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Review Article

Effect of Community-Based Interventions for Childhood Asthma: A Meta-Analysis

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Abstract

Background: This study aimed to appraise and compare the influence of community-based interventions (C-BIs) on childhood asthma.

Methods: We reviewed meta-analysis data and used a dichotomous or continuous model with random or fixed effects to get odds ratios (OR) and mean differences (MD) with 95% confidence intervals (CIs). This review included 13 papers and 8824 children with asthma. The range of studies years were between 2006 and 2024 from Google Scholar, Embase, Cochrane library, Pubmed, and OVID databases.

Results: Children with C-BI had significantly lower asthma-connected emergency department visits (OR, 0.29; 95% CI, 0.22-0.39, *P*<0.001), hospitalizations (OR, 0.24; 95% CI, 0.15-0.40, *P*<0.001), asthma symptoms days (MD, -2.56; 95% CI, -2.84- -2.28, *P*<0.001), nighttime asthma symptoms (MD, -2.14; 95% CI, -2.94- -1.34, *P*<0.001), and bronchodilator uses (OR, 0.28; 95% CI, 0.16-0.51, *P*<0.001), and higher asthma action plan use (OR, 8.87; 95% CI, 3.85-20.45, *P*<0.001) compared to children without C-BI in asthma**.**

Conclusion: Children with C-BI had significantly lower asthma-connected emergency department visits, hospitalizations, asthma symptoms days, nighttime asthma symptoms, bronchodilator use, and higher asthma action plan use compared to children without C-BI in asthma**.** Nevertheless, due to the limited number of research studies involved in the comparisons, their values warrant careful consideration.

Keywords: Asthma; Asthma-connected emergency; Hospitalizations

Introduction

Overall, 339 million people worldwide suffer from asthma, making it a serious public health issue. Asthma ranks 16th in terms of disability-adjusted life years lost and 28th in terms of illness burden, according to the Global Asthma Report (1). Asthma continues to be a cause of avoidable emergency department visits and hospital admissions in children, although advances in disease understanding and accessibility of efficient therapies (2).

Numerous factors contribute to poor success in pediatric asthma control, such as medication noncompliance issues, insufficient asthma education, ineffective environmental trigger mitigation,

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poor coordination within and between healthcare providers, etc. (3). Asthma-connected health outcomes in children can be improved by creating and implementing an efficient community-based strategy, as causes of these issues frequently lay outside the acute care system. A community-based strategy involves working with and within a specific community to address its needs and improve well-being. It's a multi-faceted approach that combines individual and environmental change strategies across various settings, aiming to prevent problems and promote positive outcomes for the target population. This often involves collaboration between community members, organizations, and government agencies. Most community-based initiatives created in the past few decades to enhance pediatric asthma tactics have primarily concentrated on a single intervention, such as teaching children and caregivers how to manage their asthma in a specific community context, such as their home or school. Reports on these therapies' efficacy, however, have not always been reliable (4).

Asthma education alone significantly decreased the likelihood of emergency department visits for asthma, but the influence on hospital admissions and vital care physician visits was not statistically significant (4, 5). This is most likely because asthma is a complicated illness with many underlying causes, including social, environmental, and behavioral determinants of health in addition to physiological ones. To improve health consequences for children with asthma, a combination of interventions that bridge the gap between hospital- and community-based services and address social behavioral, and physiological features of asthma are required.

The present meta-analysis aimed to measure the efficacy of the community-based strategies that link various stakeholders.

Methods

Design of examination

The meta-analyses were assessed and joined with an epidemiological statement utilizing a predefined procedure. Several databases were accessed in gathering and analyzing data. These datasets were applied to collect analyses that compared and gauged the influence of community-based interventions for childhood asthma. The study followed the PRISMA checklist (6).

Data pooling

This research investigated the primary result of the inclusion parameter. Language problems were not taken into account throughout the inclusion of research or screening procedures for potential participants. No limitations existed on the number of volunteers available for research but with children only as described in the selected studies. As letters, reviews, and editorials do not provide a position in meta-analysis, we excluded this type from our compilation. Fig. 1 illustrates the complete inspection identification process (7).

