Effectiveness of Community-Based Nursing Intervention for Asthmatic Children: A Systematic Review and Meta-Analysis

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Abstract

Background: Preventive care can support and direct the nurse's efforts to deliver an asthma intervention for children as part of nursing interventions. Despite the significance, there have been few meta studies demonstrating the effectiveness of nursing interventions for the treatment of childhood asthma that includes only randomised controlled trials (RCTs). Therefore, this meta study was conducted to comprehensively evaluate the efficacy of nursing care interventions for the management of childhood asthma.

Methods: STATA 14.2 (StataCorp, College Station, TX, USA) was used to conduct the meta-analysis. From 1964 to July 2022, we searched Medline, the Cochrane library, EMBASE, Scopus Science Direct, and Google Scholar. Depending on the type of outcome, a meta-analysis was performed using a random-effects model, pooled weight mean difference (WMD), standardised mean difference (SMD), and/or risk ratio (RR) with stated 95 percent confidence intervals (CIs). PRISMA guidelines were followed for conducing this study.

Results: Nine studies were analysed in total. The pooled RR for emergency visits was 0.49 (95%CI: 0.32 to 0.77), for hospitalizations was 0.64 (95%CI: 0.21 to 1.89). The pooled SMD for frequency of asthma attacks was -2.88 (95%CI: -3.22 to -2.54), quality of life was 0.49 (95%CI: 0.22 to 0.75) and asthma control was 1.25 (95%CI: -0.77 to 3.28).

Conclusion: Paediatric asthma patients who received nursing interventions reported an improved quality of life and a decrease in emergencies and acute attacks due to asthma. Future RCTs should focus on uncovering the short- and long-term effects of these nursing interventions to provide optimal management and care.

Keywords: Childhood asthma; Nursing; Nurses; Meta-analysis

Introduction

Asthma is one of the most prevalent chronic illnesses affecting children worldwide (1). Despite improvements in medical facilities, childhood asthma prevalence and exacerbation rates continue to be persistent issues (2). Children with asthma also run the risk of becoming disabled, performing poorly in school, and having emotional issues (3-4). Asthma is poorly controlled in many children. Parents' education about asthma, exposure to hazardous environments, medication adherence, and regular asthma control visits are all factors that influence asthma control and severity. Management of such a chronic disease in children involves both medical therapy and self-care

management. Given that it has a lifelong impact on children, it is crucial to prioritise these self-care techniques in order to improve overall health and prevent asthma flare-ups in the future (5).

Existing literature has consistently reported the impact of the asthma intervention programme on child health outcomes (6-8). In these investigations, diverse study team members, including parents, instructors, nurses, and doctors, provided the interventions. However, the majority of these interventions need extra funding, labour, or other logistical resources, which could have an impact on how long they are effective in actual situations. However, interventions delivered by nurses or teachers in schools, communities, hospitals, or workplaces are much more enduring and result in fewer emergency visits, a lower rate of hospital admissions, better medication compliance, an improved quality of life, and increased self-efficacy in managing asthma (6-8).

The application of nursing interventions for the management of childhood asthma has also been endorsed by the GINA recommendations (2).The preventative care for asthma is one of these interventions that can aid and direct the nurse's efforts to give interventions for the children. As a result, nurses concentrate primarily on providing preventive nursing care rather than treating children whose asthma has flared up (9). Despite its significance, there have been fewer evaluations of the effectiveness of nursing interventions for the treatment of childhood asthma, with only randomised controlled studies (RCTs). The highest level of evidence on the efficacy of an intervention may be provided by combining the evidence from RCTs, the most trustworthy type of evidence.

Therefore, this study was conducted to evaluate comprehensively the efficacy of nursing care interventions for the management of childhood asthma.

Methods

Study Design

Only RCTs (cluster RCTs or parallel arm individual RCTs) were included. A total of 09 studies were included. Out of 09 studies, 05 studies were individual arm RCTs whereas remaining 04 were cluster RCTs. Further, we have not calculated intra-cluster correlation coefficient for cluster studies due to availability of very less number of studies. Unpublished publications were excluded whereas full texts or abstracts were included.

