Review Article

Educational interventions for children with asthma: An analytical review of the literature*

LÍVIA FONSECA DA SILVA CARVALHO DE AZEVEDO SANTANA[1], RITA DE CÁSSIA SANTOS BASTOS[2], MARTHA SILVIA MARTINEZ-SILVEIRA[3], LEDA SOLANO DE FREITAS SOUZA[4]

ABSTRACT

A review of the literature published from 1992 to 2002 was performed in order to evaluate educational interventions for asthmatics from 0 to 18 years of age and to identify characteristics related to the efficacy of such interventions. Various databases were used, and a manual search of the references found in the studies selected was conducted. Thirty-nine studies (including 27 controlled studies) were selected, and, although presenting varying results, these studies provided valuable insights into the validity of education in the control of pediatric asthma. The studies evaluated the following parameters: morbidity, use of health care services, quality of life, pulmonary function, knowledge of the disease and self-care abilities. In 32 studies (82%), a beneficial effect was attributed to one or more of the variables. Among the 27 controlled studies, 85.7% presented evidence of improvement in self-care abilities, 83.3% demonstrated increased knowledge, 80% showed a reduction in diurnal and nocturnal asthma symptoms, 71.4% demonstrated fewer unscheduled medical visits, 66.6% showed that the capacity for physical activity increased, 54.5% reported fewer hospital admissions, 50% demonstrated fewer emergency room visits, 50% presented evidence of improved pulmonary function, 22,2% showed fewer school absences, and 20% found an improvement in quality of life. Among the educational programs reviewed, the number of topics was the only characteristic that was found to correlate with the degree of efficacy. The use of sophisticated educational techniques did not lead to better results. Although asthma education programs for children and adolescents has beneficial effects, further studies with better control of confounding variables are needed in order to evaluate the efficacy of such programs with greater precision.

Keywords: Asthma/prevention & control; Health education; Health knowledge, attitudes, practice; Child; Questionnaires

*Study conducted at the Universidade Federal da Bahia (UFBA, Federal University of Bahia), Salvador, Bahia, Brazil
1. Masters student in Health Care at the Universidade Federal da Bahia (UFBA, Federal University of Bahia), Salvador, Bahia, Brazil
2. Physician at the Universidade Federal da Bahia (UFBA, Federal University of Bahia), Salvador, Bahia, Brazil
3. Masters student in Information Sciences at the Universidade Federal da Bahia (UFBA, Federal University of Bahia), Salvador, Bahia, Brazil
4. PhD in Medicine and Health Care from the Universidade Federal da Bahia (UFBA, Federal University of Bahia), Salvador, Bahia, Brazil
Correspondence toa: Lívia Fonseca da Silva Carvalho de Azevedo Santana. Rua Dr. Hosannah de Oliveira 112, apt 1.102 sul, Alto do Itaigara, Salvador - Bahia. CEP: 41840-190; e-mail - liviafonseca2004@terra.com.br
Submitted: 23 June, 2004. Accepted, after review: 21 January, 2005.

INTRODUCTION

The motivation behind the implementation of programs of asthma education is based on the hypothesis that such programs reduce morbidity rates and improve quality of life by promoting understanding of the disease and helping patients learn self-management skills. It is supposed that programs of asthma education are capable of changing attitudes and beliefs related to the disease and thereby increase adherence to treatment.

In the USA, the virtues of asthma education programs for children have been extolled since 1970.[1-2] In March of 1989, the National Asthma Education and Prevention Program was inaugurated under the auspices of the National Heart, Lung and Blood Institute in order to study the increased prevalence, morbidity and mortality related to asthma.[3] In 1991, the institute began to distribute a guide for the diagnosis and management of asthma, in which patient education is listed as one of the four principal components of asthma control.[4] In 1995, in an effort to promote the implementation of these recommendations in different populations around the world, the National Heart, Lung and Blood Institute and the World Health Organization developed a global strategy for the prevention and management of asthma, the preparation of which involved specialists from various countries.[5]

In 1996, the first Brazilian consensus regarding asthma education was published, in which it was proposed that an asthma education program be implemented in Brazil, and that such a program be applied in conjunction with medical treatment and be adapted to the socioeconomic and cultural characteristics of the target population.[6] The Brazilian Ministério da Saúde (Ministry of Health), in conjunction with the *Coordenação Nacional de Pneumologia Sanitária* (National Pulmonology Health Care Council) and with the support of various Brazilian professional societies (Pulmonology and Phthisiology; Pediatrics; Allergology; Immunopathology; Clinical Medicine), established, in directive 1394/MS (issued in 1999), a national plan of action to prevent and combat asthma, the *Plano Nacional de Controle da Asma* (National Asthma Control Plan). The plan includes instructions aimed at teaching patients and their families how to properly treat their asthma, both at home and at school.[7-8]

The most recent international review on this theme, conducted by the Cochrane Airways Group, analyzed 32 studies, published between 1984 and 1998, involving a total of 3706 patients, from 2 to 18 years of age, who were submitted to controlled, randomized programs of education focusing on self-management.[9]

The present study was carried out with the objective of identifying educational initiatives for asthmatic children described in the international literature since 1992, and to evaluate the efficacy of such initiatives. For pulmonologists and pediatricians, this topic is of the utmost importance. It is necessary to determine whether asthma education provides significant therapeutic gains, and, if so, whether pulmonologists and pediatricians should be trained in the technique of instituting educational measures for children and their families from the very first visit. It is our intention that this review of the literature will be of use to pulmonologists and pediatricians by identifying important aspects of such educational programs that can be used in day-to day practice.

METHODS

The analytical review technique was used, involving careful and extensive searches of the principal bibliographic databases available.

For inclusion of studies in the review, we used the following criteria: analyzing educational interventions in childhood asthma (aimed at children and adolescents up to the age of 18); published between January 1992 and April 2002 in English, Portuguese or Spanish; involving quantitative evaluations of the results of educational interventions in asthma, comparing pre-and post-intervention status or comparing study and control groups; utilizing one or more of the evaluation parameters level of knowledge regarding the disease, self-management capacity, pulmonary function and indicators of morbidity (defined based on the Clinical Relevance Guidelines coming out of the Asthma Results Conference and adapted by Clark and Starr-Schneidkraut)[10] in order to determine daytime and nighttime symptoms, school absenteeism, quality-of-life indices, functional status (degree of limitation in daily physical activities) and the frequency of health care services use.

Exclusion criteria were as follows: including

unquantifiable post-intervention results; employing evaluation parameters other than those mentioned in the inclusion criteria; dealing with adult asthma patients; dealing with adult and pediatric asthma patients simultaneously; simultaneously involving children with asthma and children presenting other lung diseases or other accompanying chronic illnesses.

