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RESEARCH ARTICLE

Clinical pharmacist counseling improves outcomes for Taiwanese asthma patients

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Abstract *Objective* To assess the impact of an asthma educational program provided by a nurse combined with asthma counseling provided by a pharmacist on asthma knowledge, quality of life and clinical outcomes in Taiwanese patients with asthma. *Setting* All patients were recruited from Pulmonary Medicine outpatient clinic, the Tri-Service General Hospital, Taipei, Taiwan. Asthma education was given in three one-hour sessions offered during monthly clinic visits. *Method* A total of 91 asthma patients were randomly assigned to a nurse-administered education program (Group 1), the education program with additional pharmacist counseling (Group 2), or a control group receiving routine care only (control). Three questionnaires were used for assessment at months 0, 3 and 6. Outcomes were compared between groups to determine efficacy. *Main Outcome Measure* Asthma knowledge, health-related quality of life, and medication adherence were measured at baseline and 3 and 6 months after enrollment. *Results* A total of 104 patients were enrolled; 91 completed the study. Knowledge scores of patients in Groups 1 and 2 increased significantly compared to control group. Both intervention groups showed significant increases in knowledge scores with longer follow-up. Group 2 showed a significant improvement in clinical symptoms between baseline (month 0) and month 6 (4.99 vs. 4.21, $P = 0.008$). No significant differences in medication adherence were seen among groups. *Conclusion* Regular nurse-administered asthma education with additional pharmacist counseling improves asthma knowledge and clinical symptoms in asthma patients.

Keywords Asthma · Clinical outcomes · Medication adherence · Patient education · Pharmacists · Taiwan

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Impact of findings on practice

- Regular nurse-administered asthma education with additional pharmacist counseling improves clinical symptoms for patients with asthma.
- Asthma knowledge can be improved when the asthma patients participate in nurse administered program or receive nurse-administered program plus pharmacist counseling.

Introduction

Asthma is a chronic inflammatory disorder of the airways that remains on the rise worldwide [1]. In Taiwan, asthma is the eleventh leading cause of death and, despite advances in treatment, mortality remains high [2]. Asthma has been shown to lead to recurrent episodes of breathlessness, wheezing, coughing, and chest tightness, particularly at night or in the early morning [1]. Fluctuation of these symptoms is shown to limit physical and psychosocial activities for asthma patients [3, 4]. Since asthma is an incurable chronic condition, treatment focuses on disease management, including controlling symptoms, preventing exacerbations and controlling factors that contribute to asthma severity. Global Initiative for Asthma (GINA) [5] guidelines emphasize education as a critical component of asthma management, increasing the motivation, skills and confidence of asthma patients.

Behavioral factors shown to improve morbidity and mortality in asthma patients include patient understanding of the disease process [6], compliance with prescribed medical regimens [7] and a good relationship with healthcare providers [6]. Self-efficacy, a sense of having control over events, has also been shown to improve self-management in adolescents [8] and adults [9] with asthma. Asthma education results in reduced emergency visits, reduced medication use during hospital stays [10–13], improved symptom scores [14, 15], and improved inhalation techniques [3, 16]. Research on the effect of patient education on knowledge and health-related quality of life (HRQOL) has shown benefits of asthma education and self-management as recommended by GINA guidelines [17, 18]. Among others, Gibson and Powell [19] have shown that individualized written action plans to treat exacerbations consistently improved asthma health outcomes. Nevertheless, important questions remain about the role of pharmacists in asthma education.

GINA guidelines [1] call for national guidelines tailored to local conditions. The medical center in which the study was conducted had proposed a modified program for Asthma education, combining nurse-delivered education with pharmacist consultation. Based on the work of Diamond and Chapman [20]. and Narhi et al. [21], we sought to evaluate the efficacy of this type of intervention on self-management in asthma patients. Our goal in this study was to assess the effect on asthma knowledge, HRQOL and medication adherence in asthma patients in Taiwan of participation in a nurse-administered asthma education program with or without added pharmacist counseling.

Method

Design

Asthma patients were randomly assigned to one of three groups as described in Fig. 1. Established, previously published questionnaires were used for follow up assessment, including the Asthma Quality of Life Questionnaire (AQLQ) [22], the Chinese language version of the Asthma General Knowledge Questionnaire for Adults (AGKQA-C) [23], and the Self-Assessment of Medication Adherence questionnaire [24]. Outcomes were compared between intervention and control groups to determine the efficacy of the intervention programs. Because disease severity has been associated with quality of life [25], asthma severity was determined for each participant based on the GINA guidelines [1]. Data were collected from the three groups at three points: at enrollment (baseline, month 0), and at months 3 and 6. A standardized procedure was established