Eligibility of included studies

The effect of C-BIs on childhood asthma was studied. Only examinations that talked about how interferences influenced the occurrence of different clinical results were encompassed in sensitivity analysis. Subclass and sensitivity analyses were implemented by associating numerous subtypes with interference groups (8).

Inclusion criteria and exclusion criteria:

When inclusion criteria were satisfied, the literature was combined into a study:

1. Research was a randomized controlled study, observational, retrospective, and prospective.
2. Children with asthma were investigated as elect subjects.
3. Interference incorporated community-based interventions.
4. The study demonstrates the eminent effect of community-based interventions for childhood asthma.

The exclusion of non-comparative study designs occurred.

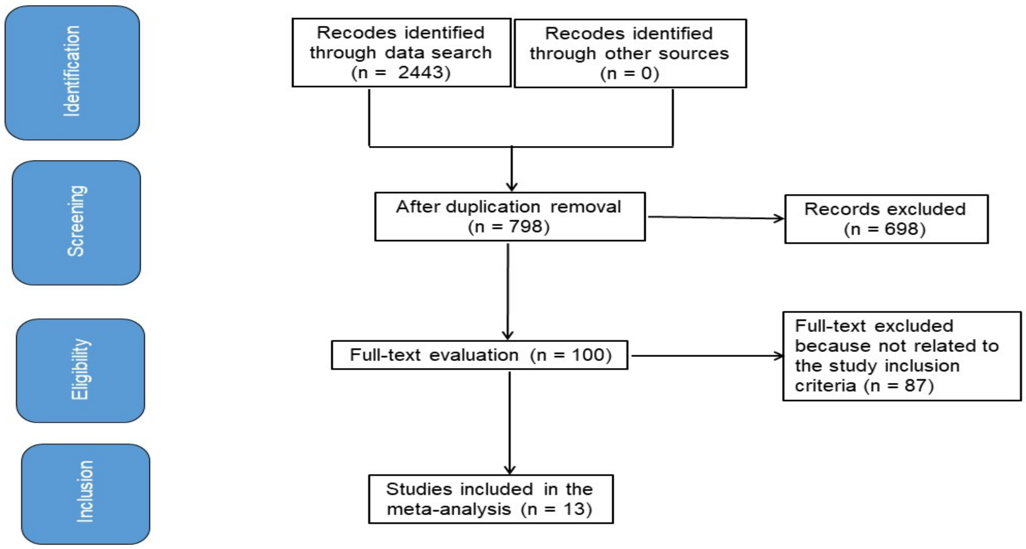


Fig. 1: Schematic diagram of examination procedure

Search strategy

A protocol of search algorithms was established and specified by the PICOS principle, (9) which states: P (population) Children with asthma; C-BI was I (interference); C (comparison): comparison among children with C-BI and children without C-BI. O (outcome): different clinical results; S (study design): planned valuation was unlimited (10). By using keywords in Table 1, we led a thorough exploration of Google Scholar, Embase, Cochrane library, Pubmed, and OVID databases through April 2025. Appraisals were led on entire articles encompassed in a reference management program, comprising Authors, titles, and abstracts. Also, two authors assess publications to detect appropriate tests (11).

