School-Based Educational Interventions Can Significantly Improve Health Outcomes in Children with Asthma

Pussayaban Suwannakeeree MD*,
Jitladda Deerojanawong MD*, Nuanchan Prapphal MD*

** Department of Pediatrics, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand*

Background: *Lack of asthma knowledge among the pediatric patients and their caregivers contribute to poor asthma control in children. There is no data from Thailand on the health outcomes of school-based educational interventions for asthmatic children.*

Objective: *To assess the effectiveness of school-based asthma educational interventions on health outcomes, asthma control, and management in asthmatic children.*

Material and Method: *Forty-seven asthmatic students (6-15 years old), 14 caregivers, and five teachers from the Homkred School participated in the study. Asthma knowledge, workshops on pMDI (pressurized metered dose inhaler) techniques, use of asthma diaries, and self-management plans were provided. Pre- and post-tests were administered to assess the asthma knowledge of the asthmatic students, their caregivers, and teachers. Pulmonary function tests (PFT) were used to assess the health outcomes. The controls of asthma and self-management behaviors were assessed at three and six months post-intervention.*

Results: *There were significant improvements of asthma knowledge in all groups ($p<0.01$) immediately post-intervention and six months later. At pre-intervention phase, there were 18 children who had FEV_1 less than 80% of the predicted value. Their PFT significantly improved for all parameters at post-intervention, but in children who had normal FEV_1 at baseline, there were no significant changes. Control of asthma was significantly better three and six months post-intervention. The rate of regular use of ICS (inhaled corticosteroid) significantly increased to 40% at three months and 30% at six months ($p<0.001$) post-intervention. In addition, the self-management behaviors in the asthmatic children improved. The teachers' management of asthmatic attacks during the classes also improved. As a result of this, there were fewer emergency room (ER) visits.*

Conclusion: *School-based educational interventions can significantly improve asthma outcomes in children with asthma. Therefore, the authors highly recommend the use of this intervention.*

Keywords: *Asthma, School-based educational interventions, Asthma knowledge, Control of asthma*

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Global Initiative for Asthma (GINA) 2015 reported an estimated 300 million individuals worldwide are affected by asthma. It is a serious global health problem affecting all age groups, with increasing prevalence in many developing countries, especially among those younger than 18 years old[1]. Even in Thailand, the prevalence of asthma in 6- to 14-year-olds was shown to be 8.8%[2]. Asthma is not only a common chronic problem in children but it can also significantly affect their families and become a heavy burden for the public health care system[1-3]. For example, the direct and indirect effects of asthma can interfere with the children's physical exercise, disrupt the children's education due to frequent absences and symptoms, and result in poor academic performances at school due to lack of sleep. As for those children with a more severe case of asthma, their educational performance is significantly poorer due to numerous school absences. At the same time, asthma can also burden the family or caretakers who have to take time off work to care for the sick child[3-5].

Despite all the advances made in the field of asthma, yet it continues to be poorly controlled even in the Asia-Pacific region. In 2003, it was shown that in 884 children and 2,323 adults from urban areas of China, Hong Kong, Korea, Malaysia, Philippines, Singapore,

Correspondence to:
Deerojanawong J, Department of Pediatrics, Faculty of Medicine, Chulalongkorn University, 1873 Rama 4 Road, Bangkok 10330, Thailand.
Phone: +66-2-2564951, Fax: +66-2-2564911
E-mail: jitladda@chula.md, jitladda.d@chula.ac.th

Taiwan, and Vietnam, had daytime asthma symptoms half of the time and around 44.3% had interrupted sleep in the past four months[7]. These problematic symptoms are attributed to poor understanding of the disease and its inflammatory impact because only 13.6% used inhaled corticosteroids and 56.3% used reliever medication. Several studies from developed countries have shown that the factor associated with poor asthma control in children was the underuse of inhaled corticosteroid, which indicated that asthma education was deficient in the children and their caregivers due to the countries' underestimation of the asthma severity, and overestimation of the degree of asthma control[8-10].