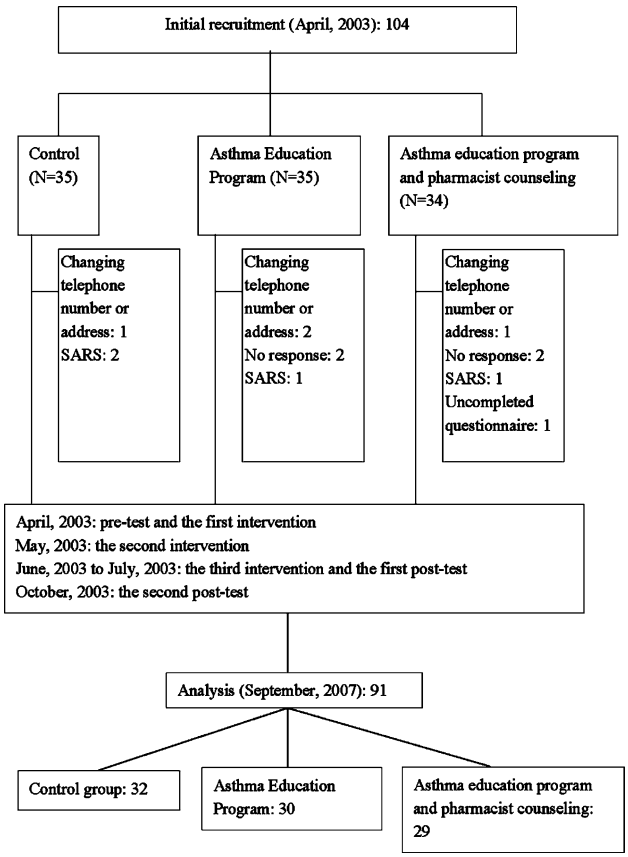

Fig. 1 Study flow for the 91 subjects studied. In general, the pre-test and the first intervention were initiated in April 2003 (month 0), the second intervention started in May, and the third intervention and post-test were begun in June (month 3). After 3 months, the second post-test was collected from September to November 2003 (month 6)

to increase inter-rater reliability. Before data collection, all data collectors were trained in questionnaire content, presentation style and data collection method. The rater read the questionnaires to patients and self-reporting was supervised.

Patients participated in either the standard nurse-administered asthma education program, or the same education program with additional pharmacist counseling with the pharmacist. A detailed workbook prepared by chest physicians was used for each session. The asthma education program covered four topics taught in sequence in three 1-h sessions offered during monthly clinic visits (at months 1, 2 and 3). Topics covered were: (1) definition, etiology, diagnosis, disease progress, and complications of asthma; (2) instruction to monitor disease severity, especially skills needed to use the peak expiratory flow (PEF) meter and the format to record symptoms in a diary; (3) introduction on medications for asthma therapy, including protocol of a stepwise treatment plan, pharmacology of leading asthma drugs and correct inhaler techniques; and (4) guidelines for self-management, including understanding potential environmental triggers and irritant factors, environmental control and standard procedure for coping with asthma attacks. Pharmacist counseling covered information related to the action and side effects of asthma medications, treatment plans for individualized medication, and modification of medications in response to progressive asthma.

Sample

Inclusion criteria for study participants were: (1) outpatient aged 18–80 years, (2) good cognitive function, (3) able to understand Chinese, (4) confirmed diagnosis of bronchial asthma as determined by clinical features before treatment, (5) clinically stable, and (6) willing to participate. Patients with other medical conditions that could impact quality of life, including psychiatric illness or cognitive impairment, were excluded. Ethical approval for the study was granted by the administrative department of Tri-Service General Hospital. Prior to participation, all enrolled subjects signed a written consent form and were assured of the confidentiality of their responses.

Measures

Three questionnaires were used to measure participants' knowledge, HRQOL, and medication adherence pre- and post-intervention. Acceptable validity and reliability of the instruments had been previously determined [22–24, 26–28]. Asthma patients' quality of life was measured with the AQLQ [22], a 32-item questionnaire with four subscales of activity limitations, symptoms, emotional status, and exposure to environmental triggers. The instrument's reliability has been validated [26] after seven years of use in clinical trials. A recent study by Abruz et al. [27]. also demonstrated acceptable validity and reliability of the instrument, with internal consistency ranging from 0.80 to 0.96 and a correlation between AQLQ and asthma disease severity. Yang et al [28]., confirmed the efficacy of this scale in a Taiwanese population. The AGKQA-C [23] has been shown to have acceptable reliability and validity to evaluate knowledge levels of education on quality of life of adult asthma patients in Taiwan [27]. Domains tested include causes of asthma, pathophysiological changes in upper respiratory tract during onset of asthma, asthma drugs, evaluation of asthma severity, symptom management, and stimulant control and movement. The Self-Assessment of Medication Adherence questionnaire [24] includes four items on specific self-management behavior in use of asthma medication within the past month.

Analysis of data

Because continuous variables, such as age and peak expiratory flow rate (PEFR), were not normally distributed, we present median scores and range for each variable. Other scores are presented as mean ± standard deviation (SD). Categorical variables, including gender, marital status, education, employment, duration of disease, smoking status, severity of disease and history of emergency visits or hospital admission are expressed as a frequency (percentage). For baseline comparisons, chi-square test and Fisher's exact test were used to determine the difference in proportion of a categorical variable between groups. To determine statistically significant differences, age and PEFR were tested by the Kruskal–Wallis test. To determine statistically significant differences in other continuous variables, the three groups were tested by a mixed model at each time point. If significant differences were found between the three groups, the Bonferroni correction test was used to make multiple comparisons between each of two groups. The mixed model was also used to test differences between two time points within the same intervention group. Significance was defined as $P < 0.05$, and adjusted Bonferroni level or Cronbach α performed as appropriate. All statistics were performed using SAS version 9.1.3 (SAS Inc., Cary, NC).