Table 1: Database Search Strategy for inclusion of examinations

Database	Search strategy
Google Scholar	#1 "asthma" OR "asthma-connected emergency department visits" #2 "asthma symptoms days" OR "children with community-based intervention" OR " "hospitalizations" OR "nighttime asthma symptoms" #3 #1 AND #2
Embase	#1 'asthma' /exp OR 'asthma-connected emergency department visits' /exp OR 'hospitalizations' #2 'asthma symptoms days'/exp OR 'children with community-based intervention'/exp OR 'nighttime asthma symptoms' #3 #1 AND #2
Cochrane library	#1 (asthma):ti,ab,kw (asthma-connected emergency department visits):ti,ab,kw (hospitalizations):ti,ab,kw (Word variations have been searched) #2 (asthma symptoms days):ti,ab,kw OR (children with community-based intervention):ti,ab,kw OR(nighttime asthma symptoms):ti,ab,kw (Word variations have been searched) #3 #1 AND #2
Pubmed	#1 "asthma"[MeSH] OR "asthma-connected emergency department visits"[MeSH] OR "hospitalizations" [All Fields] #2 "asthma symptoms days"[MeSH Terms] OR "children with community-based intervention"[MeSH] OR "nighttime asthma symptoms "[All Fields] #3 #1 AND #2
OVID	#1 "asthma"[All Fields] OR "asthma-connected emergency department visits" [All Fields] OR "hospitalizations" [All Fields] #2 "asthma symptoms days"[All fields] OR "children with community-based intervention"[All Fields] or "nighttime asthma symptoms"[All Fields] #3 #1 AND #2

Screening of studies

The investigation is given in a standard style, along with all of its parts. Some of the things that were used to narrow down the data were the first author's last name, the study's date, the country where it took place, the gender of the child who took part, the total number of subjects, their clinical and treatment characteristics, demographic information, and the qualitative and quantitative evaluation methods that were used (12). Two authors looked at the possibility of bias in studies and the quality of the methods used in the papers that were chosen for further study. Two authors looked at the methods used for each assessment without bias (13).

Statistical analysis

This meta-analysis evaluated odds ratios (OR) and mean differences (MD) with a 95% confidence interval (CI) using a dichotomous or continuous model with random or fixed effects. The calculated I2 index ranges from 0 to 100 and is represented as a percentage. Elevated I2 values (above 50%) indicate heightened heterogeneity, whereas diminished I2 values signify reduced heterogeneity (below 50%). If I2 was 50% or greater, a random effect was picked; otherwise, a fixed effect was utilized (14). The implications of the initial investigation were categorized as part of the subcategory analysis. Bias was assessed by Egger's tests employed for quantitative analysis, and it was deemed present if $P>0.05$ (15, 16). *P*-values were computed using a two-tailed method. Reviewer Manager Version 5. 3 (The Nordic Cochrane Centre, the Cochrane Collaboration, Copenhagen, Denmark) was used to construct the graphs and statistical analysis (17).

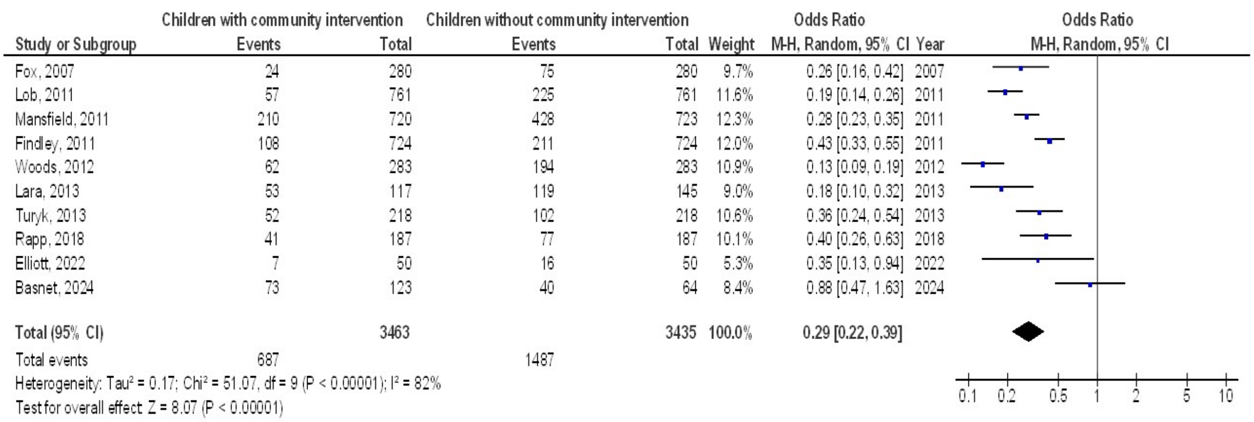
Results

After examining 2443 pertinent publications, 13 research that were published between 2006 and 2024 satisfy requirements and were encompassed in this study (18-30). Table 2 details these 13 studies. Overall, 8824 children were studied.