Study Participants

Studies involving asthmatic children under the age of 18 were considered.

Intervention type

Studies that directly compared the effectiveness of any form of community-based nursing intervention (led by nurses at the level of school, community or home either face-to-face or web based) for managing children with asthma against the standard care were included.

Outcomes

Asthma control status, Frequency of acute attacks, Hospital admission, Emergency department (ED) visits, Quality of Life (QoL)

Search strategy

A thorough, systematic, and thorough examination of the literature was conducted by doing searches in a number of databases, including Medline, the Cochrane library, Scopus, EMBASE, Science Direct, and Google Scholar. For carrying out our search strategy, we have merged free-text headings and the medical topic headings (MeSH). Using the appropriate Boolean operators ("AND," "OR," and "NOT") in between the pre-defined search phrases, we carried out the search strategy. During the literature search procedure, the following additional filters were also used: period (1964 to July 2022), and language (English). The Supplementary Appendix contains a thorough search strategy details.

Study selection

The title, keywords, and abstract were examined as part of the initial step in the study selection process by two independent researchers. The full-text papers were retrieved by each of the two investigators, who then shortlisted those for the second round of screening based on the eligibility requirements. By coming to an agreement, the two investigators were able to settle any disagreements that arose during the initial screening stage. The second phase was the screening of the retrieved full-texts by the two researchers, who ultimately included those that met the eligibility requirements and underwent additional analysis based on these studies.

Data extraction

Both investigators participated in the manual data extraction process utilising a pre-specified semi-structured data collection form that was established at the stage of protocol itself after deciding which full-text publications were appropriate for inclusion and analysis in the review. The following details were gathered: the name of the authors, the study's title, the year it was published and the year it was conducted, the length of the study, its design, its setting, its country or region, its sample size, the outcome assessment tool, and other information, the participants' average age, the specifics of its randomization, and its eligibility requirements. The first author entered the data, and the second author double-checked the accuracy of the data entry before it was recorded.

Risk of Bias Assessment

The authors independently assessed the bias risk of the included studies using "Cochrane risk of bias tool for Randomized controlled trials (RoB 2)" (10). The randomization method, divergence from the intended intervention, missing data, outcome measurement, and selective reporting of outcomes were the assessment domains. Each study received one of three grades based on these domains: "low risk," "high risk," or "some concerns."

Statistical Analysis

STATA 14.2 (StataCorp, CollegeStation, TX, USA) was used to conduct the meta-analysis. The number of events and sample sizes in each group were entered for the binary outcomes, and the pooled risk ratio (RR) with a 95% confidence interval (CI) was used to interpret the final estimate. The mean and standard deviation (SD) for each group were input for the continuous outcomes, and the final estimate was expressed as a weighted mean difference (WMD) or standardised mean difference (SMD) with a 95%CI. It was done using a random effects model with inverse variance to account for methodological variation (11). The WMD was calculated when the outcome was measured in the same units whereas overall estimate was calculated in terms of SMD when the outcome was measured using different rating instruments across the trials. The selection of model was done based on the variation among studies. The random effect model was preferred if the variations among studies is high whereas fixed effect model was preferred if variations among studies was low.

The chi square test was used to assess heterogeneity, and the I^2 statistic was used to measure the degree of consistency. The results of I^2 were interpreted as follows: <25% indicates minimal, 25-75% moderate, and >75% large heterogeneity (11). To represent the study-specific estimate and the pooled estimate graphically, a forest plot was utilised. Sensitivity analysis was used to assess how reliable the pooled estimate was. For outcomes with more than 10 studies, the Egger's test and a funnel plot were used to assess publication bias.