Therefore, education and self-management programs are essential components of asthma control[10,11]. Several studies from western countries have shown that various different educational interventions can improve the clinical outcomes and quality of life in asthmatic children and their families[11-18]. One of the interventions of interest is the school-based program known as the Asthma Friendly School Initiative[19], established by the American Lung Association since 2001, provides educational interventions such as asthma action plans for all students with asthma, education for all school personnel on basic information of asthma and emergency response, and tools and resources for schools and communities. This Program was able to significantly improve the asthma symptoms and self-management behavior in the children, reduce the number of emergency room visits and decrease school absences. Yet, this Program is available only in Australia and England[20,21]. There are no such school-based educational interventional programs in Thailand or other resource-limited countries for the control of asthma. Hence, the authors ascertained whether the effects of school-based educational interventions could improve the health outcomes in asthmatic children or not. The authors also assessed the teachers' knowledge of asthma.

Material and Method

This prospective study surveyed the prevalence of asthma in 550 students from the Homkred School, Nakhon Pathom. The Thai International Study of Asthma and Allergies in Childhood (ISAACS) questionnaires[22] were used to screen for all participants. From 550 completed questionnaires, only 70 children reported having wheezing in the last 12 months. Two chest physicians examined the 70 children and the research assistants collected the children's asthmatic history. Fifty children were diagnosed with asthma and were recruited into the study. Three children were excluded because they could not perform the pulmonary function test (PFT). Thus, only 47 children completed this study between January and December 2012. School-based educational interventions were provided to the asthmatic children, their caregivers, and teachers.

The study was conducted in three phases, pre-intervention phase, intervention phase, and follow-up at three and six months after intervention. During the pre-intervention phase, the following data were collected from the 47 asthmatic students, demographic data, asthma severity, level of asthma control, and PFT. During the intervention phase, the asthmatic children, their caregivers, and teachers were invited to participate in the school-based educational interventions that were composed of knowledge on asthma, hands-on workshops on metered dose inhaler (MDI) techniques, breathing exercises, use of asthma diaries, and self-management plans. In this study, inhaled corticosteroid (ICS) and bronchodilator-based asthma treatments were provided to the participants. Pre- and post-tests, based on the Pediatric Asthma Caregiver's Quality of Life Questionnaire[23,24], were administered to assess the asthma knowledge of the asthmatic students, their caregivers, and teachers. During the follow-up phase, the authors re-examined the students' asthmatic symptoms and management (e.g. regular use of ICS, management and frequency of asthmatic attacks, school absences, and number of emergency room visits) as well as their PFT. This study was approved by the Institutional Review Board of Chulalongkorn University (IRB number 233/55). Both informed consents and assents were obtained from the participants as appropriate.

Statistical analysis

All statistical analyses were performed using the SPSS package (version 18, SPSS Inc., Chicago, IL, USA). The demographic data, pre- and post-test scores, pulmonary function parameters, and asthma symptoms were expressed using descriptive statistics (i.e., frequency, mean, standard deviation, and range). Categorical variables for the pre- and post-intervention data were compared using the compared t-test.

Results

The mean age of the asthmatic children was 10.9$\pm$2.3 years of which 62% were boys. Most of their

primary caregivers (85%) were parents. Based on the severity of the asthma symptoms and the results obtained from the pulmonary function tests, 65% had persistent asthma. Twenty percent of these children were prescribed ICS but none of them regularly used ICS as shown in Table 1. The results of the pulmonary function tests at the pre-intervention phase are shown in Table 2. All students with intermittent and mild persistent asthma had normal PFT. The abnormal PFT parameters were found in students with moderate persistent asthma. The authors detected 18 students (38.3%) with Forced expiratory volume in one second (FEV_1) less than 80% of the predicted value.