Table 2: Characteristics of studies

Study	Country	Total	Children with community-based intervention	Children without community-based intervention
Portnoy, 2006 (18)	USA	186	93	93
Thyne, 2006 (19)	USA	130	65	65
Fox, 2007 (20)	USA	560	280	280
Lob, 2011 (21)	USA	1522	761	761
Mansfield, 2011 (22)	USA	1443	720	723
Findley, 2011 (23)	USA	1448	724	724
Woods, 2012 (24)	USA	566	283	283
Lara, 2013 (25)	USA	262	117	145
Turyk, 2013 (26)	USA	436	218	218
Janevic, 2016 (27)	USA	1610	805	805
Rapp, 2018 (28)	USA	374	187	187
Elliott, 2022 (29)	USA	100	50	50
Basnet, 2024 (30)	USA	187	123	64
	Total	8824	4426	4398

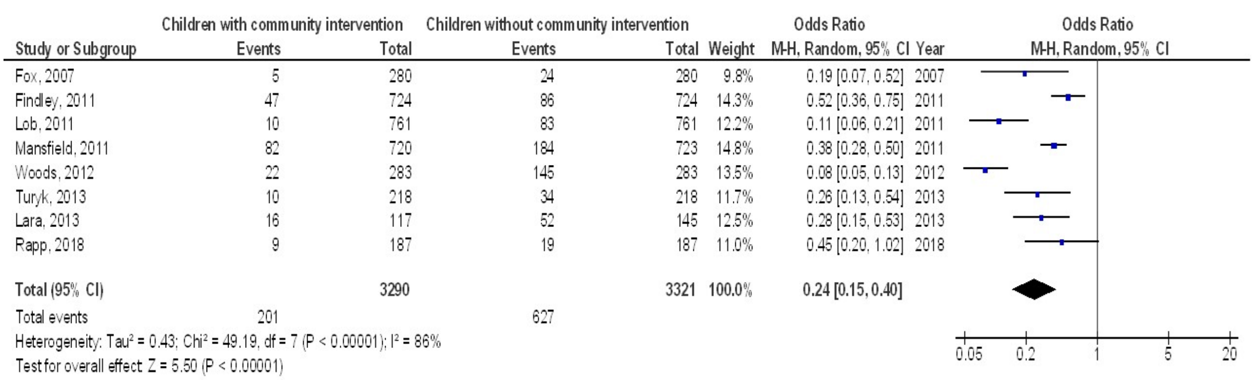
Children with C-BI had significantly lower asthma-connected emergency department visits (OR, 0.29; 95% CI, 0.22-0.39, *P*< 0.001) with high heterogeneity (I^2 = 82%), hospitalizations (OR, 0.24; 95% CI, 0.15-0.40, *P*<0.001) with high heterogeneity (I^2 = 86%), asthma symptoms days (MD, -2.56; 95% CI, -2.84- -2.28, *P*<0.001) with low heterogeneity (I^2 = 37%), nighttime asthma symptoms (MD, -2.14; 95% CI, -2.94- -1.34, *P*<0.001) with high heterogeneity (I^2 =84%), and bronchodilator uses (OR, 0.28; 95% CI, 0.16-0.51, *P*<0.001) with high heterogeneity (I^2 =87%), and higher asthma action plan use (OR, 8.87; 95% CI, 3.85-20.45, *P*<0.001) with high heterogeneity (I^2 =95%) compared to children without C-BI in asthma, as shown in Figs. 2-7. There was no evidence of investigation bias (*P*=0.90, 0.88, 0.92, 0.93, 0.91, and 0.92, respectively) (*P*=0.86) in the quantitative Egger regression test or the visual reading of the effect's forest plot. Nonetheless, the majority of the related studies had poor technical quality and that there was no bias in the selective reporting (Fig. 8).