For the bibliographic research, the following databases were chosen: MEDLINE, Excerpta Medica database (EMBASE), Educational Resources Information Center (ERIC), BIOSIS (a source for abstracts of papers in the biological sciences field), Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS, Latin American and Caribbean Health Sciences Literature), and Evidence-Based Medicine (EBM) Reviews. A manual search was also conducted through perusal of the lists of references of the studies selected.

The search terms to be used were selected through a careful search of the subject lists of the databases. After various tests, employing combinations, synonyms and subthemes, the terms chosen were: Asthma; Wheeze; Asthma/Prevention and Control; Patient Education; Self Care; Self Management; Infant; Child; Adolescent.

The initial selection of articles was made through the reading of abstracts. To obtain the full texts of those articles, we resorted to the bibliographic exchange services available through the Biblioteca Regional de Medicina (BIREME, Regional Medical Library), the British Library and the Instituto Brasileiro de Informação em Ciência e Tecnologia (Brazilian institute for Information in Science and Technology). The studies selected were read in their entirety by three reviewers, who made a second cut based on the inclusion and exclusion criteria established. For each article selected in this phase, a registration form was filled out in order to identify the study and collect data. The form included the following: title; numerical identifier; author; year of publication; country of origin; study design; principal objective; number of participants; demographic characteristics of the study sample; asthma severity among the study subjects; desciption of the educational intervention; eucational techniques employed; length of follow-up period; evaluation parameters; results obtained; and study limitations.

The parameters measured to evaluate the impact of the interventions were classified as intermediate or outcome variables. The parameters defined as intermediate variables were cognitive level (degree of knowledge regarding the disease) and psychomotor skills (capacity for self-management) since they are not, in themselves, indicative of the physical and emotional well-being of the children. Various parameters that reflect the health and quality of life of the children were considered outcome variables. These included frequency of emergency room visits, frequency of hospitalizations, number of school days missed, quality of life, level of pulmonary function, frequency of daytime and nighttime symptoms, frequency of unscheduled visits to the doctor, and the degree of physical limitation-functional status.

Based on the parameters measured, the studies were subdivided into two groups: studies evaluating intermediate variables only (Group A); and studies evaluating at least one outcome variable, with or without intermediate variables (Group B).

Each group was further subdivided based on the results obtained from the educational intervention and based on the presence or absence of a control group. Group A (intermediate variables only) was divided into Subgroup A1a (studies evaluating interventions involving control groups and showing beneficial results), Subgroup A1b (studies evaluating interventions without control groups but showing beneficial results); Subgroup A2a (studies evaluating interventions involving control groups and showing no benefit), and Subgroup A2b (studies evaluating interventions without control groups and showing no benefit). Group B (at least one outcome variable) was divided into Subgroup B1a (studies evaluating interventions involving control groups and showing beneficial results), Subgroup B1b (studies evaluating interventions without control groups but showing beneficial results); Subgroup B2a (studies evaluating interventions involving control groups and showing no benefit), and Subgroup B2b (studies evaluating interventions without control groups and showing no benefit).

In order to evaluate the credibility and efficacy of each educational intervention, the controlled studies were scored using a point system, as seen in Chart 1. This point system was created by the authors of the present study. In evaluating the credibility and pertinence of the results, the number of measured variables was considered the most

Chart 1 - Point system for the classification of controlled clinical trials in relation to the educational interventions analyzed

Criteria	Points		
	0	1	2
Number of variables measured	1 or 2	3 or 4	5 to 8
Number of variables with improvement	1 or 2	3 or 4	5 to 8
% of variables with improvement in relation to those measured	0% a 40%	> 40% to 70%	> 70% a 100%
Type of variables measured (I or O)	I only	Number of I equal to or greater than O	Number of O greater than I or O only
Type of variables improved (I or O)	I only or none	Number of I equal to or greater than O	Number of O greater than I or O only

I: intermediate variables; O: outcome variables

important aspect. For evaluating the efficacy of the educational interventions, the aspects considered important were the number of variables in which improvement was seen, the proportion of variables showing such improvement and the type of variables (intermediate or outcome) that showed improvement.

Studies presenting high scores (from 8 to 10) were selected as those addressing educational interventions that were considered the most efficacious and showing the most useful results (better efficacy in the measurements of the outcome variables). Studies presenting such scores composed a group designated the high-scoring study (HSS) group. Studies scoring from 0 to 4 points were classified as addressing educational interventions that were considered less efficacious and presenting fewer outcome measures. These studies were collectively designated the low-scoring study (LSS) group. In order to evaluate the quality of the methodology used in the controlled clinical trials included in the HSS and LSS groups, we applied the Jadad criteria (randomized, use of the double-blind method and identification of losses during and after the intervention), with possible scores ranging from 0 (lowest quality) to 5 (highest quality).[11]

Taking into consideration the possibility of errors in the evaluation of the results (caused by the lack of a control group in some studies), the analysis of efficacy was restricted to the controlled clinical trials since these were considered more credible and therefore more suitable for the evaluation of the interventions.[12] We chose to use no statistical tests, opting instead to perform a descriptive analysis of the studies.

RESULTS

Using the chosen key terms to search the selected databases, a total of 840 articles were found. A critical reading of this list was conducted, leading to the removal of titles incompatible with the objectives of this review and leaving 306 articles. The abstracts of these 306 articles were read, and, based on the inclusion and exclusion criteria, 104 were selected for review. All of the 104 studies selected were read in their entirety and re-evaluated in terms of the inclusion and exclusion criteria. This led to the exclusion of another 66 studies: 29 that did not address educational interventions; 15 that included adult asthma patients; 8 that did not present post-intervention results; 4 that were written in other languages; 3 that measured variables other than those chosen for this review; 2 that were themselves review articles; and 2 that involved children with other chronic diseases. One additional study was included based on the perusal of the references cited in the 104 studies.

Therefore, for this review, a total of 39 studies were included.[13-51] Of these, 27 were controlled clinical trials, of which 18 were randomized and 12 employed no control groups (Table 1). Of the 39 studies evaluated, 21 were conducted in the USA, 6 in Australia, 2 in the United Kingdom, 2 in Mexico, 1 in the Netherlands, 1 in Russia, 1 in New Zealand, 1 in Venezuela, 1 in China, 1 in Canada, 1 in Germany and 1 in Italy (Table 1). We found no Brazilian studies addressing educational interventions and published during the period under review.