Results

Study selection process

A total of 979 records were found throughout the literature search, and full texts for 55 of these studies were found to be pertinent. By looking up the references to the entire texts that were found during the initial screening, three more full texts are found. The decision to include 9 studies was

unanimously agreed upon following the final screening against eligibility criteria. (Fig. 1)
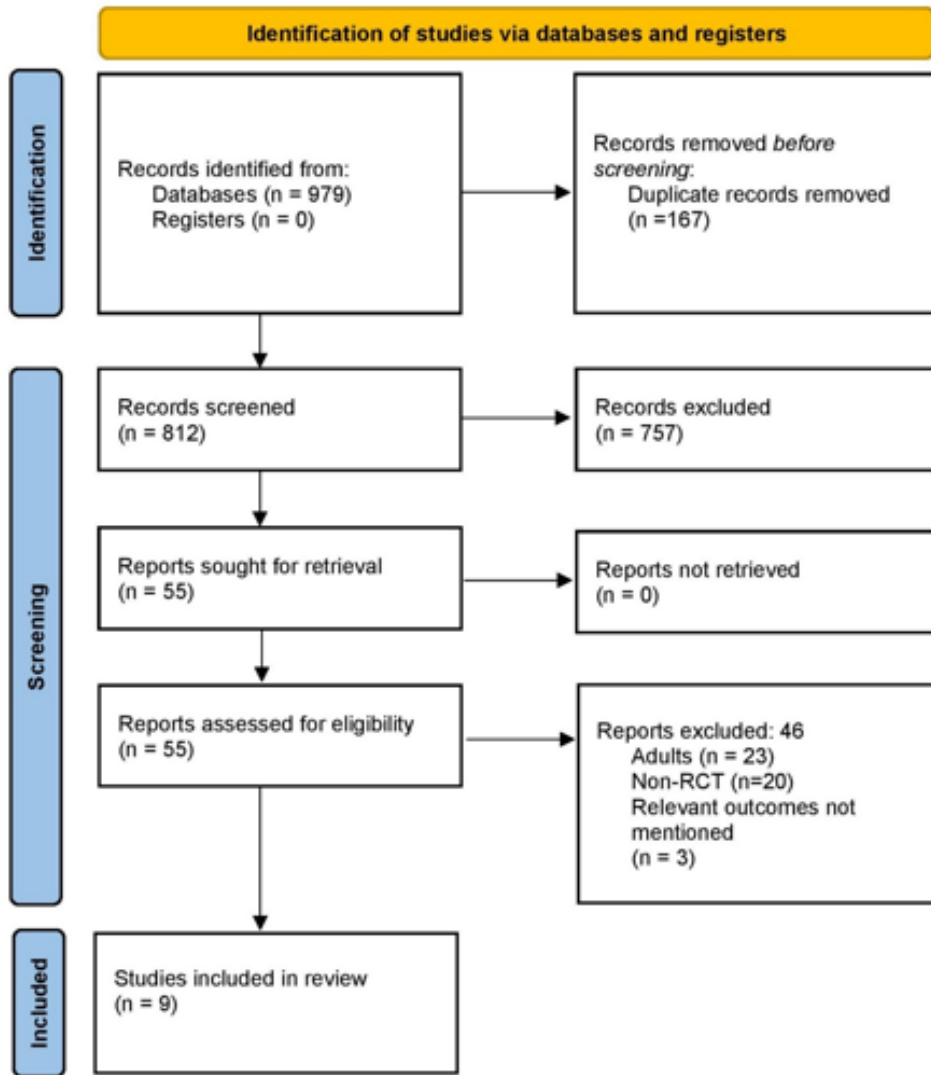
(3,7,12-18).

Identification of studies via databases and registers

Identification

Records identified from:
Databases (n = 979)
Registers (n = 0)

Records removed *before screening*:
Duplicate records removed
(n =167)

Screening

Records screened
(n = 812)

Records excluded
(n = 757)

Reports sought for retrieval
(n = 55)

Reports not retrieved
(n = 0)

Reports assessed for eligibility
(n = 55)

Reports excluded: 46
Adults (n = 23)
Non-RCT (n=20)
Relevant outcomes not mentioned
(n = 3)

Included

Studies included in review
(n = 9)

Fig. 1: PRISMA flow diagram

Characteristics of studies included

Most research was done in China and the United States of America (3 studies each). With sample sizes ranging from 36 to 1317, overall, 2,255 people were included. While the sample size in the control group spans from 18 to 625, it ranges from 18 to 692 in the intervention group. Most investigations were done using a face-to-face intervention method (either in a school setting (four studies) or at home (one study), with the other studies using the internet or the web (4 studies). The follow-up period varied from two to fourteen months (Table 1).