Study or Subgroup	Children with community intervention Events	Total	Children without community intervention Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Fox, 2007	24	280	75	280	9.7%	0.26 [0.16, 0.42]	2007
Lob, 2011	57	761	225	761	11.6%	0.19 [0.14, 0.26]	2011
Mansfield, 2011	210	720	428	723	12.3%	0.28 [0.23, 0.35]	2011
Findley, 2011	108	724	211	724	12.0%	0.43 [0.33, 0.55]	2011
Woods, 2012	62	283	194	283	10.9%	0.13 [0.09, 0.19]	2012
Lara, 2013	53	117	119	145	9.0%	0.18 [0.10, 0.32]	2013
Turyk, 2013	52	218	102	218	10.6%	0.36 [0.24, 0.54]	2013
Rapp, 2018	41	187	77	187	10.1%	0.40 [0.26, 0.63]	2018
Elliott, 2022	7	50	16	50	5.3%	0.35 [0.13, 0.94]	2022
Basnet, 2024	73	123	40	64	8.4%	0.88 [0.47, 1.63]	2024
Total (95% CI)		**3463**		**3435**	**100.0%**	**0.29 [0.22, 0.39]**	
Total events	687		1487				

Heterogeneity: Tau² = 0.17; Chi² = 51.07, df = 9 (P < 0.00001); I² = 82%
Test for overall effect: Z = 8.07 (P < 0.00001)

Fig. 2: Effect's forest plot of children with community intervention on asthma-connected emergency department visits compared to children without community intervention in children with asthma



Study or Subgroup	Children with community intervention Events	Total	Children without community intervention Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Fox, 2007	5	280	24	280	9.8%	0.19 [0.07, 0.52]	2007
Findley, 2011	47	724	86	724	14.3%	0.52 [0.36, 0.75]	2011
Lob, 2011	10	761	83	761	12.2%	0.11 [0.06, 0.21]	2011
Mansfield, 2011	82	720	184	723	14.8%	0.38 [0.28, 0.50]	2011
Woods, 2012	22	283	145	283	13.5%	0.08 [0.05, 0.13]	2012
Turyk, 2013	10	218	34	218	11.7%	0.26 [0.13, 0.54]	2013
Lara, 2013	16	117	52	145	12.5%	0.28 [0.15, 0.53]	2013
Rapp, 2018	9	187	19	187	11.0%	0.45 [0.20, 1.02]	2018
Total (95% CI)		**3290**		**3321**	**100.0%**	**0.24 [0.15, 0.40]**	
Total events	201		627				

Heterogeneity: Tau² = 0.43; Chi² = 49.19, df = 7 (P < 0.00001); I² = 86%
Test for overall effect: Z = 5.50 (P < 0.00001)

Fig. 3: Effect's forest plot of children with community intervention on hospitalizations compared to children without community intervention in children with asthma

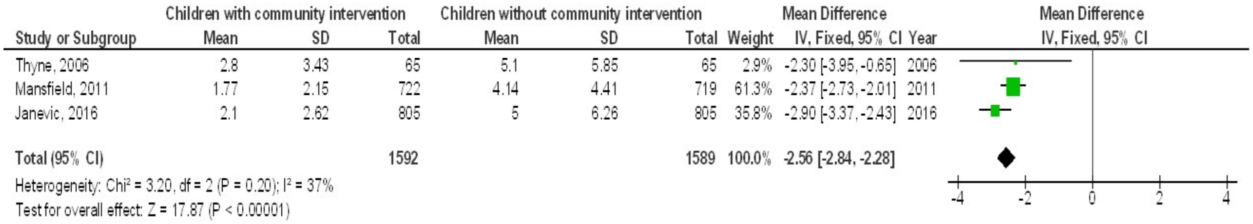


Fig. 4: Effect's forest plot of children with community intervention on asthma symptoms days compared to children without community intervention in children with asthma