The 39 clinical trials involved a total of 5513 patients. The controlled trials included 4205 patients: 2044 controls and 2161 study subjects. The number of patients involved in each individual study ranged from 15 to 1033 (Table 1). In 19 studies, adolescents were included, and 10 studies included children of two years of age or younger (Table 1). The length of the post-intervention follow-up period ranged from 3 weeks to 24 months. The proportion of subjects remaining in

TABLE 1

Principal characteristics reported in 39 studies analyzing asthma education in pediatric patients (1992-2002)

Author (Reference)	Year of publication	Country of origin	Study design	Age of the children	Sample size group	Study group	Control by	Conducted
Perrin[13]	1992	USA	RCCT	6-14	56	29	27	Phys
Toelle[14]	1993	Australia	RCCT	8-11	120	65	55	Phys
Colland[15]	1993	Netherlands	CCT	8-12	112	48	34/30	-
Mesters[16]	1993	USA	UCT	0-4	50	-	-	Phys & Res
Charlton[17]	1993	Australia	RCCT	3-16	91	48	43	Phys & Nur
Detwiler[18]	1994	USA	UCT	4-8	128	-	-	Nur
Lewis[19]	1994	USA	RCCT	7-12	125	66	59	-
Greineder[20]	1995	USA	UCT	1-17	53	-	-	Phys & Nur
Sorrels[21]	1995	USA	UCT	6-12	90	-	-	-
Wilson[22]	1996	USA	RCCT	3.8 (mean)	76	41	35	Nur
Persaud[23]	1996	USA	CCT	8-12	36	18	18	Nur
Christiansen[24]	1997	USA	CCT	9-12	66	34	32	Nur
Brazil[25]	1997	USA	UCT	6-18	50	-	-	Phys, Nur & PT
Roncheti[26]	1997	Itália	RCCT	9.6 (mean)	312	162	150	-
Madge[27]	1997	UK	RCCT	2-15	201	96	105	Nur
Gibson[28]	1998	Australia	CCT	12-15	92	62	30	Stu
Gebert[29]	1998	Germany	CCT	7-14	81	27/29	25	Phys, PT & Psych
Maslennikova[30]	1998	Russia	RCCT	4-14	209	50	60/62/37	Phys
Higgins[31]	1998	USA	UCT	2-17	61	-	-	Phys & Nur
Holzheimer[32]	1998	Australia	RCCT	2-5	80	-	-	undefined
Mathews[33]	1998	New Zealand	UCT	3-5	15	-	-	Phys & Nur
Lopez[34]	1998	Mexico	UCT	6-10	45	-	-	Phys, AS, Psych
Evans[35]	1999	USA	CCT	5-11	1033	515	518	Phys &Com
Perez[36]	1999	Venezuela	RCCT	6-14	29	17	12	Phys
Greineder[37]	1999	USA	RCCT	1-15	57	28	29	Nur
Bartholomeu[38]	2000	USA	RCCT	7-17	133	70	63	Phys & MA
Kelly[39]	2000	USA	CCT	2-16	78	38	40	Phys & Nur
Chan[40]	2001	USA	UCT	< 18	210	-	-	Phys, Nur & Pharm
Jones[41]	2001	USA	UCT	7.2 (mean)	122	-	-	Comm
Young[42]	2001	Canada	CCT	6-12	373	230	143	Phys & Nur
Shah[43]	2001	Austrália	RCCT	12-15	251	114	137	Stu
Bruzzese[44]	2001	USA	UCT	8-11	59	-	-	Stu
Liu[45]	2001	Australia	RCCT	1-14	158	31/29/30/35	33	Phys
Evans[46]	2001	USA	RCCT	9.1 (mean)	239	-	-	HE
Harish[47]	2001	USA	RCCT	2-17	129	60	69	Phys, Nur & SW
Hui[48]	2002	China	UCT	< 18	106	-	-	Nur
Guendelman[49]	2002	USA	RCCT	8-16	134	66	68	Nur
Stevens[50]	2002	UK	RCCT	1-5	200	99	101	Nur
Gardida[51]	2002	Mexico	CCT	6-10	53	24	29	-

RCCT: randomized controlled clinical trial; CCT: controlled clinical trial; UCT: uncontrolled clinical trial; Phys: physician; Res: researcher; Nur: nurse; PT: physical therapist; Psych: psychologist; MA: multimedia aide; Stu: student; Comm: community personnel; Pharm: pharmacist; HE: health educator; SW: social worker

the study for the full duration of the follow-up period ranged from 43% to 100% in the 31 studies that provided such data. Information regarding the teams that carried out the educational instruction was included in 33 studies (Table 1). The venue in which the educational activities were conducted in various venues, including homes, hospitals, schools, camps and clinics. In 2 studies, the educational sessions were conducted in more than one venue.[45,49]

Regarding the content of the educational programs, all included knowledge of the disease (etiopathogenesis and physiopathology), 29 taught self-management skills, 28 addressed asthma treatment, 25 addressed aggravating factors (triggers), 22 focused on the importance of measuring peak expiratory flow, and 11 addressed environmental control measures. A therapeutic plan for asthma treatment, furnished to patients in written form, was used in 17 studies, all of which stressed the use of clinical or functional parameters (peak expiratory flow), to inform therapeutic decisions. Training patients in the use of inhalers for the administration of medication was promoted in 19 studies.

There was considerable variance in the educational techniques used. All of the interventions featured, as the principal method, formal educational sessions, some of which were conducted in groups (27 studies) and some as individual sessions (10 studies). In 1 study, both modalities were employed. The number of sessions varied from 1 to 10, and (in the studies reporting his variable) the duration of each session varied from 20 minutes to 4 hours. Programs including fewer sessions employed sessions of longer durations. Such formal educational sessions were used as the only measure in 18 studies (individual sessions in 10 and group sessions in 8). However, in the remaining 21 studies, one or more additional measure was employed. Auxiliary resources, such as study notes, educational brochures, and posters, were also used in some programs.

Intermediate variables only were measured in 8 studies (Group A studies), and 31 studies measured at least one outcome variable (Group B studies). Of the 39 studies reviewed, 32 (82%) reported post-intervention benefits, and 24 reported improvements in the outcome variables. In Group A, all 8 studies, 4 of which were controlled (subgroup A1a)[29,36,45-46] and 4 of which were uncontrolled (subgroup A1b),[16, 25, 41, 44] showed post-intervention improvements. No studies fit the criteria of subgroups A2a and A2b. In Group B, 24 studies (77.4%) reported post-intervention benefits (subgroup B1), and 7 reported no post-intervention benefits (subgroup B2). In subgroup B1, 17 were controlled clinical trials (subgroup B1a),[14-15, 17, 19, 22-23, 26-27, 30, 32, 35, 37-39, 43, 47, 49] and 7 were uncontrolled clinical trials (subgroup B1b).[18, 20-21, 33-34, 40, 48] In subgroup B2, 6 studies were controlled clinical trials (subgroup B2a),[13, 24, 28, 42, 50-51] and 1 was an uncontrolled clinical trial (subgroup B2b).(31) Of the 23 controlled studies in Group B, 17 (74%) reported post-intervention improvement in various outcome variables, and 6 reported no benefit.

Most [20] of the studies reviewed determined the level of knowledge regarding the disease. Among the outcome variables, hospitalization rates and number of emergency room visits were the evaluation variables most frequently used (in 17 and 16 studies, respectively). The variables evaluated and the results obtained are shown in Table 2 and are described hereafter:

The level of knowledge regarding the disease was determined in these studies through the use of questionnaires administered to the children or to their guardians before and after the intervention, with the objective of evaluating cognitive gains achieved by the program. In studies employing games or multimedia resources, such evaluation was achieved using the same instruments. Statistically significant improvements were found in 18 (90%) of the 20 studies in which this variable was analyzed.