Knowledge of asthma was assessed in 18 children older than 12 years old, 14 caregivers, and five teachers. Immediately after the intervention, significant improvements in the knowledge of asthma were seen in all groups. The teachers were found to have the highest scores for asthma knowledge pre-intervention (32±1.8). The knowledge scores for asthma of the teachers increased to 39 (p = 0.01) and 38 (p = 0.02) immediately after intervention and at six months post-intervention respectively. The mean pre-test score for children aged ≥12 years was 26, which increased to 32 (p<0.001) and 31 (p = 0.02) immediately after intervention and at six months post-intervention respectively. As for the caregivers, the mean pre-test score was 29, which increased to 35 immediately after

Table 1. Baseline characteristics of the asthmatic children

Characteristics	n (%)
Age (year), mean ± SD	10.9±2.3
Sex	
Males	29 (61.7)
Females	18 (38.3)
Primary caregiver	
Parents	40 (85.0)
Others	7 (15.0)
Family's income <10,000 baht/month	36 (76.6)
Median age of onset (year), range	3.16 (0.5-9)
Severity of asthma	
Intermittent	17 (36.2)
Mild persistent	14 (29.8)
Moderate persistent	16 (34.0)
Prescribed with a bronchodilator	20 (42.5)
Prescriptions for patients with persistent asthma (n = 30)	
Prescribed with an inhaled corticosteroid	6 (20)
Regularly used inhaled corticosteroids	0 (0)

Table 2. Pulmonary function test at the pre-intervention phase (n = 47)

Severity of asthma	FVC (% predicted)	FEV_1 (% predicted)	FEV_1/FVC (%)	$FEF_{25-75\%}$ (% predicted)
	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)
Intermittent	89.9±10.8	92.9±8.8	97.9±8.1	98.6±20.4
Mild persistent	92.4±13.4	95.1±13.0	95.4±5.7	93.0±17.9
Moderate persistent	74.1±13.3	67.5±10.9	84.9±8.5	52.0±12.0

Table 3. Pre- and post-test scores

Group	Pre-test	Post-test at day 0		Post-test at 6 months	
	(mean ± SD)	(mean ± SD)	p-value*	(mean ± SD)	p-value**
Children ≥12 years old (n = 18)	25.9±5.0	31.8±3.7	<0.001	31.17±6.4	0.02
Caregivers of children ≤12 years old (n = 14)	28.9±5.1	35.2±1.4	<0.001	-	-
Teachers (n = 5)	32.4±1.8	39.2±1.4	0.010	38.4±2.0	0.02

p-value* = comparison between the pre-test score and post-test score immediately after intervention
p-value** = comparison between the pre-test score and post-test score 6 months after intervention

intervention (p<0.001) as shown in Table 3.

The effects of the intervention on the pulmonary function of the asthmatic children were also assessed. Twenty-nine children had normal pulmonary function at the pre-intervention phase. There were no significant changes for the averages of Forced vital capacity (FVC), FEV_1, FEV_1 ratio and Forced expiratory flow rate at 25% and 75% of vital capacity ($FEF_{25-75\%}$) post-intervention. However, the pulmonary functions of 18 children with pre-intervention FEV_1 less than 80% of the predicted value was significantly associated with the improvement for FVC (74.4±12.5 vs. 80.0±0.02, p = 0.02), FEV_1 (68.5±10.8 vs. 77.5±12.2, p<0.001) and $FEF_{25-75\%}$ (55.8±17.8 vs. 76.8±25.5, p<0.001) at three months post-intervention. There was a significant improvement in only $FEF_{25-75\%}$ at six months post-intervention (55.8±17.8 vs. 70.5±25.5, p = 0.01).