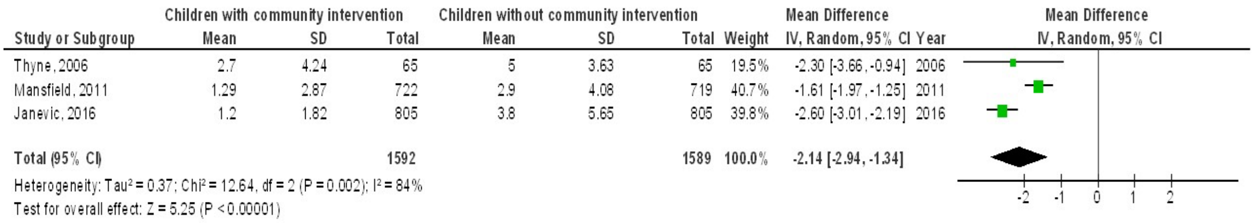


Fig. 5: Effect's forest plot of children with community intervention on nighttime asthma symptoms compared to children without community intervention in children with asthma

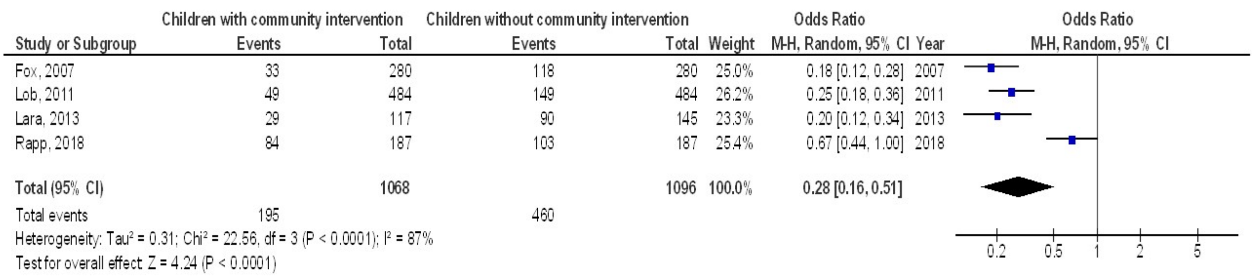


Fig. 6: Effect's forest plot of children with community intervention on bronchodilator uses compared to children without community intervention in children with asthma

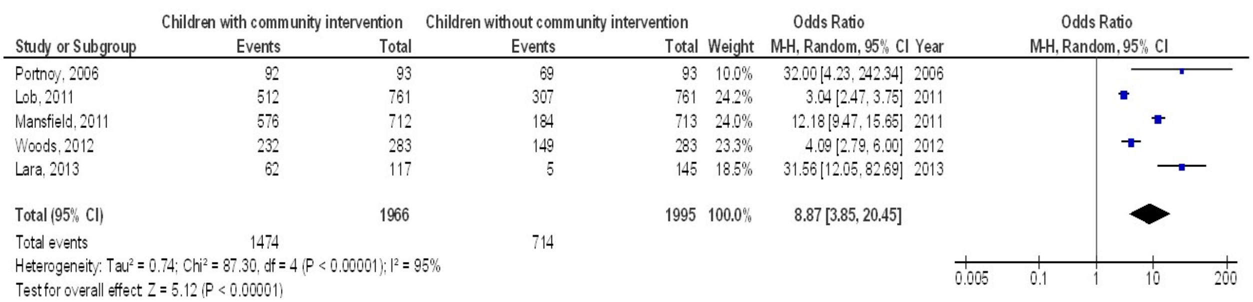


Fig. 7: Effect's forest plot of children with community intervention on asthma action plan compared to children without community intervention in children with asthma