To evaluate self-management skills, acquired skills, correct use of inhalers and correct implementation of the proposed therapeutic plan were analyzed, based on the identification of clinical variables presenting worsening or on the measurement of peak expiratory flow. This variable was measured in 12 studies, and improvement was reported in 10 (83.3%) of those 12.

Among the evaluated variables related to the use of health care services was hospitalization, which was evaluated in 17 studies, using various indices (percentage of patients hospitalized, percentage of children hospitalized at least once, post-intervention percentage reduction in the number of hospitalizations, total number of hospitalizations and mean number of hospitalizations), 11 (64.7%) of

TABLE 2

Distribution of the 39 studies analyzing asthma education in pediatric patients in relation to the variables measured and results obtained, as well as the presence or absence of a control group (1992-2002)

Variable evaluated (n)	Bibliographic references of the studies showing a benefit		Bibliographic references of the studies showing no benefit	
	Controlled	Uncontrolled	Controlled	Uncontrolled
Knowledge (20 studies)	13, 15, 22, 24, 28, 29, 32, 36, 38, 45	16, 18, 25, 33, 34, 41, 44, 48	14, 50	-
Hospitalization (17 studies)	19, 27, 37, 38, 39, 51	20, 21, 34, 40, 48	17, 24, 35, 49, 50	31
Emergency room visits (16 studies)	14, 19, 23, 26, 37, 51	20, 21, 48	24, 27, 38, 39, 49, 50	31
Self-management skills (12 studies)	29, 30, 36, 38, 46, 49	16, 18, 33, 44	50	25
School absenteeism (11 studies)	15, 43	21,48	13, 17, 23, 24, 30, 49	33
Unscheduled visits to the doctor (10 studies)	14, 19, 30, 32, 39	18, 48	35, 50	31
Pulmonary function (9 studies)	14, 17, 30, 49	33	23, 24, 47	-
Nighttime symptoms (8 studies)	14, 15, 22, 27, 48	48	17, 49	-
Daytime and nighttime symptoms (6 studies)	22, 27, 30, 35	40	49	-
Quality of life (6 studies)	43	48	28, 39, 42, 50	-
Limitations in physical activities (6 studies)	15, 17, 38, 49	-	14, 27	-

n: number of studies

these studies reporting improvement in this variable. Another such variable was the number of emergency room visits, which was evaluated in 16 studies, also using various indices (mean number of emergency room visits, post-intervention percentage reduction in the number of emergency room visits, total number of emergency room visits and mean percentage of children visiting the emergency room), 9 (56.2%) of these studies reporting improvement in this variable. In addition, unscheduled visits to the doctor were evaluated in 10 studies, using three indicators (number of visits/year, total number of unscheduled visits and number of children having had at least one such unscheduled visit), 7 (70%) of these studies reporting improvement in this variable.

As indicators of morbidity, the studies reviewed evaluated the following variables: school absenteeism, evaluated in 11 studies by determining the mean number of school days missed or the proportion of children missing school, 4 (36.4%) of these studies reporting improvement in this variable; nighttime symptoms, evaluated in 8 studies through assessing the relationship between the mean symptom scores during the study period and the number of days in the period, the proportion of children presenting nighttime symptoms, and the mean number of nights/week on which the parents were awakened as a result of such symptoms, 6 (75%) of these studies reporting improvement; daytime and nighttime symptoms, which were evaluated in 6 studies by determining the mean number of symptomatic days, symptom scores (established in each study), mean number of symptom-free days, mean number of symptoms/year or number of children presenting cough or wheezing, 5 (83.3%) of these studies reporting improvement; limitations in physical activities (functional status), which were evaluated in 6 studies by assessing mean study-specific scores or proportion of children presenting limitations in physical activities (at school, at home or in practicing

TABLE 3

Characteristics of the 7 high-scoring studies that reported on the educational interventions for asthmatic children that were considered the most efficacious, including the respective scores for methodological quality (Jadad criteria), content, techniques used and parameters in which improvements were seen (1992-2002)

Reference	Jadad	Content	Educational techniques employed	Measured variables showing a benefit
(30)*	2	PEF, MDI, AEF, T	G(4)	Daytime and nighttime symptoms, pulmonary function, unscheduled visits to the doctor, self-management skills
(14)*	2	PEF, MDI, AEF, T, TF, WTP	G(2)	Emergency room visits, nighttime symptoms, pulmonary function, unscheduled visits to the doctor
(15)	0	MDI, AEF, T, TF, SMS	G (10) + RP + RE + BT + M	Knowledge, school absenteeism, nighttime symptoms, functional status
(19)*	2	AEF, T, TF, ECM	G (4)	Hospitalization, emergency room visits, unscheduled visits to the doctor
(22)*	3	MDI, AEF, T, TF, ECM, WTP, SMS	G (4) + Video	Knowledge, nighttime symptoms, daytime and nighttime symptoms
(27)*	3	PEF, AEF, T, TF, WTP, SMS	I (3) + Flannelgraph	Hospitalizations, nighttime symptoms, daytime and nighttime symptoms
(38)*	2	PEF, AEF, T, TF, WTP, SMS	Multimedia	Knowledge, self-management skills, hospitalizations, functional status

*Randomized controlled clinical trial

PEF: peak expiratory flow; MDI: metered-dose inhaler; AEF: asthma etiopathogenesis and physiopathology; T: treatment; TF: triggering factors; WTP: written therapeutic plan; SMS: self-management skills; ECM: environmental control measures; G: group educational sessions (number of sessions); I: individual educational sessions (number of sessions); RE: relaxation exercises; RP: role play; BT: behavioral therapy; M: music

sports), 4 (66.6%) of these studies reporting improvement.

Pulmonary function was evaluated in 9 studies by analyzing the variables: mean percentage of the total follow-up period in which peak expiratory flow was below 30% of predicted; mean forced expiratory volume in one second score; mean peak expiratory flow as percent of predicted; mean forced expiratory volume in one second as percent of predicted; and proportion of children presenting peak expiratory flow in the yellow or red zone. Improvement was reported in 5 (55.5%) of these studies.

Quality of life was evaluated in 6 studies through administration of the Pediatric Asthma Quality of Life Questionnaire and the Asthma Quality of Life Questionnaire,[52-53], 2 (33.3%) of the 6 reporting improved quality of life.

Analyzing the controlled clinical trials reviewed as a group apart, the frequency of beneficial outcomes was similar to that seen in the 39 studies as a whole.