The authors assessed the level of asthma control in the children by dividing them into two groups based on a cut-off level of 12 years old because the latter group of children was able to take care of themselves. In the first group, 29 children were younger than 12 years old so the symptoms of asthma control were obtained from their caregivers. Before the intervention, only 48% of them had daytime symptoms less than two times per week. At three and six months after intervention, 90% of them had daytime symptoms less than two times per week (p<0.001). The nighttime symptoms also significantly decreased at six months after intervention (58.6% vs. 82.7%, p = 0.02).The emergency room visits decreased from 58% to 31% by three months post-intervention (p = 0.04) and to 20% by six months post-intervention (p = 0.002). For the school absences, nearly half of them (48.3%) reported school absences within the last three months prior to the intervention. The school absence rate decreased to 24% (p = 0.01) and 17% after three and six months post-intervention. For this group of children, the authors detected significant improvements in the control of asthma and fewer school absences.

As for the other group that was composed of 18 children, ages >12 years, the authors did not detect

Table 4. Comparison of pulmonary function between pre- and post-intervention in the abnormal spirometry group (n = 18)

% predicted	Pre-intervention	3 months post-intervention		6 months post-intervention	
	Mean ± SD	Mean ± SD	*p*-value*	Mean ± SD	*p*-value**
FVC	74.4±12.5	80.0±11.6	0.020	76.8±10.6	0.26
FEV_1	68.5±10.8	77.5±12.2	<0.001	73.4±12.4	0.10
FEV_1/FVC	86.3±9.2	84.9±6.6	0.720	83.5±8.5	0.45
$FEF_{25-75\%}$	55.8±17.8	76.8±25.5	<0.001	70.5±25.5	0.01

p-value*: comparison between the pulmonary function at pre-intervention and 3 months post-intervention
p-value**: comparison between the pulmonary function at pre-intervention and 6 months post-intervention

Table 5. Asthma control in children aged <12 years old (pre-intervention vs. 3 and 6 months post-intervention) (n = 29)

Asthma symptoms	Pre-intervention	3 months post-intervention		6 months post-intervention	
	n (%)	n (%)	*p*-value*	n (%)	*p*-value**
Day-time symptoms					
≤2 times/week	14 (48.3)	26 (89.6)	<0.001	26 (89.6)	<0.001
No night symptoms	17 (58.6)	21 (72.4)	0.120	24 (82.7)	0.020
Bronchodilatoruse					
≤2 times/week	29 (100.0)	29 (100.0)	1.000	26 (89.6)	0.250
Emergency room visits	17 (58.6)	9 (31.0)	0.040	6 (20.6)	0.002
School absences	14 (48.3)	7 (24.1)	0.010	5 (17.2)	0.004

p-value*: comparison between the asthma control at pre-intervention and 3 months post-intervention
p-value**: comparison between the asthma control at pre-intervention and 6 months post-intervention

any significant changes in their asthmatic symptoms, number of emergency room visits, and school absences at three months post-intervention. However, at six months post-intervention, the authors detected significant reduction of daytime symptoms, fewer emergency room visits, and school absences.

In this study, self-management behaviors of asthmatic children before intervention were abysmal. The authors detected a significant improvement in the behaviors to manage asthma at three and six months post-intervention. In children with persistent asthma, the rate of regular ICS use significantly increased from 0% to 40% at three months ($p<0.001$) and 30% at six months ($p<0.001$) post-intervention. Frequency of asthmatic attacks significantly decreased at six months after intervention. The children reported using inhaled bronchodilator at home whenever they had an acute asthmatic attack. The teachers also provided inhaled bronchodilators during the children's asthmatic attack while at school. The frequency of ER visits was lower at both three and six months post-intervention compared to the baseline level.

Discussion

In this study, most of the asthmatic children were from low socioeconomic families with monthly income less than 10,000 Baht. Their caregivers lacked asthma knowledge, which may be an important factor contributing to a poor asthma control in these children. The school-based educational interventions from this study provided the doctors an opportunity to work with the asthmatic children, their caregivers, and the teachers. For the asthmatic children, improving asthma knowledge enhanced their self-management behaviors.