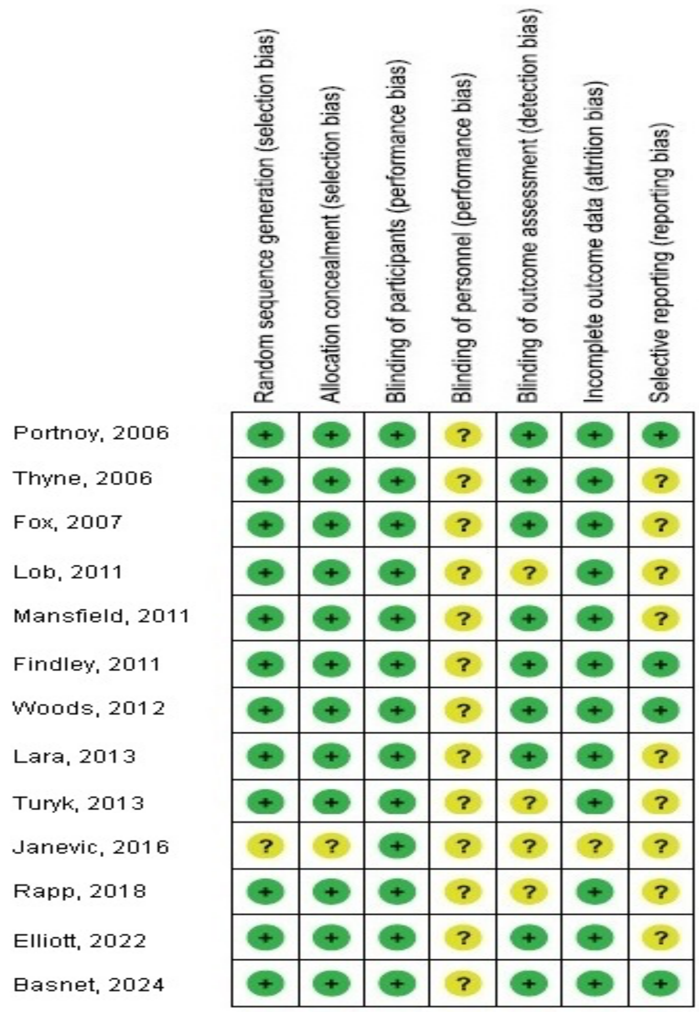


Fig. 8: Risk-of-bias plot

Discussion

For the current meta-analysis, 13 research that were published between 2006 and 2024 were included; of these, 8824 children were studied (18-30).

Children with C-BI had significantly lower asthma-connected emergency department visits, hospitalizations, asthma symptoms, nighttime asthma symptoms, bronchodilator use, and asthma action plan use compared to children without C-BI in asthma**.** However, comparisons comprised a small number of studies, and thoughtfulness ought to be prearranged to their values.

Since there is no known cure for asthma, the goal of asthma management should be to achieve the best possible control over the condition while lowering the risk of serious consequences. Effective asthma management, like that of many other chronic illnesses, necessitates the participation of numerous stakeholders, including the patient's family, school, community, and policy organizations or agencies, to support the patient's status as a health manager (31, 32).

Chronic Care Model was developed by Wagner and colleagues to address shortcomings in the management of chronic diseases, including poor adherence to practice guidelines, an absence of care matching and planned care, an absence of active follow-up, and insufficient patient education (32). Six elements of the Chronic Care Model are self-management support, community resources, decision support, delivery system design, organizational support, and clinical information systems. most important of the six Chronic Care Model components is self-management, which entails emphasizing the patient's pivotal role in controlling their condition and offering patients and families the assistance they need to develop knowledge and self-assurance necessary to oversee their medical treatment (31). Our meta-analysis clearly shows that this is very important for asthma care, with one of the key core interventions being education on fundamental asthma knowledge and self-management skills.

To achieve the best possible asthma control, an intervention approach that solely focuses on asthma education might not be sufficient. Researchers recently found some improvement in caregivers' knowledge and skills about asthma, but no discernible improvement in unscheduled medical visits or quality of life for aboriginal children with asthma who participated in a community outreach program focused on asthma education (33). According to a study (34), studies that used asthma education alone did not show these kinds of improvements in asthmatic children's acute service utilization or clinical symptoms. Prior research on educational programs for asthma self-management has also been the subject of several meta-analyses, however, findings were mixed (4, 35), indicating that asthma education might not be enough on its own to effectively manage asthma, particularly in young patients. Among research in this analysis, home visits and assessments of environmental triggers are two more often employed therapies. Asthma exacerbations are associated with indoor dwelling conditions and exposure to allergens, including bugs, ambient tobacco smoke, and poor ventilation (36).