Results

A total of 104 patients who met study criteria were recruited from the Pulmonary Medicine outpatient clinic, the Tri-Service General Hospital, Taipei, Taiwan. The study is a random block design. The investigator randomly

assigned patients to one of three groups: 35 were assigned to the nurse-administered asthma education program (Group 1), 34 to the education program combined with pharmacist counseling (Group 2), and 35 received routine asthma care only (Control group). Nurse-administered asthma education and patient follow-up was conducted between April 1, 2003 and June 30, 2003 at monthly clinic visits. All groups received routine asthma care during their scheduled clinic visits. Data at follow-up were available in the intervention and control groups for 30, 29, and 32 patients, respectively (Fig. 1). Major reasons for loss of participants during follow up included unannounced changes in telephone number or contact address, no answer on at least three attempts to contact by telephone, disruption due to the 2003 SARS outbreak in Taiwan and other Asian countries, and inability or unwillingness to repeatedly complete questionnaires. A total of 91 patients completed the study, including 65 males and 26 females with a median age of 25.0 (range 19.0–68.0) years. Fifty-eight patients (64.9%) were single, 44 (48.4%) had more than a junior college education, 72.2% were employed, and 61.1% had never smoked. Fifty patients (58.1%) had <10 years of asthma history, 47.8% had a family history of asthma and most (75.6%) had not received prior asthma education. Patient characteristics are summarized in Tables 1 and 2. Ninety-one of 104 patients (Table 1) who met study criteria completed the study, including 30 in Group 1, 29 in Group 2, and 32 Controls. No statistically significant differences were found between the three groups at baseline (Table 1).

Table 1 Demographical characteristics of study patients ($n = 91$)

Variables	Total ($n = 91$)	Control group ($n = 32$)	Group 1 ($n = 30$)	Group 2 ($n = 29$)	P value
Age (years)[a]	25.0 (19.0, 68.0)	32.0 (20.0, 64.0)	26.0 (19.0, 68.0)	24.0 (19.0, 62.0)	0.28
Male gender[b]	65 (71.4)	21 (65.6)	21 (70.0)	23 (79.3)	0.49
Married[b,c]	32 (36.1)	15 (46.9)	10 (24.1)	7 (24.1)	0.18
Education[b]					0.66
<Junior school	20 (22.0)	6 (18.8)	8 (26.7)	6 (20.7)	
High school	27 (29.6)	12 (37.5)	6 (20.0)	9 (31.0)	
Junior college or above	44 (48.4)	14 (43.7)	16 (53.3)	14 (48.3)	
Employed[b,c]	65 (72.2)	20 (64.5)	21 (70.0)	24 (82.8)	0.30
Ex- or current smoker[b,c]	35 (38.9)	14 (45.2)	11 (36.7)	10 (34.5)	0.82

Control group receiving routine care only, *Group 1* nurse-administered education program, *Group 2* education program + pharmacist counseling

[a] Kruskal–Wallis test was used for these continuous variables. Data are presented as median (range) for continuous variables

[b] Chi-square test was used for these categorical variables. Data are presented as number (percentage) for categorical variables

[c] Summed number of cases does not equal total cases because of missing data

Table 2 Asthma-related characteristics of study patients ($n = 91$)

Variables	Total ($n = 91$)	Control group ($n = 32$)	Group 1 ($n = 30$)	Group 2 ($n = 29$)	P value
PEFR[a]	420 (140, 820)	425 (140, 820)	390 (200, 790)	420 (160, 720)	0.87
Duration of asthma ≥ 11 years[b,c]	36 (41.9)	11 (34.4)	9 (33.3)	16 (59.3)	0.09
Family history of asthma[b,c]	43 (47.8)	18 (56.4)	11 (36.7)	14 (48.3)	0.28
Asthma medication use[b]	42 (46.2)	18 (56.3)	15 (50.0)	9 (31.0)	0.13
History of hospital visits for asthma[b]	12 (13.2)	2 (6.3)	3 (10.0)	7 (24.1)	0.09
History of emergency visits for asthma[b]	34 (37.4)	8 (25.0)	11 (36.7)	15 (51.7)	0.10
Disease severity of asthma[b]					0.22
Mild	43 (47.3)	18 (56.3)	15 (50.0)	10 (34.5)	
Moderate to severe	48 (52.7)	14 (43.7)	15 (50.0)	19 (65.5)	
Asthma education[b,c]	22 (24.4)	9 (28.1)	9 (31.0)	4 (14.0)	0.25

Control group receiving routine care only, *Group 1* nurse-administered education program, *Group 2* education program + pharmacist counseling

PEFR peak expiratory flow rate, *PEFR* was measured at baseline

[a] Kruskal–Wallis test was used for these continuous variables. Data are presented as median (range) for continuous variables

[b] Chi-square test was used for these categorical variables. Data are presented as number (percentage) for categorical variables

[c] Summation of number of cases does not equal total cases because of missing data

Table 3 Comparison of asthma knowledge[a] and asthma medication adherence[b] between groups by time point