Table 2 shows, for each evaluated variable, the number of studies reporting improvement or no benefit. It can be seen that there were more studies demonstrating a benefit than studies reporting no benefit for the variables: frequency of unscheduled visits to the doctor, nighttime symptoms, daytime or nighttime symptoms, limited capacity for physical activity, hospitalizations, emergency room visits, pulmonary function, level of knowledge regarding the disease, and self-management skills. In contrast, the number of studies, showing a reduction in school absenteeism and an improvement in quality of life was lower than the number of studies showing no such benefits. Taking into consideration only the controlled studies, the number of studies showing a benefit was equal to that of those showing no benefit in terms of frequency of emergency room visits and pulmonary function. For all other parameters (number of measures, educational techniques, and types of professionals carrying out the interventions), a similar balance

TABLE 4

Characteristics of the 11 low-scoring studies that reported on the educational interventions for asthmatic children that were considered the least efficacious, including the respective scores for methodological quality (Jadad criteria), content, techniques used and parameters in which improvements were seen (1992-2002)

Reference	Jadad	Content	Educational techniques employed	Measured variables showing a benefit
(24)	1	PEF, AEF, T, WTP, SMS,	G (5)	knowledge
(32)*	1	MDI, AEF, T, TF, SMS,	G (3) + reading + AL + games	knowledge, unscheduled visits to the doctor
(50)*	3	MDI, AEF, T, TF, WTP, SMS, ECM	I (2)	-
(13)*	2	AEF, T G (4) + RespEx + RE	knowledge	
(36)*	2	AEF, T G (6) + games	knowledge, self-management + RE + BT	skills
(29)	0	PEF, AEF, T, SMS	G (5) + AL + PA + RE + RespEx + BT + video + RP	knowledge, self-management skills
(28)	0	AEF	G (3) + video + workshop	knowledge
(46)*	4	AEF, TF, SMS	G (6) + Hist + games + multimedia	self-management skills
(45)*	3	AEF, SMS	I + G (2) + vídeo	knowledge
(47)*	3	PEF, MDI, AEF, T, TF, WTP, SMS, ECM	G (?)	hospitalizations, emergency room visits
(42)*	2	AEF, SMS	G (4) + video	-

*Randomized controlled clinical trial

PEF: peak expiratory flow; MDI: metered-dose inhaler; AEF: asthma etiopathogenesis and physiopathology; T: treatment; TF: triggering factors; WTP: written therapeutic plan; SK: self-management skills; ECM: environmental control measures; G: group educational sessions (number of sessions); I: individual educational sessions (number of sessions); RespEx: respiratory exercises; RE: relaxation exercises; RP: role play; Hist: history; BT: behavioral therapy; PA: physical activity (sports)

was observed between studies showing improvement and those showing no improvement.

The data from 7 HSSs[14-15, 19, 22, 27, 30, 38] are presented in Table 3. For comparison purposes, Table 4 shows those from 11 LSSs.[13, 24, 28-29, 32, 36, 42, 45-47, 50] Tables 3 and 4 show, respectively, the scores obtained by the HSS and LSS groups according to the Jadad criteria, as well as the techniques used, measures taken and parameters presenting relative benefits in the interventions evaluated in the HSSs and LSSs. Among the HSSs, 1 study(15) was classified (using the Jadad criteria) as methodologically inappropriate for not having randomized patient groups and not having mentioned the use of the double-blind method, and having lost patients during the follow-up period. Among the LSSs, 4 studies were classified as methodologically inappropriate, 2[28-29] for the same reasons as the HSS cited above, 1[24] for lack of randomization, and 1 for not having reported losses during the follow-up period.[32] The study receiving the highest score in the second round of scoring (Jadad criteria) was actually in the LSS group.[46]

In Table 3, it can be seen that the 7 HSSs used from 4 to 7 content variables each (mean, 5.4), and Table 4 shows that the 11 LSSs used from 1 to 8 content variables each (mean, 3.8), 6 using only 1 to 3 content variables. Etiopathogenesis and physiopathology of the disease were included in the programs evaluated in the 7 HSSs and 11 LSSs; aggravating factors (asthma triggers) were addressed in 6 HSSs (85.7%) and 5 LSSs (45.4%); treatment was discussed in 7 HSSs (100%) and in 6 LSSs (54.5%); asthma self-management skills were taught in 4 HSSs (57.1%) and in 8 LSSs (72.7%); 4 (57.1%) of the HSSs and 3 (27.2%) of the LSSs trained patients in the use of asthma inhalers; 4 (57.1%) of the HSSs and 3 (27.2%) of the LSSs addressed the monitoring of peak expiratory fow in control of the disease; written

treatment plans were also used by 4 (57.1%) of the HSSs and 3 (27.2%) of the LSSs; and environmental control measures were addressed in 2 HSSs (28.5%) and 2 LSSs (18.2%).

With the exception of 1 HSS,[15] in which four supplementary techniques (role play, music, relaxation exercises and behavior therapy) were used in addition to the group sessions, the studies receiving the highest scores used either one or two educational method (Table 3): group sessions only (3 studies); group sessions and video (1 study); individual sessions and flannelgraph (1 study); and multimedia (1 study). The LSSs used from 1 to 8 educational methods, 7 studies using 3 or more (Table 4).

Each of the 7 HSSs measured from 3 to 6 evaluation variables, and the 11 LSSs measured from 1 to 8 (Table 2). The 7 HSSs, taken together, performed 31 evaluations, 25 of which (80%) produced positive results. Each of these studies reported post-intervention improvement in 3 or 4 variables (Table 3). There were 3 HSSs(15, 19, 22) showing beneficial effects of all variables measured in the evaluation of the educational interventions analyzed. The 11 LSSs made 28 evaluations, 16 (57.1%) producing positive results. Each of the LSSs showed beneficial effects for 1 to 3 variables (Table 4). There were 6 LSSs(29, 32, 36, 45-47) showing beneficial effects of all variables evaluated. Of those 6, 2(32, 47) measured intermediate and outcome variables, whereas 4 measured intermediate variables only (Table 2).

DISCUSSION

Of note was the small number of studies addressing asthma education in pediatric asthma patients, published during the stipulated period and meeting the review criteria. Also notable was the great diversity in study design, likely reflecting the lack of consensus regarding many topics in this area. Faced with the considerable heterogeneity of the studies reviewed, we opted for conducting an analytical review (secondary analysis of data) in order to allow a more wide-ranging analysis, including studies of varying design and evaluating diverse educational methods.

Every attempt to evaluate therapeutics methods of treatment asthma finds itself confronted with difficulties resulting from the natural variability in asthma severity over time, influenced by seasonal, environmental and age-related aspects. Modifications resulting from treatment are distinguished from those related to the natural course of asthma (confounding factor) through the use of control groups and random allocation of study subjects. In this review, only 18 of the selected studies met the criteria of establishing a control group and randomizing subjects. Another 8 studies included a control group but did not randomize subjects, and 13 studies evaluated educational interventions in which all children were treated equally, without a control group (Table 1). In order to reduce the potential for errors in the evaluation of the results, the analysis of the efficacy of the educational interventions addressed in the studies reviewed was limited to the 27 controlled trials.