During home visits, possible environmental factors for asthma exacerbations can be identified and addressed. While studies regularly documented improvements in asthma symptoms and fewer emergency department visits, the degree of asthma control and hospital admissions for asthma remained unclear (37). Additionally, to remove potential triggers from the home environment, families receiving home-based therapies were frequently given environmental remediation goods e.g., vacuum cleaners, bed coverings, and insect abatements. According to several suggestions, the provision of environmental remediation goods might not yield a greater advantage in terms of asthma outcomes (38). To help patients or families navigate health care or social systems, care coordination is a critical component. It makes communication easier between families and medical professionals as well as connections to social services for family needs and issues. Care coordination, along with self-management education and home environmental valuation, is one of the main interventions in all of the asthma programs that we have studied here. A noteworthy decrease in emergency department visits and hospital admissions was consistently found previously in studies that focused specifically on care coordination; this suggests the significance of care coordination in enhancing health outcomes for children with asthma. Future studies should examine whether care coordination on its own is sufficient to attain successful asthma control, as this has not yet been established (22, 23, 27). The majority of reviewed studies aimed at promoting asthma awareness and support, as well as advocating for more asthma-friendly environments or policy changes, expanded their interventions beyond core strategies to include schools, primary care practices, public organizations, and the broader community. There were significant differences in components of interventions of remaining studies, even though nine studies exhibited analogous program designs encompassing all seven intervention aspects, specifically the three main components along with the engagement of schools, primary care practitioners, community campaigns, and policymakers/organizations, among others (23, 27). As a result, it is impossible to pinpoint the precise mix of intervention components that produced improvement seen in summary effects.

The usage of telehealth care, received a lot of attention in the wake of the COVID-19 pandemic epidemic, was not included in any of the research. Telehealth, as a term, often describes health services that are provided via electronic communication channels e.g., Internet, video, or phone. It has been demonstrated to be cost-efficient in giving patients with chronic illnesses health advice and education, and it is effective in getting over geographical obstacles (39). However, there was no discernible increase in patients' quality of life or emergency department visits for those with asthma, according to the latest meta-analysis of 21 randomized controlled studies using telehealth therapy including text messaging, phone calls, video conferences, etc. (40, 41). Further studies are required to validate the effect of telemedicine on children's asthma management. There are a few things to be aware of with this review. Randomized controlled studies are hard to come by for multimodal community-based therapies, especially when it comes to childhood asthma. In our meta-analysis, we found a single randomized controlled study. A low number of included studies and varied study designs, contexts, and intervention components likely contributed to the high amount of heterogeneity that was found. To integrate between-study variability, random effect models were employed to determine the summary effect size. All studies included were carried out in the USA, and participants were primarily from low-income households and ethnic minorities. The findings of this analysis might not apply to other nations because of the uniqueness of the US healthcare system.

Higher sample sizes are required for studies to produce more compelling data. Because of inadequate reporting and a lack of clarification from study authors, it was frequently unclear whether studies were susceptible to bias. Additionally, the bias assessment revealed extremely low to intermediate methodological quality, which means we are unable to make definitive judgments. The evaluations in the certainty assessment were significantly impacted by the domains of indirectness of evidence and risk of bias. The lack of information about allocation concealment reduced the quality of evidence by one degree. Since we discovered a significant amount of variation in the results for which we were unable to find a reasonable explanation, the generalization outcome's certainty evaluation was also reduced by one notch for inconsistency. These findings support the need for more study and will probably significantly affect our ability to predict the management's effectiveness. As a result, more high-quality studies and data are required to enhance future research. Additionally, observational evidence, small sample sizes, high heterogeneity, learning-curve bias, and short follow-up; comparing results meta-analyses without restating numbers already presented are all limitations of this study.

Conclusion

Children with C-BI had significantly lower asthma-connected emergency department visits, hospitalizations asthma symptoms, nighttime asthma symptoms, bronchodilator uses, and asthma action plan use compared to children without C-BI in asthma. More research is necessary to confirm this finding, and care must be used while interacting with its values since most of the comparisons comprised a small number of studies. The significance of the reviewed assessments would be affected by that. Therefore, improvements are promising but remain tentative until larger randomized controlled studies are completed.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interests.

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