	Control group ($n = 32$) Mean ± SD	Group 1 ($n = 30$) Mean ± SD	Group 2 ($n = 29$) Mean ± SD	P value
Knowledge of asthma[c]				
Baseline (month 0)	18.88 ± 4.31	19.13 ± 4.27	16.86 ± 5.03	0.107
Month 3	20.22 ± 4.11	23.03 ± 3.36†,‡	20.79 ± 3.44‡	0.007*
Month 6	21.03 ± 3.49	24.83 ± 3.70†,‡	23.57 ± 3.51†,‡	<0.001*
Asthma medication adherence				
Baseline (month 0)	9.19 ± 6.02	10.27 ± 4.22	9.52 ± 5.29	0.271
Month 3	12.5 ± 2.86‡	12.70 ± 2.48‡	13.11 ± 2.18‡	0.704
Month 6	12.6 ± 2.73‡	13.40 ± 2.40‡	13.62 ± 1.95‡	0.718

Control group receiving routine care only, *Group 1* nurse-administered education program, *Group 2* education program + pharmacist counseling

Mixed model was used

SD standard deviation

[a] Two options were listed: 1 = correct and 2 = incorrect or do not know

[b] Likert scale with 4 levels were defined as: 1 = always forgot, 2 = sometimes forgot, 3 = sometimes remembered, and 4 = always remembered

[c] Multiple comparisons were performed using Bonferroni test with an adjusted α ($\alpha' = 0.05/3 = 0.0167$)

* Significantly different among three groups, $P < 0.05$

† Significantly different from control group, $P < 0.0167$

‡ Significantly different from baseline, $P < 0.0167$

Table 3 shows the comparison of outcome indicators by group at each time point. Knowledge scores among the three groups differed significantly at month 3 (23.03 vs. 20.22, $P = 0.007$) and month 6 (24.83 vs. 21.03, $P < 0.001$). Compared with controls, knowledge scores for Group 1 were significantly increased at month 3 (23.03 vs. 20.22) and 6 (20.79 vs. 21.03, all $P < 0.0167$), and knowledge scores for Group 2 were significantly increased at month 6 (23.57 vs. 21.03, $P < 0.0167$). Compared with baseline, knowledge scores for both intervention groups (Groups 1 and 2) significantly increased (19.13–24.83 and 16.86–23.57, respectively, all $P < 0.0167$) with time, but not in the control group. However, mixed model analysis indicated that the overall time trend for asthma knowledge scores was significant ($P < 0.001$) (Fig. 2).

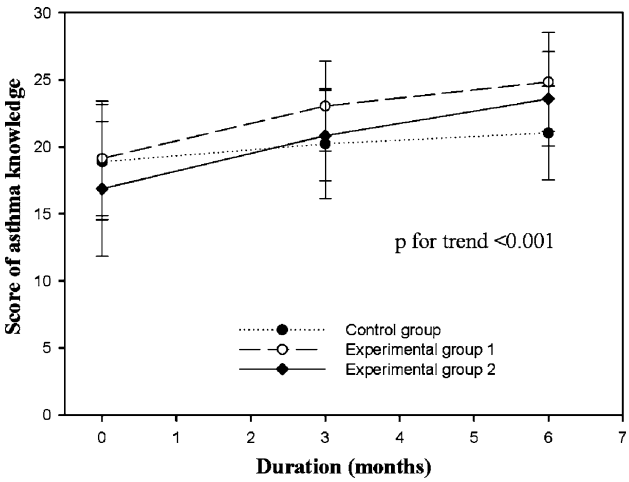

Fig. 2 Time trend for score of asthma knowledge. Data are presented as mean ± standard deviation (SD). There were 32 subjects in the control group, 30 subjects in experimental group 1 (education), and 29 subjects in experimental group 2 (education + pharmacist)

No significant differences were found in medication adherence scores among the three groups at each time point, even though medication adherence scores for all three groups increased significantly with time (9.19–12.6 for control group, 10.27–13.40 for Group 1, and 9.52–13.62 for Group 2, all $P < 0.0167$) (Table 3). Results of mixed model analysis also indicated that the overall time trend for medication adherence scores was significant ($P < 0.001$) (Fig. 3).

Four subscales (activity limitations, symptoms, emotional status and exposure to environmental triggers) were used to assess HRQOL in study subjects. No significant differences were found in HRQOL scores among the three groups at any time point (Table 4). In terms of time-effect, overall HRQOL scores increased with time, but results were not significant ($P = 0.070$). Differences in scores by subscale among the three groups were not significant except for symptoms (Table 4). Symptom scores increased significantly between baseline (month 0) and month 6 for experimental Group 2 (4.99 vs. 4.21, $P = 0.008$) (Table 4), indicating symptom improvement. All four scores increased with time, but results were not significant.