Table 6. Asthma control in children aged ≥12 years (pre-intervention vs. 3 and 6 months post-intervention) (n = 18)

Asthma symptoms	Pre-intervention	3 months post-intervention		6 months post-intervention	
	n (%)	n (%)	*p*-value*	n (%)	*p*-value**
Day-time symptoms					
≤2 times/week	9 (50.0)	12 (66.6)	0.250	15 (83.3)	0.030
No night symptoms	9 (50.0)	10 (55.6)	0.900	11 (61.1)	0.020
Bronchodilator use					
≤2 times/week	18 (100.0)	14 (77.8)	0.700	14 (77.8)	0.700
Emergency room visits	7 (38.9)	5 (27.8)	0.060	1 (5.6)	<0.001
School absences	7 (38.9)	4 (22.2)	0.250	1 (5.6)	0.030

p-value*: comparison between the asthma control at pre-intervention and 3 months post-intervention
p-value**: comparison between the asthma control at pre-intervention and 6 months post-intervention

Table 7. Asthma management behaviors

	Pre-intervention	3 months post-intervention		6 months post-intervention	
	n (%)	n (%)	*p*-value*	n (%)	*p*-value**
Regular ICS use (n = 30)	0 (0)	12 (40)	<0.001	9 (30)	<0.001
Asthmatic attack ≥1 episode (n = 47)	24 (51.1)	20 (42.5)	0.700	17 (36.1)	0.020
Behaviors during asthmatic attack					
ERvisits	24 (51.1)	14 (29.8)		7 (14.9)	
Bronchodilator at home	0 (0.0)	4 (8.5)		7 (14.9)	
Bronchodilator given at school by the teachers	0 (0.0)	2 (4.3)		3 (6.4)	

p-value*: comparison between the asthma management behavior at pre-intervention and 3 months post-intervention
p-value**: comparison between the asthma management behavior at pre-intervention and 6 months post-intervention

For the caregivers and teachers, improving the asthma knowledge provided them an awareness of the children's health problems. After providing asthma knowledge, hands-on workshops on MDI techniques, breathing exercises, use of asthma diaries, and self-management plans, the authors assessed the effects of this educational intervention by comparing the scores from the pre- and post-tests. The authors discovered that the teachers had a higher pre-test score compared to the asthmatic patients and the caretakers. In addition, their scores significantly improved after the educational intervention. Improvement of the teachers' asthma knowledge may help asthmatic students in schools control their asthma symptoms. A randomized controlled trial from the USA showed that the asthma knowledge, health outcomes and overall quality of life of the asthmatic students significantly improved after the teacher-led asthmatic educational program ($p = 0.003$ vs. $p = 0.82$)[24]. Teachers who participated in the program also had significant improvement in their asthma knowledge compared to teachers who did not participate in the program ($p<0.001$).

In addition, if the caregivers were also educated, this significantly helped to improve their knowledge of asthma as shown in this study. Their mean pre-test score was 29, which increased to 35 immediately post-intervention. Increasing knowledge of asthma in caregivers has been shown to reduce asthmatic symptoms and significantly improve the asthma control in these children[25]. Aside from providing the teachers and the caregivers the asthma knowledge, it is also essential to provide the asthmatic children with educational interventions so they are aware of their asthma severity, frequency, and impact of the disease. In this study, the authors noticed that the educational interventions for the children were able to significantly reduce the frequency and severity of the asthmatic attacks immediately post-intervention and six months later. From this study, we can deduce that the asthma knowledge will be maintained over time but this does not mean that the practice will be sustained. As a result of this, a longer follow-up period may be beneficial as well as providing annual refresher courses. For example, the authors noticed that the rate of ICS use in the asthmatic children at six months after intervention was fewer than at three months after intervention. This indicated that asthma self-management should be monitored periodically and frequently to ensure continuous good control of the asthma by the patients themselves and their caregivers.