The rate of positive outcome for at least one of the variables measured was high: 82% of the 39 studies reported improvement in at least one of the variables evaluated. Among the Group B studies, the rate of success in at least one outcome variable was 77.4%. In virtually all of the 27 controlled studies, one or more variables were found to present no post-intervention improvement, even among the 7 HSSs (Table 2). Notable among the outcome variable results were reductions in the frequency of daytime and nighttime symptoms, observed in 80% of the controlled studies that evaluated the variable, and in the limitation of physical activities, observed in 66% of the controlled studies evaluating it. The indicators of the use of health care services were improved after some interventions: the hospitalization rate, the frequency of emergency room visits and the frequency of unscheduled visits to the doctor decreased, respectively, by 54.5%, 50% and 71.4% in the controlled studies measuring these variables, likely reflecting reduced morbidity. In the educational programs evaluated, the emphasis given to treatment of the disease and to self-management skills, some programs even providing free medication to both study subjects and controls, probably influenced these results.[27, 30, 39, 47, 51]

Some controlled studies demonstrated benefits in the variables measured, whereas other controlled studies showed no benefit in those same variables (Table 2). The number of studies showing benefit or no benefit varied by variable: hospitalization rates, emergency room visits and pulmonary function were equally represented; there were more studies showing benefits gained in knowledge of the

disease, self-management skills, unscheduled visits to the doctor, frequency of daytime and nighttime symptoms, and limitations in physical activities; and there were fewer studies showing improvements in school absenteeism and quality of life. The fact that several studies demonstrated positive results indicates that those studies must have been in some way distinct, perhaps in the way the educational intervention was conducted or perhaps in the profile of the asthmatic children involved and that of their families. The outcome of any educational process is dependent upon certain determining factors, such as content, presentation of topics and the quality of the student-teacher relationship. The studies reviewed, although making reference to the content/topics addressed, provided no indications regarding student-teacher relationships, which might have been one of the variables responsible for the differences in the outcomes observed since the objective characteristics of the interventions did not differ in any significant way.

The dialog among physicians, patients and family members during the consultation, taking into consideration the particularities and problems of each individual family, as well as discussions regarding solutions for achieving better management of the asthma in each particular situation, was not addressed or reported as an educational modality in the majority of studies reviewed. Exceptions were seen in 3 studies, in which there was explicit expression of greater concern about the more individualized aspects of patients and their families. In those studies, positive results were obtained in the outcome variables, and 2 of those studies were classified as HSSs.[15-22,35]

The majority of the studies measured only objective variables, ignoring (probably due to the difficulty in measuring) all subjective aspects, such as acceptance of the disease, self-confidence, safety, sense of humor, self-esteem, degree of anxiety (on the part of the children and their parents), interest in improvement and willingness to comply with treatment plans, that might have been altered as a results of the interventions. Some studies did, however, evaluate some subjective variables: attitude toward the disease;[16, 18, 23] parental anxiety;[16, 45] behavioral changes(13, 25) (one through application of the Child Behavior Checklist);[54] and psychological aspects of the children.[36] Of these studies, 3 were controlled studies.[13, 23,45] All demonstrated improvement in the variables evaluated, with the exception of 1 study, the 1 evaluating parental anxiety, which was unaffected.[16]

It is possible that, in some cases, undetermined subjective variables in some way influenced the demonstration of the effects that a particular intervention had on the objective variables. Some aspects merit emphasis.

Of the 8 controlled studies that evaluated school absenteeism, only 2 (25%) reported fewer school absences, despite reporting considerable improvements in other indicators of morbidity. In another of those studies, less limitation in physical activities was found, together with psychological and behavioral improvement, and yet there was no reduction in school absenteeism.[13] The influence of subjective factors such as teacher reluctance to have children with "problems" in the classroom, a situation with which few are trained to cope, or parental insecurity, can be suspected. The school environment could be used as a platform for some activities related to asthma education, training teachers in how to aid children with asthma, since asthma affects the school activities (sports, etc.) in which a child can engage. In this review, some authors conducted educational interventions independently (not in affiliation with any health care facility).[14, 21, 24, 41-46] There are some ongoing experiments such as the Open Airways program,[1] initiated in 1986 for children in the third to fifth grade in select schools in the USA, that have produced positive results in terms of recognition of signs and symptoms, as well as in better management of the disease. These positive results have been reproduced in other schools across the USA, as reported in another study,(44) in which only intermediate variables were evaluated, and in other countries implementing similar programs, which also produced some benefit in outcome variables.[26, 30] The transposition of such interventions to Brazil will require careful adaptation, taking into account local cultural and socioeconomic aspects.

The quality of life index improved in only 1[43] of the 5 studies evaluating this variable. The Pediatric Asthma Quality of Life Questionnaire was applied in 4 studies. However, it must be borne in mind that, in the majority of pediatric cases, the questionnaires are completed by the parent or guardian, which compromises the quality of this

instrument of evaluation.

The use of a variety of techniques was not found to de associated with greater efficacy. Of the 7 studies evaluating the most efficacious interventions, 6 used only one or two techniques (Table 3). Dealing with pediatric patients, one would suppose that certain educational techniques would be more motivating and efficient than others in each age bracket. However, none of the studies reviewed evaluated this theme, and our analysis was not capable of identifying the most significant effects when techniques (multimedia, video, games, etc.) were employed as supplements to the formal educational sessions. The use of nontraditional educational practices results in problems of cost and availability of qualified professionals qualified to develop and coordinate such practices, making it necessary to document a positive cost-benefit ratio in order to justify their use, which was not possible in this review.

The number of topics included in the content of the programs may influenced their success or failure since it was observed that the more efficacious interventions included greater numbers of topic: the educational interventions evaluated in the 7 studies obtaining the highest scores included 4 to 8 asthma topics, despite the fact that 11 of the LSSs included an equal number of topics. Among the topics reported in the studies reviewed, environmental control measures received little attention, despite the significance of its participation in asthma pathogenesis. It must be reiterated that the analysis of the content of the educational programs was based on references made to this aspect in the various studies. This information may occasionally have been omitted. Therefore, the number of topics in the content of the programs may be underrepresented in the presentation of the results of this review.

The efficacy of some educational programs for adults has been well established.[55] However, in the systematic review conducted by the Cochrane Airways Group, the principal results obtained with educational interventions in children were limited. Modest reduction were seen in school absenteeism, number of nights with symptoms, frequency of emergency room visits, and number of days on which physical activities were limited.[9] In the present review, the results were diverse, depending on the variable measured, and, in some ways, controversial in comparison to other studies. Nevertheless, the high frequency of beneficial effects in at least one measured variable indicates the therapeutic potential of educational interventions in pediatric asthma patients and the need to conduct further research in this area. The evaluation of the methodological quality of the studies, using the Jadad criteria, revealed that there was a higher concentration of studies of satisfactory quality among the HSSs than among the LSSs, although 7 LSSs were also classified as being of satisfactory or good quality. One HSS[15] and 3 LSSs[24, 28-29] were not randomized. It was not possible to evaluate the influence of methodological design on the differences in efficacy seen among the various educational interventions analyzed in the HSSs and LSSs.