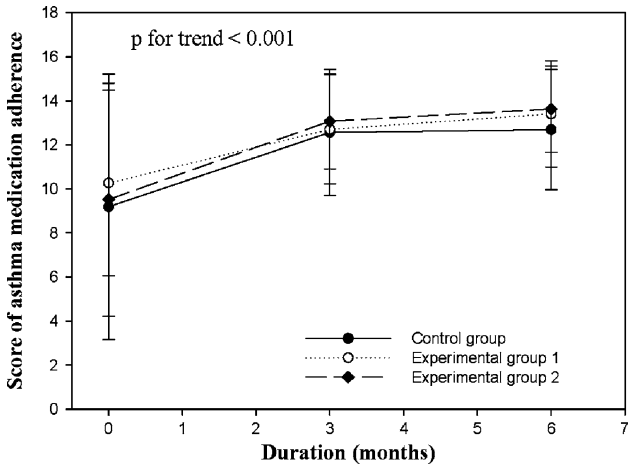

Fig. 3 Time trend for score of asthma medication adherence. Data are presented as mean ± standard deviation (SD). There were 32 subjects in the control group, 30 subjects in experimental group 1 (education), and 29 subjects in experimental group 2 (education + pharmacist)

Discussion

The major findings in this study were that knowledge scores increased significantly at month 3 in asthma patients receiving a nurse-administered education program and the same program with pharmacist intervention compared to controls. Asthma knowledge significantly increased in both intervention groups with increased follow-up. No significant differences were seen between groups in medication adherence, suggesting that patients complied with asthma therapy and medication, with or without nurse-based or pharmacist-based intervention.

No significant differences were seen in overall quality of life between the three groups. However, we observed significant symptom improvement at month 6 for patients receiving asthma education with pharmacist counseling ($P < 0.0167$) (Table 4). This change was consistent with a difference in symptoms on the AQLQ [22], which measures the intrusion of asthma symptoms into normal daily functioning, including sleep (data not shown). Unlike the Asthma Control Test [29], which measures asthma controlled over four weeks, the AQLQ asks patients to recall symptoms over the past two weeks. While the AQLQ is self-reported, its validity has been confirmed in a number of studies [26, 30–35].

Although knowledge of asthma did not differ significantly between the three groups at baseline, the significant improvement in asthma knowledge scores were maintained from 3 to 6 months. These findings strongly indicate that both nurse-administered asthma education alone and nurse-administered asthma education plus pharmacist counseling result in increasing patients' knowledge about asthma, agreeing with previous studies of increased knowledge associated with asthma education [5, 10, 12, 14–17].

While studies of asthma education often involve nurses or doctors (shown to be equally effective [36]), many have shown the efficacy of using pharmacists in the community setting [37–49]. A recent study by Petkova [37] reported on a 4-month educational intervention based in community pharmacies. Those supplied information by the pharmacists had better clinical outcomes (PEFR rate, wheezing, breathlessness, hospitalizations, and doctor visits) than controls. Similarly, Kritikos et al. [38] demonstrated that a pharmacist outreach educational program in rural Australia increased both asthma knowledge and requests for additional information. In the present study, implementing nurse-administered asthma education with pharmacist counseling resulted in improved asthma knowledge scores, enabling patients to monitor, control, and manage their disease through the study period while following an asthma workbook. Study findings indicated increases in knowledge of control group patients, believed to result from heightened awareness and improved understanding of asthma when asthmatic patients are questioned about their asthma condition.

A major finding of this study was significant improvement in symptoms scores 6 months after nurse-administered asthma education with additional pharmacist counseling. This result suggests that pharmacy-based programs may be key in improving clinical outcomes when implemented as an adjunct to nurse-administered education programs in the clinical setting. Diamond and Chapman [20] evaluated the impact of a pharmacy-based educational intervention on self-management behavior and symptom control of asthma patients. Results obtained 30 days after the educational intervention showed that patients experienced significant decreases in the frequency of daytime asthma symptoms, nocturnal symptoms, and medication use. Armour et al. [50] examined the impact of a community pharmacy-based education and monitoring program in 50 pharmacies throughout Australia. Patients who received community pharmacist intervention (assessment, goal setting, monitoring and review) had improved symptoms, better medication adherence, less use of reliever medication, improved quality of life, more asthma knowledge and better asthma control [50].

Our Pharmacy Department is currently conducting a pharmacists counseling system for asthmatic patients which includes pharmacists counseling by phone. These results therefore provide an important benchmark to practices in different parts of the world. These outcomes reinforce other findings that pharmacists, who already interact with patients as they fill their prescriptions, are well suited not only to provide regular education and counseling, but also to help correct patients' misconceptions about their condition and medications, thereby encouraging self-management practices that support better outcomes [37–49].

Table 4 Quality of life questionnaire scores between groups by time point

	Control group ($n = 32$) Mean ± SD	Group 1 ($n = 30$) Mean ± SD	Group 2 ($n = 29$) Mean ± SD	P value
Quality of life				
Overall				
Baseline (month 0)	4.78 ± 0.90	4.76 ± 1.11	4.47 ± 0.97	0.394
Month 3	4.84 ± 1.02	4.97 ± 1.09	4.95 ± 0.97	0.856
Month 6	4.88 ± 1.05	5.02 ± 1.05	5.09 ± 0.89	0.711
Activity limitations				
Baseline (month 0)	4.91 ± 1.06	4.89 ± 1.23	4.66 ± 1.11	0.635
Month 3	4.87 ± 1.16	5.11 ± 1.12	5.05 ± 1.03	0.672
Month 6	4.91 ± 1.13	5.16 ± 1.11	5.15 ± 0.96	0.584
Symptoms				
Baseline (month 0)	4.53 ± 1.07	4.51 ± 1.16	4.21 ± 0.99	0.436
Month 3	4.73 ± 1.04	4.78 ± 1.14	4.79 ± 1.02	0.965
Month 6	4.82 ± 1.05	4.82 ± 1.07	4.99 ± 0.93*	0.754
Emotional status				
Baseline (month 0)	4.94 ± 1.06	4.88 ± 1.31	4.54 ± 1.27	0.382
Month 3	4.94 ± 1.05	5.05 ± 1.14	5.01 ± 1.11	0.922
Month 6	4.93 ± 1.12	5.07 ± 1.10	5.14 ± 0.99	0.725
Environmental exposure[a,5]				
Baseline (month 0)	4.98 ± 0.78	5.03 ± 1.19	4.63 ± 1.17	0.277
Month 3	4.95 ± 1.00	5.07 ± 1.21	5.04 ± 1.09	0.900
Month 6	4.93 ± 1.07	5.17 ± 1.12	5.16 ± 0.90	0.577

