*	–	0.304*	–0.028	0.225*	0.197*
Asthma symptom control	–	–	–	–	–	–	0.740*	–	0.740*
	$R^2 = 0.689$			$R^2 = 0.556$			$R^2 = 0.672$		

Note: *P < 0.05. DE = direct effect. IE = indirect effect. TE = total effect.

related quality of life but do not yield clinically significant improvements; one noticeable point was that quality of life in the included studies was measured with different concepts [16]. It is also noteworthy that self-management behaviors in previous studies mainly focused on ‘adherence’, which was only one aspect of self-management [36,39], while the current study viewed asthma self-management behaviors as a multidimensional concept [30], including prevention, monitoring, management, and communication. Thus, it is logical to see their control over asthma symptoms as a direct outcome of self-management rather than health-related quality of life. When these adolescents succeed in asthma symptom control, their health-related quality of life will consequently be improved.

4.2. Factors influencing asthma self-management behaviors

The study found that health literacy had a direct influence on asthma self-management behaviors, thus supporting the premise that good self-management of asthma requires good health literacy specific to asthma. Consistent with previous studies of African American adolescents with asthma [12] and undiagnosed asthma [13], adolescents with poor health literacy were less likely to have sufficient self-management. Adolescents with asthma who have good health literacy are likely to possess adequate reading and writing skills; they are able to obtain, process, understand and apply asthma-related information/materials and services. Moreover, they are able to use this knowledge to make health-related decisions in a variety of different environments. Such health literacy skills are crucial for responding to the demands of managing the various aspects of asthma, including the avoidance of asthma triggers, adherence to medication, adjusting asthma action plans, or deciding to seek advice when experiencing a worsening condition [40]. In contrast, insufficient health literacy could prevent patients with asthma from accessing and understanding health information, which, in turn, would lead these people to rely heavily on certain informal sources of information that may not be accurate. Moreover, these patients with limited health literacy did not consider checking the information given to them; thus, the efficacy of their self-management behaviors was questionable [41].

In this study, adolescents who perceived good support from families and friends showed appropriate asthma self-management behaviors. This finding is very logical because asthma in both children and adolescents imposes a treatment burden not only on patients but also on their families; as a result, family involvement in asthma management is important. A qualitative study revealed that Thai school-age children described support from family in three forms: teaching them to take medicine, monitoring and reminding them to take medications, and promoting a positive attitude toward

asthma and treatment [42]. Likewise, systematic reviews indicated that family support could act as a facilitator of asthma self-management by reminding them to take medication, educating them about the disease, calming them during the asthma attack, providing transportation to medical appointments, and providing emotional support [5,6]. In addition to family support, peers are a significant source of support during the transition from childhood to adolescence. When they feel support from their friends, adolescents’ feelings of isolation are reduced, and their feelings of normalcy increase [43]; consequently, they are encouraged to maintain self-management behaviors. They also feel more comfortable taking medicine in public and communicating their symptoms to others [5]. Moreover, an empirical study also revealed that a peer-led asthma self-management program had high acceptability among friends with asthma [44].

As expected, the relationships with health care providers was found to have a direct influence on asthma self-management behaviors. Previous systematic reviews have indicated that a mutually trusting relationship between health care providers and patients could significantly facilitate asthma self-management [5,6,10]. Adolescents are often considered only on the way to adulthood and are not fully capable of forming opinions to make decisions; thus, they are not sufficiently informed or optimally supported, and they are unable to play a role in medical decision-making, which is an important part of self-management [45]. Thus, when health care providers build trusting relationships with them by communicating and listening to patients with understanding as well as advising them with helpful key things, adolescents are more likely to have better self-management. A recent Thai qualitative study also revealed that children with asthma could manage their asthma symptoms and medications because they had a chance to talk and share experiences with health care providers during follow-up visits [42].