Table 1: Characteristics of the included studies (N=9)

Author and Year	Country	Type of intervention	Mode of intervention	Sample size	Follow-up duration	Mean age (in years)
Chen 2021	China	Nurse led hierarchal management	Web based	I=60 C=60	6 months	I=4.4 C=4.2
Cicutto 2013	Canada	Public health nurse delivered asthma program	Face-to-face at schools	I=692 C=625	1 year	I=8.2 C=8.3
Harrington 2017	United States of America	School nurse given medications	Face-to-face at schools	I=21 C=23	60 days	I=8.4 C=8.0
Horner 2015	United States of America	School nurse led educational intervention	Face-to-face at schools	I=96 C=100	1 year	I=8.8 C=8.7
Lv 2019	China	Mobile app assisted nurse led model	Web based	I=77 C=73	1 year	I=7.8 C=8.1
Madge 1998	United Kingdom	Nurse led teaching programme	Face-to-face at home	I=96 C=105	14 months	I=6 C=4.3
Ng 2021	China	Nurse-led web-based home asthma education program	Web based	I=56 C=56	6 months	I=4.8 C=5.3
Persaud 1996	United States of America	School nurse led educational sessions	Face-to-face at schools	I=18 C=18	20 weeks	I=10.2 C=10.2
Xu 2010	Australia	Specialist nurse led telephone or email education	Web based	I=40 C=39	6 months	I=6.5 C=7.4

I – Intervention; C – Comparator

Risk of bias assessment

The randomization technique and variation from targeted interventions were determined to be low risk in all of the investigations. Three studies (7, 15-16) showed a significant probability of missing outcome data, measuring outcome, and selectively presenting results relative to the other areas. Five out (3,13-14,17-18) of the 9 studies (more than half) had some concerns or an overall low risk of bias. (Table 2).

Table 2: Risk of bias assessment N=9

S.No	Author and year	Randomization process	Deviation from intended intervention	Missing outcome data	Measurement of the outcome	Selection of the reported results	Overall
1	Chen 2021	Low	Low	Low	High	High	High
2	Cicutto 2013	Low	Low	Low	Low	High	Some concerns
3	Harrington 2017	Low	Low	Low	Low	Low	Low
4	Horner 2015	Some concerns	Some concerns	High	Low	Low	High
5	Lv 2019	Low	Low	Some concerns	Some concerns	Low	Some concerns
6	Madge 1998	Some concerns	Some concerns	High	High	High	High
7	Ng 2021	Low	Low	High	High	Low	High
8	Persaud 1996	Low	Low	Low	Low	Low	Low
9	Xu 2010	Some concerns	Some concerns	Low	Low	Low	Some concerns

Asthma control status

The impact of nurse intervention on asthmatic children's control status has been documented in two trials (14, 16) in total. The pooled SMD was 1.25 (95%CI: -0.77 to 3.28; I^2=98.1%). Despite the fact that children receiving nursing intervention had a greater asthma control status, this difference was statistically insignificant (*P*=0.22) (Fig. 2).
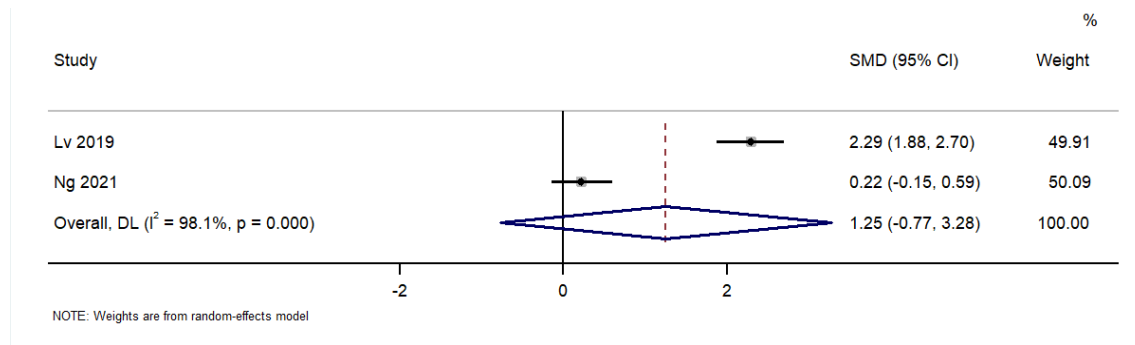