Control group receiving routine care only, *Group 1* nurse-administered education program, *Group 2* education program + pharmacist counseling

Mixed model was used

Likert scale was adopted: 1 = completely true, 2 = extremely true, 3 = highly true, 4 = true, 5 = somewhat true, 6 = slightly true, and 7 = not at all true

SD standard deviation

[a] Environmental exposure refers to triggers and irritant factors

* Significantly different from baseline, $P < 0.0167$

Thus, arranging regular and repeated guidance by pharmacists through outpatient services would be valuable for asthma patients. While pharmacist interventions are not without costs, the economic costs of asthma are rising [51], and increased costs are associated with poor symptom control [52, 53]. McLean et al. [48] found that pharmaceutical care is more cost-effective than usual care in controlling most direct and indirect costs in asthma patients.

The present study failed to demonstrate that a nurse-administered asthma education program improved overall scores of HRQOL and four subscales. In a recent study, Kheir et al. [54] tested the AQOL against another quality of life instrument in a community pharmacy setting. The AQOL Environmental stimuli domain was less sensitive in reporting change in patients. In our study, patients improved in all domains, but the results did not achieve statistical significance. Patients may generally require more than 6 months to assimilate new information from the education program and adopt new techniques to influence their HRQOL. Studies with longer follow-up periods may be needed.

Although the nurse-administered asthma education program was shown to be effective, bias may exist in data interpretation due to the relatively small sample size and differences in patients' asthma status. While outcomes did not differ by disease severity, this factor has been associated in adolescents with low educational attainment, use of medication, passive smoking, and being employed, suggesting potential impact on outcomes [25]. Although distribution of family history of asthma was different for experimental and control groups, the difference was not significant ($P = 0.28$). However, larger studies should certainly control for family history. In addition to the limitation of small sample size, the numbers of sessions in the program were also limited, the period of follow-up was relatively brief, and quality of intervention among instructors may have varied. Additional research is needed

to demonstrate more effective models for integrating pharmacist counseling into the nurse-administered asthma education program, and better administration systems for encouraging pharmacists to work with nurses in the program. Finally, long-term studies may also be needed to determine the cost and benefit of nurse-administered asthma education combined with pharmacist counseling.

Conclusion

Our results indicate that pharmacist counseling, as an adjunct to nurse-administered asthma education, significantly increased patients' knowledge of asthma and improved asthma symptoms.