It is possible that education practiced in a simple and flexible fashion during each visit, taking into consideration the situation of each of the patients and their families (personalized), had an equal or greater effect than that of interventions based on more varied and sophisticated educational techniques. Instruction given during the treatment of the asthmatic child might be more cost effective, be more suited to any health care facility, and could be initiated at the time of diagnosis. In order to test this hypothesis, future studies should involve better control of confounding factors and should focus on simplified and more natural models of education that restore and recognize the value of the relationships among physicians, patients and families of patients. This review shows that the range of the positive results was more frequent in studies that measured only intermediate variables, and that there was a drop in the success rate when outcome variables were included (Table 2). This is an important point to be considered in the planning of educational activities for patients with asthma. Strategies should be chosen that produce results beyond the simple ability to memorize theoretical content and that affect habits, perceptions and conduct, effectively translating to lower morbidity and improved quality of life.

Beneficial alterations in some variables were reported in various studies, which is an indication that such interventions have a real effect on asthma, thereby justifying their continuation and their further evaluation. The number of content topics was the only characteristic of the educational

programs evaluated in the studies reviewed that was associated with greater efficacy. The use of sophisticated educational techniques was not found to lead to better results. Studies involving better analysis of confounding factors are warranted and could contribute to the evaluation of the efficacy of asthma education in pediatric patients.

ACKNOWLEDGMENTS

The authors are grateful to Doutor Maurício Cardeal, statistician and Professor at the Universidade Federal da Bahia (Federal University of [the state of] Bahia) and at the Fundação para Desenvolvimento das Ciências (Foundation for Scientific Development), for his valuable contribution in the analysis of the results of this review.

REFERENCES

1. National Heart Lung and Blood Institute. Open Airway: asthma self management program. Bethesda, Maryland: National Institute of Health; 1984. [NIH Publication No. 84-2365].
2. National Heart, Lung, and Blood Institute. Air power: management of asthma through education. Bethesda, Maryland: National Institute of Health; 1984. [NIH Publication No. 84-2362].
3. National Heart, Lung, and Blood Institute [home page in Internet]. National Asthma Education and Prevention Program (NAEPP). [cited 2004 Mar 22]. Available from: http://www.nhlbi.nih.gov/about/naepp/
4. National Heart Lung and Blood Institute. National Asthma Education Program. Expert panel report: guidelines for the diagnosis and management of asthma. Bethesda, Maryland: National Institute of Health; 1991. [NIH Publication No. 91-3042].
5. National Heart Lung and Blood Institute. World Health Organization. Global Iniciative for Asthma (GINA): global strategy for asthma management and prevention. Bethesda, Maryland: National Institute of Health; 1995. [NHLBI/ WHO Workshop Report. NIH Publication No. 95-3659]
6. Fernández ALG, Cabral ALB, Faresin SM, coordenadores. I Consenso Brasileiro de Educação em Asma. J Pneumol. 1996;22(Supl 1):1-24.
7. Brasil. Ministério da Saúde. Portaria No.1394 de 13 Dez. 1999. Cria o Grupo de Trabalho de Controle da Asma.[texto na Internet]. [citado 2004 Mar 22]. Disponível em: http://portalweb02.saude.gov.br/saude/area.cfm?id_area=169
8. Santos MARC, Sant´Anna CC. Responsabilidade médica sobre a conscientização dos pais e pacientes (1). Rio de Janeiro: Sociedade Brasileira de Pediatria; 2003. (Asma Pediátrica)
9. Wolf FM, Guevara JP, Grum CM, Clark NM, Cates CJ. Educational interventions for asthma in children (Cochrane Review). In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.
10. Clark NM, Starr-Schneidkraut NJ. Management of asthma by patients and families. Am J Respir Crit Care Med. 1994;149(2 Pt 2):54S-66S; discussion S67-8.
11. Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJ, Gavaghan DJ, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? Control Clin Trials. 1996;17(1):1-2.
12. Furlan AD. Em busca de evidência para a prática médica diária. Acta Fisiátrica. 2000;7(1):20-8.
13. Perrin JM, MacLean WE Jr, Gortmaker SL, Asher KN. Improving the psychological status of children with asthma: a randomized controlled trial. J Dev Behav Pediatr. 1992;13(4):241-7.
14. Toelle BG, Peat JK, Salome CM, Mellis CM, Bauman AE, Woolcock AJ. Evaluation of a community-based asthma management program in a population sample of schoolchildren. Med J Aust. 1993;158(11):742-6.
15. Colland VT. Learning to cope with asthma: a behavioural self-management program for children. Patient Educ Couns. 1993;22(3):141-52.
16. Mesters I, Meertens R, Crebolder H, Parcel G. Development of a health education program for parents of preschool children with asthma. Health Educ Res. 1993;8(1):53-68.
17. Charlton I, Antoniou AG, Atkinson J, Campbell MJ, Chapman E, Mackintosh T, et al. Asthma at the interface: bridging the gap between general practice and a district general hospital. Arch Dis Child. 1994;70(4):313-8.
18. Detwiler DA, Boston LM, Verhulst SJ. Evaluation of an educational program for asthmatic children ages 4-8 and their parents. Respir Care. 1994;39(3):204-12.
19. Lewis, MA, Rachelefsky G, Lewis CE, Leake B, Richards W. The termination of a randomized clinical trial for poor Hispanic children. Arch Pediatr Adolesc Med. 1994;148(4):364-7.
20. Greineder DK, Loane KC, Parks P. Reduction in resource utilization by an asthma outreach program. Arch Pediatr Adolesc Med. 1995;149(4):415-20.
21. Sorrells VD, Chung W, Schlumpberger JM. The impact of a summer asthma camp experience on asthma education and morbidity in children. J Fam Pract. 1995;41(5):465-8.
22. Wilson SR, Latini D, Starr NJ, Fish L, Loes LM, Page A, et al. Education of parents of infants and very young children with asthma: a developmental evaluation of the Wee Wheezers program. J Asthma. 1996;33(4):239-54. Erratum in: J Asthma. 1997;34(3):261.
23. Persaud DI, Barnett SE, Weller SC, Baldwin CD, Niebuhr V, McCormick DP. An asthma self-management program for children, including instruction in peak flow monitoring by school nurses. J Asthma. 1996;33(1):37-43.
24. Christiansen SC, Martin SB, Schleicher NC, Koziol JA, Mathews KP, Zuraw BL Evaluation of a school-based asthma education program for inner-city children. J Allergy Clin Immunol. 1997;100(5):613-7.
25. Brazil K, McLean L, Abbey D, Musselman C. The influence of health education on family management of childhood asthma. Patient Educ Couns. 1997;30(2):107-18.
26. Ronchetti R, Indinnimeo L, Bonci E, Corrias A, Evans D, Hindi-Alexander M, et al. Asthma self-management programmes in a population of Italian children: a multicentric study. Italian Study Group on Asthma Self-Management Programmes. Eur Respir J. 1997;10(6):1248-53.
27. Madge P, McColl J, Paton J. Impact of a nurse-led home management training programme in children