Fig. 2: Forest plot showing the effectiveness of nursing intervention in improving the asthma control status

Frequency of acute attacks

Two studies (12, 14) in total have examined the impact of nursing intervention on the incidence of asthma attacks in young patients. When compared to children receiving standard care, the children receiving nursing intervention had a significantly lower frequency of asthma attacks, as measured by the pooled SMD, which was determined to be 2.88 (95%CI: -3.22 to -2.54; I^2=0%). (*P*<0.001) (Fig. 3). The random effect model was preferred as variation among studies in terms of sample size, gender, age groups is high even though heterogeneity among studies was calculated by I square statistics is low.
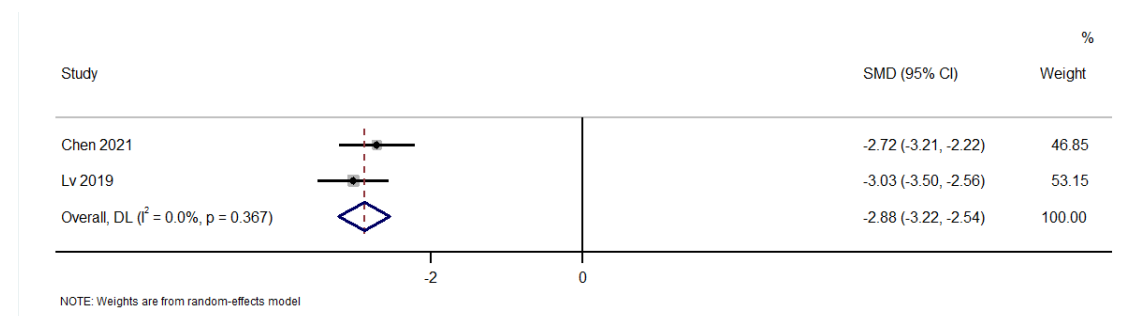

Fig. 3: Forest plot showing the effectiveness of nursing intervention in reducing the frequency of asthma attacks