4.3. Factors not influencing asthma self-management behaviors

In general, individuals with depressive symptoms often express sadness, tearfulness, loneliness, hopelessness, and frustration. As a consequence, such adverse moods affect intentions, motivation, and action in desirable daily behaviors such as self-management behaviors. Unexpectedly, the current study showed contradictory results. Consistent with a study by Patel and colleagues [46], the effect of depression on self-management behavior was found to be negative but not statistically significant, which suggests that it might be due to chance, and more research should be done for further investigation. A scoping review reported that relationships between depressive symptoms and self-management behaviors varied by the type of self-management studied among adolescents

with asthma [47]. Nonetheless, it is noted that in the current study, both depression and asthma self-management behaviors were highly correlated ($r = -0.694$, $P < 0.01$). It could be concluded that depression was related to asthma self-management behaviors, but after controlling for all other study factors, a direct effect of depression was not observed ($\beta = -0.055$, $P > 0.05$).

Self-management mostly tends to decrease as the number of comorbidities increases. A previous study explained that this is because patients with comorbidities are more likely to obtain several treatments from medical health care providers; it is possible that therapeutic competition between asthma and other illnesses becomes more complicated and difficult to manage, resulting in aggravating asthma symptoms [48]. However, the current study showed differing results; comorbidity did not have a direct effect on self-management and asthma control. A possible reason may be that less severe comorbid conditions were found in this study; approximately 70% of patients reported only one comorbidity, and allergic rhinitis was reported in all cases. In addition, the treatment for asthma could also cover the symptoms of allergic rhinitis. Moreover, approximately two-thirds of the study adolescents had good asthma control. Thus, less severe allergic rhinitis together with controllable asthma would probably obscure the direct effect of comorbidity on asthma self-management behaviors.

Generally, family plays a major role in managing the home environment to reduce asthmatic triggers, and the involvement of their children with asthma in such management may vary from family to family. We expected that family participation in eliminating sources of allergens and asthma triggers would be a model of home environment management for their children in learning how to self-manage their asthma. The study findings did not support this hypothesis; that is, the home environment was not found influence adolescents' self-management. According to the literature review, it is highly possible that tensions and conflicts arose when parents were overanxious and tried to monitor their adolescents to be on the track of keeping a healthy home environment [49,50]; the adolescents viewed parents' commands as annoying and perceived them as a form of control [51]. Thus, parents' home environment management might not noticeably contribute to adolescents' self-management.

4.4. Limitations

This study had limitations that could prevent the findings from being generalized. First, data collection was performed during the COVID-19 pandemic. Most adolescents stayed home, wearing face masks outdoors and physically distanced to avoid infection. Such health protective behaviors might contribute to more effective asthma symptom control than usual. Second, we recruited adolescents with asthma who attended tertiary hospitals offering specialty allergy and immunology clinics for children and adolescents with asthma. In addition, the caregivers were well educated and accompanied by the adolescents to the clinics. We assume that the adolescents involved in the study received very good care from hospitals and caregivers. Consequently, our study findings may not be generalized to the population of asthmatic adolescents in Thailand. Thus, the results should be interpreted with caution.

5. Conclusion

The findings underlined the significance of asthma self-management behaviors and depression, as both factors affected asthma symptom control, resulting in health-related quality of life. Thus, it is essential to develop a nursing intervention to promote self-management for Thai adolescents with asthma. To optimize and sustain the effectiveness of the self-management intervention,

the factors influencing asthma self-management (including health literacy, support from family and peers, and trusting relationships with health care providers) should also be incorporated as core elements of the intervention. Screening for depressive symptoms among Thai adolescents with asthma should not be overlooked.

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Nothing to declare.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

CRediT authorship contribution statement

Jinnaphat Sangngam: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft. **Tassanee Prasopkittikun:** Conceptualization, Methodology, Validation, Formal analysis, Writing – original draft, Writing – review & editing. **Apawan Nookong:** Conceptualization, Methodology, Validation; Writing – review & editing. **Punchama Pacharn:** Conceptualization, Methodology, Validation, Supervision for data collection. **Chalermopol Chamchan:** Conceptualization, Methodology, Validation, Statistical consultation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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