admitted to hospital with acute asthma: a randomised controlled study. Thorax. 1997;52(3):223-8.
28. Gibson PG, Shah S, Mamoon HA. Peer-led asthma education for adolescents: impact evaluation. J Adolesc Health. 1998;22(1):66-72.
29. Gebert N, Hummelink R, Konning J, Staab D, Schmidt S, Szczepanski R, et al. Efficacy of a self-management program for childhood asthma-a prospective controlled study. Patient Educ Couns. 1998;35(3):213-20.
30. Maslennikova, GY, Morosova ME, Salman NV, Kulikov SM, Oganov RG. Asthma education programme in Russia: educating patients. Patient Educ Couns. 1998;33(2):113-27.
31. Higgins JC, Kiser WR, McClenathan S, Tynan NL. Influence of an interventional program on resource use and cost in pediatric asthma. Am J Manag Care. 1998;4(10):1465-9.
32. Holzheimer L, Mohay H, Masters lB. Educating young children about asthma: comparing the effectiveness of a developmentally appropriate asthma education video tape and picture book. Child Care Health Dev. 1998;24(1):85-99.
33. Matthews B, Dickinson A, Cram F. Establishment and evaluation of a preschool asthma programme: a pilot study. Adolescent and Family Service, Hutt Valley Health. Nurs Prax N Z. 1998;13(3):25-34.
34. Lopez-Campos C, Cano-Rios P, Gonzalez-Cisneros A, Martínez-Ordaz V, Arteaga-Campos L, Acosta-Ortiz B, et al. Educación a niños asmáticos y sus padres para evitar crisis. Rev Alerg Mex. 1998;45(5):134-9.
35. Evans R 3rd, Gergen PJ, Mitchell H, Kattan M, Kercsmar C, Crain E, et al. A randomized clinical trial to reduce asthma morbidity among inner-city children: results of the National Cooperative Inner-City Asthma Study. J Pediatr. 1999;135(3):332-8
36. Perez MG, Feldman L, Caballero F. Effects of a self-management educational program for the control of childhood asthma. Patient Educ Couns. 1999;36(1):47-55.
37. Greineder DK, Loane KC, Parks P. A randomized controlled trial of a pediatric asthma outreach program. J Allergy Clin Immunol. 1999;103(3 Pt 1):436-40.
38. Bartholomew LK, Gold RS, Parcel GS, Czyzewski DI, Sockrider MM, Fernandez M, et al. Watch, discover, think, and act: evaluation of computer-assisted instruction to improve asthma self-management in inner-city children. Patient Educ Couns. 2000;39(2-3):269-80.
39. Kelly CS, Morrow AL, Shults J, Nakas N, Strope GL, Adelman RD. Outcomes evaluation of a comprehensive intervention program for asthmatic children enrolled in medicaid. Pediatrics. 2000;105(5):1029-35.
40. Chan DS, Callahan CW, Moreno C. Multidisciplinary education and management program for children with asthma. Am J Health Syst Pharm. 2001;58(15):1413-7.
41. Jones JA, Wahlgren DR, Meltzer SB, Meltzer EO, Clark NM, Hovell MF. Increasing asthma knowledge and changing home environments for Latino families with asthmatic children. Patient Educ Couns. 2001;42(1):67-79.
42. Young NL, Foster AM, Parkin PC, Reisman J, MacLusky I, Gold M, et al. Assessing the efficacy of a school-based asthma education program for children: a pilot study. Can J Public Health. 2001;92(1):30-4.
43. Shah S, Peat JK, Mazurski EJ, Wang H, Sindhusake D, Bruce C, et al. Effect of peer led program for asthma education in adolescents: cluster randomized controlled trial. BMJ. 2001;322(7286):583-5.
44. Bruzzese JM, Markman LB, Appel D, Webber M. An evaluation of Open Airways for Schools: using college students as instructors. J Asthma. 2001;38(4):337-42.
45. Liu C, Feekery C. Can asthma education improve clinical outcomes? An evaluation of a pediatric asthma education program. J Asthma. 2001;38(3):269-78.
46. Evans D, Clark NM, Levison MJ, Levin B, Mellins RB. Can children teach their parents about asthma? Health Educ Behav. 2001;28(4):500-11.
47. Harish Z, Bregante AC, Morgan C, Fann CS, Callaghan CM, Witt MA, et al. A comprehensive inner-city asthma program reduces hospital and emergency room utilization. Ann Allergy Asthma Immunol. 2001;86(2):185-9.
48. Hui SH, Leung TF, Ha G, Wong E, Li AM, Fok TF. Evaluation of an asthma management program for Chinese children with mild-to-moderate asthma in Hong Kong. Pediatr Pulmonol. 2002;33(1):22-9.
49. Guendelman S, Meade K, Benson M, Chen YQ, Samuels S. Improving asthma outcomes and self-management behaviors of inner-city children: a randomized trial of the Health Buddy interactive device and an asthma diary. Arch Pediatr Adolesc Med. 2002;156(2):114-20.
50. Stevens CA, Wesseldine LJ, Couriel JM, Dyer AJ, Osman LM, Silverman M. Parental education and guided self-management of asthma and wheezing in the pre-school child: a randomised controlled trial. Thorax. 2002;57(1):39-44.
51. Gardida A, Rojas M, Tavera C, Catalan M. Evaluación de un programa educativo para el control del asma en niños de edade escolar en estado de Morelos, México. Rev Inst Enferm Resp. 2002;15(1):27-30.
52. Juniper EF, Guyatt GH, Feeny DH, Ferrie PJ, Griffith LE, Townsend M. Measuring quality of life in children with asthma. Qual Life Res. 1996;5(1):35-46.
53. Juniper EF, Guyatt GH, Ferrie PJ, Griffith LE. Measuring quality of life in asthma. Am Rev Respir Dis. 1993;147(4):832-8.
54. Achenbach TM, Ruffle TM. The Child Behavior Checklist and related forms for assessing behavioral/emotional problems and competencies. Pediatr Rev. 2000;21(8):265-71.
55. Gibson PG, Coughlan J, Abramson M, Bauman A, Hensley MJ, Walters EH, et al. The effects of self-management education and regular practitioner review in adults with asthma (Cochrane Review). In: The Cochrane Library, Issue 2, 1998. Oxford: Update Software.