This study demonstrated the improvement of the pulmonary function in 18 children who had FEV_1 <80% of the predicted value at the pre-intervention period. There were significant increases in FVC, FEV_1 and $FEF_{25-75\%}$ at three months, and significant increase in $FEF_{25-75\%}$ at six months post-intervention. To the best of the authors' knowledge, this is the first study to assess pulmonary function of the asthmatic children after they received asthma educational intervention at school. The improvement of the pulmonary function may be due to the regular usage of the inhaled corticosteroid in patients with persistent asthma. This result is consistent with the data from Denmark that showed asthmatic children treated with inhaled corticosteroid had a better FEV_1 over time compared to those children not treated with inhaled corticosteroids[26]. It is possible that the educational intervention may have directly increased the children's and their caregivers' knowledge on managing asthma appropriately resulting in increased use of the inhaled corticosteroid.

As for the asthma control, this study showed that there was significant improvement at three months post-intervention. The asthmatic symptoms were lower at three and six months post-intervention. For children younger than 12 years old, there were significantly fewer day-time symptoms, emergency room visits and school absences at three and six months post-intervention. As for children older than 12 years old, there were fewer daytime symptoms, emergency room visits and school absences but this was not significant until six months later. In contrast, a previous study in Switzerland[10] showed that children older than 12 years had a better control of their asthmatic conditions. This discrepancy may be due to the differences in the study population. For this study, many of the persistent asthmatic children were younger than 12 years old and had boundless help from their caregivers who had a better understanding of the disease and so were able to control the asthma better than those children who were older than 12 years old.

The rate of regular ICS use significantly increased from 0% to 40% at three months and 30% at six months ($p<0.001$) post-intervention. The baseline data of this study corroborates the findings from another study conducted in the Asia Pacific region which showed a very low rate of inhaled corticosteroid (13.6%) use in 3,207 asthmatic patients pre-intervention phase[7]. This indicated that the patients lacked asthma knowledge, underestimated the severity of their disease as well as may have had limited access to health care facilities.

In addition, self-management behaviors in asthmatic children significantly improved post-intervention because they used the inhaled bronchodilator at home whenever they had an asthmatic attack, and the teachers provided inhaled bronchodilator while at school. Therefore, the rates of ER visits significantly decreased post-intervention. However, the finding from this study may not be representative of asthmatic students in Thailand located elsewhere which is the study's limiting factor. The students from this study were recruited from Homkred School, which is located in the suburbs near a brewery factory from low socioeconomic status. This limitation may affect the baseline asthma knowledge and accessibility to healthcare facilities. Nevertheless, the authors have proven that providing asthma education to the family members and school personnel can help improve the management of asthma in the students.

Conclusion

School-based educational interventions can significantly improve the asthma knowledge in asthmatic children, their caregivers, and teachers, as well as improve the health outcomes of the children with asthma. Better controls of asthma in children from developing countries such as Thailand are possible with the use of school-based education interventions and are highly recommended by the authors.

What is already known on this topic?

Various asthma educational interventions both in clinical and non-clinical settings have been proposed to improve the health outcome in children with asthma.

What this study adds?

School-based educational intervention significantly improved self-management behaviors in Thai children with asthma, especially the rate of regular using inhaled steroid. Their health outcomes assessed by pulmonary function tests were also improved.

Potential conflicts of interest

None.