Hospital admission

Three studies (13, 15, 18) in all have examined the impact of nursing intervention on hospital admission rates for young patients with asthma. When compared to children receiving standard care, the children receiving nursing intervention have a lower risk of being admitted to the hospital, as indicated by the pooled RR of 0.64 (95%CI: 0.21 to 1.89; I^2=45.7%). The distinction, though, was not statistically significant (p=0.41) (Fig. 4A). The impact of nursing intervention on the number of hospital days was examined in two trials (7, 12). The pooled WMD was determined to be -0.40 (95%CI: -1.16 to 0.37; I^2=99.4%). Although children receiving nursing intervention spend less days in the hospital, this difference was not statistically significant (p=0.31) (Fig. 4B).
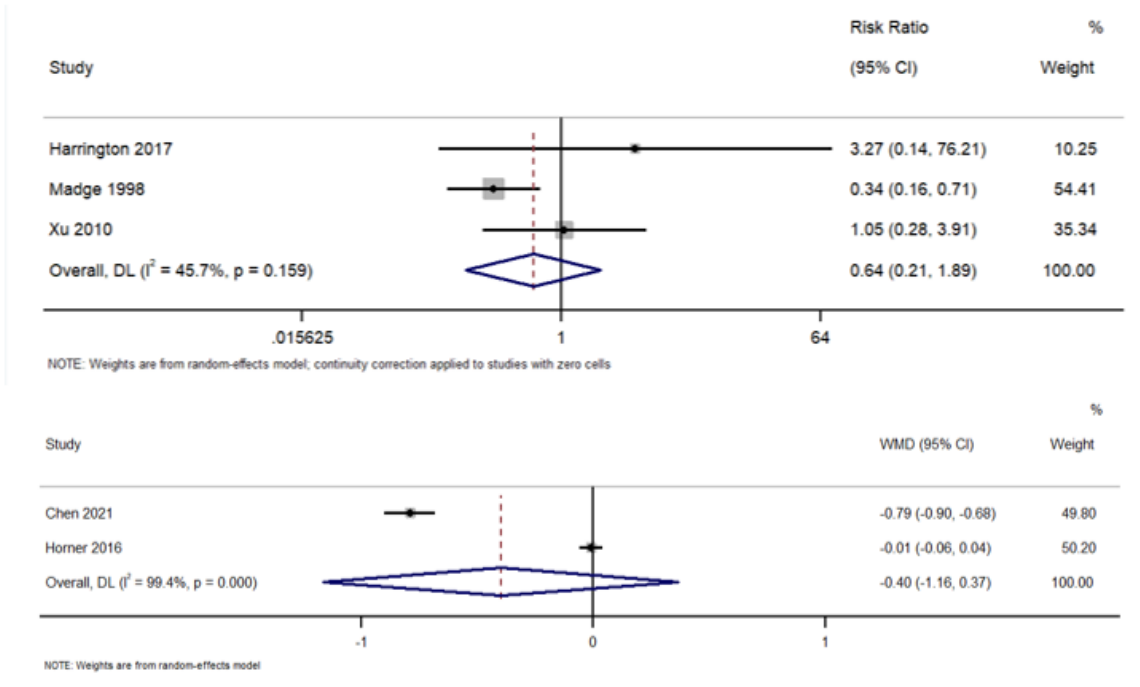
Fig. 4: Forest plot showing the effectiveness of nursing intervention in reducing the hospital admission A) events of hospital admissions; B) number of days spent in hospitals