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Conflicts of Interest None

References

1. Global Strategy for Asthma Management and Prevention. Global Initiative for Asthma (GINA) (2008). http://www.ginasthma.org. Accessed May 8, 2010.
2. Taiwan Department of Health, Executive Yuan. Health and vital statistics (2007). http://www.doh.gov.tw. Accessed May 8, 2010.
3. Garg VK, Bidani R, Rich EP, Hershey E, Hershey CO. Asthma patients' knowledge, perception, and adherence to the asthma guidelines. J Asthma. 2005;42(8):633–8.
4. Scherer YK, Bruce S. Knowledge, attitudes, and self-efficacy and compliance with medical regimen, number of emergency department visits and hospitalizations in adults with asthma. Heart Lung. 2001;30(4):250–7.
5. Bateman ED, Hurd SS, Barnes PJ, Bousquet J, Drazen JM, FitzGerald M, et al. Global strategy for asthma management and prevention: GINA executive summary. Eur Respir J 2008;31(1):143–78. http://erj.ersjournals.com/cgi/reprint/31/1/143
6. Bender BG, Rand C. Medication non-adherence and asthma treatment cost. Curr Opin Allergy Clin Immunol. 2004;4(3):191–5.
7. Bender BG, Bender SE. Patient-identified barriers to asthma treatment adherence: responses to interviews, focus groups, and questionnaires. Immunol Allergy Clin North Am. 2005;25(1):107–30.
8. Ayala GX, Yeatts K, Carpenter DM. Factors associated with asthma management self-efficacy among 7th and 8th grade students. J Pediatr Psychol. 2009;34(8):862–8.
9. Calfee CS, Katz PP, Yelin EH, Iribarren C, Eisner MD. The influence of perceived control of asthma on health outcomes. Chest. 2006;130(5);1312–8. http://chestjournal.chestpubs.org/content/130/5/1312.full.pdf+html
10. Smith JR, Mugford M, Holland R, Candy B, Noble MJ, Harrison BD, et al. A systematic review to examine the impact of psycho-educational interventions on health outcomes and costs in adults and children with difficult asthma. Health Technol Assess. 2005;9(23):iii–iv, 1–167. http://www.hta.ac.uk/execsumm/summ923.htm
11. Buist AS, Vollmer WM, Wilson SR, Frazier EA, Hayward AD. A randomized clinical trial of peak flow versus symptom monitoring in older adults with asthma. Am J Respir Crit Care Med. 2006;174(10):1077–87. http://ajrccm.atsjournals.org/cgi/reprint/174/10/1077
12. FitzGerald JM, Gibson PG. Asthma exacerbations 4: Prevention. Thorax. 2006;61(11):992–9. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2121160/pdf/992.pdf
13. Mayo PH, Weinberg BJ, Kramer B, Richman J, Seibert-Choi OS, Rosen MJ. Results of a program to improve the process of inpatient care of adult asthmatics. Chest. 1996;110(1):48–52. http://chestjournal.chestpubs.org/content/110/1/48.long
14. Bailey WC, Richards JM Jr, Brooks CM, Soong SJ, Windsor RA, Manzella BA. A randomized trial to improve self-management practices of adults with asthma. Arch Intern Med. 1990;150(8):1664–8.
15. Levy ML, Robb M, Allen J, Doherty C, Bland JM, Winter RJ. A randomized controlled evaluation of specialist nurse education following accident and emergency department attendance for acute asthma. Respir Med. 2000;94(9):900–8.
16. Barthwal MS, Katoch CDS, Marwah V. Impact of optimal asthma education programme on asthma morbidity, inhalation technique and asthma knowledge. J Assn Phys India. 2009;57(1):574–9.
17. Walker J, Winkelstein M, Land C, Lewis-Boyer L, Quartey R, Pham L, et al. Factors that influence quality of life in rural children with asthma and their parents. J Pediatr Health Care. 2008;22(6):343–50. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2592842/pdf/nihms76619.pdf
18. Powell H, Gibson PG. Options for self-management education for adults with asthma. Cochrane Database Syst Rev. 2002; Issue 3. Art. No.: CD004107. doi:10.1002/14651858.
19. Gibson PG, Powell H. Written action plans for asthma: an evidence-based review of the key components. Thorax. 2004;59(2):94–9. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1746945/pdf/v059p00094.pdf
20. Diamond SA, Chapman KR. The impact of a nationally coordinated pharmacy-based asthma education intervention. Can Respir J. 2001;8(4):261–5. http://www.pulsus.com/journals/past_issues.jsp?sCurrPg=journal&jnlKy=4&fold=Past%20Issues
21. Narhi U, Airaksinen M, Tanskanen P, Enlund H. The effects of a pharmacy-based intervention on the knowledge and attitudes of asthma patients. Patient Educ Couns. 2001;43(2):171–7.
22. Juniper EF, Guyatt GH, Epstein RS, Ferrie PJ, Jaeschke R, Hiller TK. Evaluation of impairment of health related quality of life in asthma: development of a questionnaire for use in clinical trials. Thorax. 1992;47(2):76–83. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC463574/pdf/thorax00362-0008.pdf
23. Allen RM, Jones MP. The reliability and validity of an asthma knowledge questionnaire used in the evaluation of a group asthma education self-management program for adults with asthma. J Asthma. 1998;35(7):537–45.
24. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. Med Care. 1986;24(1):67–74.
25. Nogueira KT, Silva JR, Lopes CS. Quality of life of asthmatic adolescents: assessment of asthma severity, comorbidity, and life style. J Pediatr (Rio J). 2009;85(6):523–30. http://www.jped.com.br/conteudo/09-85-06-523/ing.asp?cod=2039
26. Juniper EF, Buist AS, Cox FM, Ferrie PJ, King DR. Validation of a standardized version of the Asthma Quality of Life Questionnaire. Chest. 1999;115(5):1265–70. http://chestjournal.chestpubs.org/content/115/5/1265.full.pdf+html
27. Abruz S, Gamble J, Heaney L. Assessment of impairment in health-related quality of life in patients with difficult asthma: Psychometric performance of the Asthma Quality of Life Questionnaire. Respirology. 2007;12(2):227–33.