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การให้ความรู้โดยใช้โรงเรียนเป็นศูนย์กลางมีผลดีต่อสุขภาพของนักเรียนที่เป็นโรคหืด

ปุษยบรรพ์ สุวรรณดีรี, จิตลัดดา ดีโรจนวงศ์, นวลจันทร์ ปราบพาล

ภูมิหลัง: สาเหตุสำคัญที่การควบคุมโรคหืดในเด็กไทยยังอยู่ในระดับต่ำ คือ การที่ผู้ป่วยและผู้ดูแลขาดความรู้เกี่ยวกับโรคหืด ยังไม่มีการศึกษาในประเทศไทยถึงผลของการให้ความรู้เรื่องโรคหืดโดยใช้โรงเรียนเป็นศูนย์กลาง

วัตถุประสงค์: เพื่อศึกษาผลของการให้ความรู้เรื่องโรคหืดที่โรงเรียนต่อสุขภาพระดับการควบคุมโรคหืด และการดูแลตนเองของนักเรียนที่เป็นโรคหืด

วัสดุและวิธีการ: นักเรียนอายุ 6-15 ปีที่เป็นโรคหืดจำนวน 47 ราย ผู้ดูแล 14 ราย และครู 5 รายจากโรงเรียนหอมเกร็ดที่เข้าร่วมกิจกรรมการให้ความรู้เรื่องโรคหืดที่โรงเรียน ซึ่งประกอบด้วยการบรรยายเรื่องโรคหืด การฝึกปฏิบัติจริงเรื่องเทคนิคการพ่นยา การบริหารปอดและการจดบันทึกอาการของโรคหืด จะได้รับการประเมินความรู้เรื่องโรคหืดด้วยแบบทดสอบความรู้หลังเข้าร่วมกิจกรรมทันทีและประเมินซ้ำที่ 6 เดือนต่อมา สำหรับผลต่อสุขภาพของเด็กนักเรียนที่เป็นโรคหืดจะประเมินและติดตามโดยการตรวจสมรรถภาพปอด ร่วมกับการประเมินระดับการควบคุมโรคหืด และทักษะในการดูแลตนเองเบื้องต้นที่ 3 เดือนและ 6 เดือนหลังกิจกรรม

ผลการศึกษา: ผลการทดสอบความรู้เกี่ยวกับโรคหืดในนักเรียนที่เป็นโรคหืด ผู้ดูแล และครู เพิ่มขึ้นอย่างมีนัยสำคัญในทุกกลุ่ม ($p<0.01$) หลังเข้าร่วมกิจกรรมทันที และที่ระยะเวลา 6 เดือนต่อมา สำหรับผลต่อสุขภาพ พบว่าในนักเรียน 18 ราย ที่มีสมรรถภาพปอดผิดปกติ (FEV_1 <80%) ก่อนได้รับความรู้มีสมรรถภาพปอดดีขึ้นอย่างมีนัยสำคัญ และเมื่อประเมินอาการโรคหืด พบว่านักเรียนมีระดับการควบคุมโรคที่ดีขึ้นอย่างมีนัยสำคัญทั้งที่ 3 และ 6 เดือนหลังการร่วมกิจกรรมทั้งยังพบว่า จำนวนนักเรียนที่ใช้ยาพ่นสเตียรอยด์สม่ำเสมอเพิ่มขึ้นจากเดิมที่ไม่มีนักเรียนใช้ยาพ่นสเตียรอยด์เลยเป็นร้อยละ 40 ที่ 3 เดือนและร้อยละ 30 ที่ 6 เดือน ($p<0.001$) นอกจากนี้ยังพบว่านักเรียนที่เป็นหืดสามารถดูแลตนเองได้ดีขึ้น โดยสามารถพ่นยาขยายหลอดลมด้วยตนเองที่บ้านและครูสามารถพ่นยาขยายหลอดลมให้นักเรียนที่มีอาการจับหืดที่โรงเรียนได้ ซึ่งมีผลให้อัตราการเข้ารับการรักษาอาการหอบที่ห้องฉุกเฉินลดลง

สรุป: การจัดกิจกรรมการให้ความรู้เรื่องโรคหืดโดยใช้โรงเรียนเป็นศูนย์กลางมีผลดีต่อสุขภาพของนักเรียนโรคหืดอย่างมีนัยสำคัญ กิจกรรมดังกล่าวควรได้รับการสนับสนุน