ED visits

Five studies (3, 13, 15, 17, 18) in total have examined the effect of nursing intervention on ED visits for asthmatic children. Children getting nursing intervention have a significantly lower risk of visiting the ED than children receiving routine care, according to the pooled RR of 0.49 (95%CI: 0.32 to 0.77; I^2=16.9%; *P*=0.002). The random effect model was preferred as variation among studies in terms of sample size, gender, age groups is high even though heterogeneity among studies was calculated by I square statistics is low (Fig. 5A). The impact of nursing intervention on the number of days spent in the ED has been examined in three studies (14, 7, 17) in total. The pooled WMD was calculated to be -0.75 (95% CI: -1.97 to 0.46; I^2=99.5%). Although children receiving nursing intervention spend fewer days in the emergency room, this difference was not statistically significant (p=0.22) (Fig. 5B).
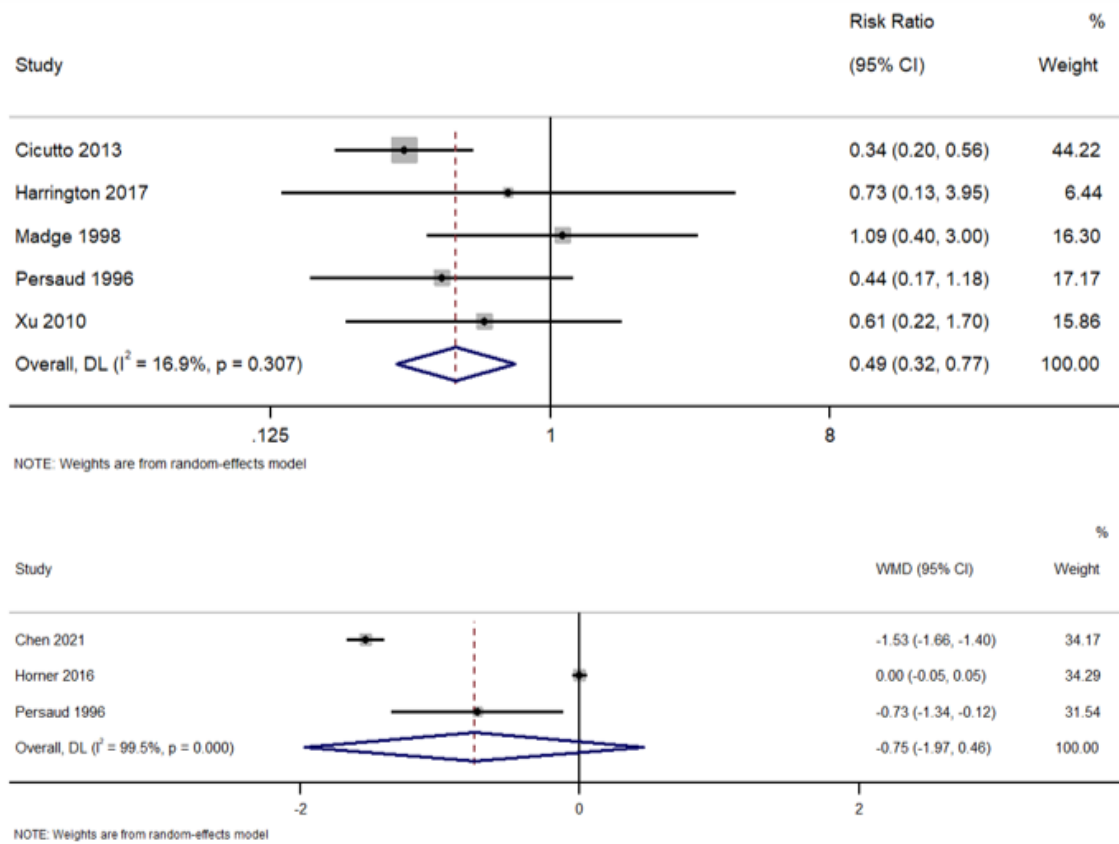
Fig. 5: Forest plot showing the effectiveness of nursing intervention in reducing the emergency department visits A) events of ED visits; B) number of days spent in ED

QoL

Two studies (3, 18) in total have examined the impact of nurse intervention on the QoL of asthmatic children. The children receiving nursing intervention had significantly better QoL than the children receiving conventional care, as indicated by the pooled SMD of 0.49 (95%CI: 0.22 to 0.75; I^2=45.2%) (P=0.007) (Fig. 6).
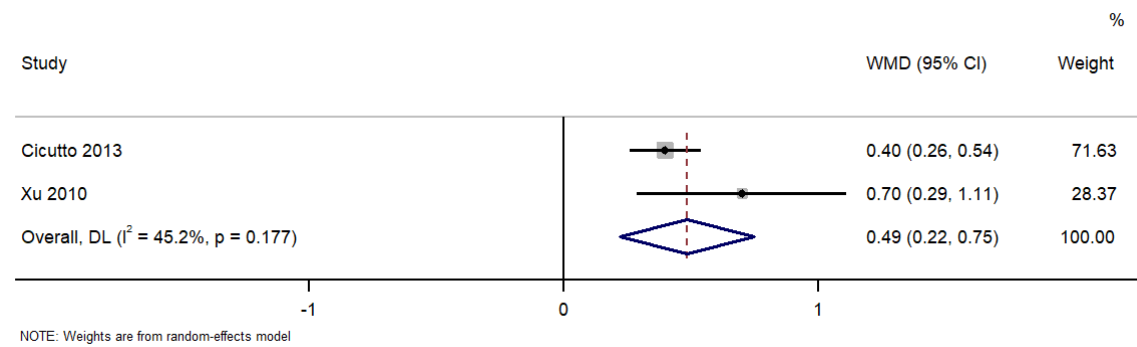

Fig. 6: Forest plot showing the effectiveness of nursing intervention in improving the quality of life

Sensitivity analysis revealed that none of the aforementioned outcomes differed significantly in terms of size or the direction of connection.