28. Yang ML, Chiang CH, Yao G, Wang KY. Effect of medical education on quality of life in adult asthmatic patients. J Formos Med Assoc. 2003;102(11):768–74.
29. Nathan RA, Sorkness CA, Kosinski M, Schatz M, Li JR, Marcus P, et al. Development of the Asthma Control Test: a survey for assessing asthma control. J Allergy Clin Immunol. 2004;113(1):59–65.
30. Juniper EF, Guyatt GH, Ferrie PJ, Griffith LE. Measuring quality of life in asthma. Am Rev Respir Dis. 1993;147(4):832–4.
31. Rutten-van Mölken MP, Custers F, van Doorslaer EK, Jansen CC, Heurman L, Maesen FP, et al. Comparison of performance of four instruments in evaluating the effects of salmeterol on asthma quality of life. Eur Respir J. 1995;8(6):888–98. http://erj.ersjournals.com/cgi/reprint/8/6/888
32. Rowe BH, Oxman AD. Performance of an asthma quality of life questionnaire in an outpatient setting. Am Rev Respir Dis. 1993;148(3):675–81.
33. Leidy NK, Coughlin C. Psychometric performance of the Asthma Quality of Life Questionnaire in a US sample. Qual Life Res. 1998;7(2):127–34.
34. Sanjuas C, Alonso J, Sanchis J, Casan P, Broquetas JM, Ferrie PJ, et al. The quality of life questionnaire with asthma patients: the Spanish version of the asthma quality of life questionnaire. Arch Bronconeumol. 1995;31(5):219–26.
35. Apter AJ, Reisine ST, Affleck G, Barrows E, ZuWallack RL. The influence of demographic and socioeconomic factors on health-related quality of life in asthma. J Allergy Clin Immunol. 1999;103(1 Pt. 1):72–8.
36. Nathan JA, Pearce L, Field C, Dotesio-Eyres N, Sharples LD, Cafferty F, Laroche CM. A randomized controlled trial of follow-up of patients discharged from the hospital following acute asthma: best performed by specialist nurse or doctor? Chest. 2006;130(1):51–7. http://chestjournal.chestpubs.org/content/130/1/51.full.pdf+html
37. Petkova VB. Pharmaceutical care for asthma patients: a community pharmacy-based pilot project. Allergy Asthma Proc. 2008;29(1):55–61.
38. Kritikos V, Saini B, Bosnic-Anticevich SZ, Krass I, Shah S, Taylor S, et al. Innovative asthma health promotion by rural community pharmacists: a feasibility study. Health Promot J. 2005;16(1):69–73.
39. Saini B, Krass I, Armour C. Development, implementation and evaluation of a community pharmacy based asthma care model. Ann Pharmacother. 2004;38(11):1954–60.
40. Saini B, Smith L, Armour C, Krass I. Instructional design and assessment: an educational intervention to train community pharmacists in providing specialized asthma care. Am J Pharm Edu. 2006;70(5):S1–S10. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1637026/pdf/ajpe118.pdf
41. Smith L, Bosnic-Anticevich SZ, Mitchell B, Saini B, Krass I, Armour C. Treating asthma with a self-management model of illness behaviour in an Australian community pharmacy setting. Soc Sci Med. 2007;64(7):1501–11.
42. Gordois A, Armour C, Bosnic-Anticevich S, Brillant M, Burton D, Emmerton L, et al. Cost effectiveness of a pharmacy asthma care program in Australia. Dis Manag Health Outcomes. 2007;15(6):387–96.
43. Saini B, Filipovska J, Bosnic-Anticevich S, Taylor S, Krass I, Armour C. An evaluation of a community pharmacy based rural asthma management service. Aus J of Rural Health. 2008;16(2):100–8.
44. Mehuys E, Van Bortel L, De Bolle L, Van Tongelen I, Annemans L, Remon JP, et al. Effectiveness of pharmacist intervention for asthma control improvement. Eur Respir J. 2008;31(4):790–9. http://erj.ersjournals.com/cgi/content/full/31/4/790
45. Dolovich L, Sabharwal M, Agro K, Foster G, Lee A, McCarthy L, et al. The effect of pharmacist education on asthma treatment plans for simulated patients. Pharm World Sci. 2007;29(3):228–39.
46. Laufenberg-Horstmann E, DeVore E, Bassuener K. The Coulee Region Community Pharmacy Asthma Intervention study. Journal of the American Pharmacists Association: JAPhA. 2006;46(6):738–46.
47. Barbanel D, Eldridge S, Griffiths C. Can a self-management programme delivered by a community pharmacist improve asthma control? A randomised trial. Thorax. 2003;58(10):851–4. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1746491/pdf/v058p00851.pdf
48. McLean W, Gillis J, Waller R. The BC Community Pharmacy Asthma Study: a study of clinical, economic and holistic outcomes influenced by an asthma care protocol provided by specially trained community pharmacists in British Columbia. Can Respir J. 2003;10(4):195–202. http://www.pulsus.com/journals/past_issues.jsp?sCurrPg=journal&jnlKy=4&fold=Past%20Issues
49. Weinberger M, Murray MD, Marrero DG, Brewer N, Lykens M, Harris LE, et al. Effectiveness of pharmacist care for patients with reactive airways disease: a randomized controlled trial. JAMA. 2002;288(13):1594–602. http://jama.ama-assn.org/cgi/content/full/288/13/1594
50. Armour C, Bosnic-Anticevich S, Brillant M, Burton D, Emmerton L, Krass I, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. Thorax. 2007;62(6):496–502.
51. Bahadori K, Doyle-Waters MM, Marra C, Lynd L, Alasaly K, Swiston J, FitzGerald JM. Economic burden of asthma: a systematic review. BMC Pulm Med [serial on the Internet]. 2009;9:24+[16 pages]. http://www.biomedcentral.com/bmcpulmmed.
52. Accordini S, Bugiani M, Arossa W, Gerzeli S, Marinoni A, Olivieri M, et al. Poor control increases the economic cost of asthma. A multicentre population-based study. Int Arch Allergy Immunol. 2006;141(2):189–98.
53. Briggs AH, Bousquet J, Wallace MV, Busse WW, Clark TJ, Pedersen SE, et al. Cost-effectiveness of asthma control: an economic appraisal of the GOAL study. Allergy. 2006;61(5):531–6.
54. Kheir NM, Emmerton L, Shaw JP. Assessing the responsiveness of the Asthma Quality of Life Questionnaire with pharmaceutical care. Pharm World Sci. 2008 Aug;30(4):322–8. http://qspace.qu.edu.qa/handle/10576/10552