The publication bias assessment was not performed due to the inclusion of less than ten studies for each outcome.

Discussion

In order to manage effectively children with chronic conditions like asthma, nurses' contributions to the management and it must be recognised more frequently. Particularly in light of the present push to ensure integrated nursing care in hospitals, the role of nurses in this context should also be stressed. Through a wide range of care and management strategies, such as guidance, education, and direct care, nurses may play a significant role in the empowerment of children and parents in improving the treatment of asthma. It is crucial to research how nurse interventions affect how severe an asthmatic children's condition is. Therefore, using only RCTs, this review was conducted to investigate the efficacy of nursing care interventions in the therapy of childhood asthma.

Nine research studies, with majority of which were carried out in Western and Asian nations, were eligible for the review. More than half of them showed lower risk of bias or some concerns. According to this meta-analysis, nursing interventions significantly enhances asthma treatment results for individuals with paediatric asthma. The findings of the review were consistent with the findings of the previous reviews, which demonstrated a considerable influence of nurse-led intervention on the management of childhood asthma (5, 19-20).

According to our analysis, the nursing interventions significantly improved the outcomes in terms of ED visits, the frequency of asthma episodes, and the children with asthma's quality of life. This demonstrates that the nursing intervention not only aids in reducing emergencies and exacerbations due to asthma, but also considerably enhances the children's quality of life. Addi-

tionally, these results agreed with those of the prior review (5, 20). The synthesis of this review's findings showed how crucial it is to use nurse-led treatments outside of hospitals, such as at schools or at homes (in person or online), with an emphasis on asthma management strategies that take into account the requirements of young patients. Asthma intervention programmes outside of the hospital setting can raise awareness among children about self-care management of the condition, which in turn improves asthma control, lowers emergency room visits, increases school attendance, and ultimately raises the quality of life for both children with asthma and their parents. In addition to this benefit, nurse-led asthma interventions in schools or communities, whether online or offline, may help children access healthcare and manage their asthma better, even those from disadvantaged, rural, and lower socioeconomic groups (6-7).

This review has several advantages. Only RCTs were included, increasing the reliability of the evidence for all outcomes compared to earlier meta-analyses (also included observational studies and pre-post designs) (5, 19-20). The studies up to 2022 were incorporated into a thorough search to find the most relevant research on this subject. Despite these strengths, there are several drawbacks to the current meta-analysis. This review only included papers written in English, which may have limited the quality of the evidence used to support the study's conclusions. For fewer outcomes, there was significant between-study variability identified.

Limitation of the study

However, the lack of sufficient research to conduct additional subgroup analysis or meta-regression prevented an investigation into the causes of heterogeneity. Additionally, due to similar factors, publication bias could not be evaluated in this review, which limits the evidence's credibility.

Conclusion

Despite these drawbacks, this study has significant clinical implications. Any community-based nursing intervention, whether it be in a classroom, home, or even virtually, must be used to manage children with asthma. Particularly for healthcare facilities lacking access to any board-certified paediatric or pulmonology experts for quick assistance, nursing measures intended to support youngsters are essential. Investing in the resource staff's education is essential for optimal patient outcomes, regardless of the unique health facility-related issues. Additionally, the emphasis should be on improving the intervention program's cultural relevancy, age-appropriateness, and ability to cater to both children's and parents' needs.

Additionally, this study affirms the demand for additional RCTs on community-based nursing interventions. Future studies should concentrate on carrying out a large-scale RCT, and it needs to assess the effects of any particular form of intervention or compare numerous combination modes of intervention to choose the optimal one. To ensure adequate management and care of children with asthma, future RCTs should also work toward decisively revealing the short- and long-term impacts of these nursing interventions.

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.

Acknowledgements

Conflict of interest

None declared

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