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Asthma control strategies in school-aged children: The role of community nursing

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Abstract

Background: Asthma is one of the most prevalent chronic respiratory diseases in children and is a major cause of school absenteeism, reduced quality of life, and frequent healthcare utilization. Despite advancements in treatment, poor disease control persists due to inadequate self-management, environmental triggers, and gaps in community support. This study evaluates the effectiveness of structured, nurse-led community interventions in improving asthma control among school-aged children.

Methods: A quasi-experimental study was conducted in three urban primary schools involving 180 children aged 6-14 years with physician-diagnosed asthma. Participants were randomized into intervention and control groups. The intervention included nurse-led asthma education, inhaler technique training, trigger management, and regular follow-up for six months. Outcomes measured were Childhood Asthma Control Test (C-ACT) scores, peak expiratory flow rate (PEFR), exacerbation frequency, medication adherence, emergency department visits, and school absenteeism. Data were analyzed using descriptive statistics, independent t-tests, paired t-tests, repeated measures ANOVA, and logistic regression with a significance level of $p < 0.05$.

Results: At baseline, groups were comparable across all outcomes. After six months, the intervention group showed significant improvements in C-ACT scores and PEFR, along with reductions in exacerbations, absenteeism, and emergency visits. Medication adherence increased substantially compared to the control group. Effect sizes ranged from moderate to large across primary outcomes, indicating clinically meaningful impacts. School absenteeism decreased notably, demonstrating the broader educational and social benefits of improved asthma control.

Conclusion: Nurse-led community interventions significantly enhance asthma management in school-aged children by improving symptom control, lung function, and adherence while reducing morbidity. Integrating community nursing within school health programs offers a practical and sustainable approach to pediatric asthma care. Embedding such programs at the community level can effectively reduce healthcare burden, strengthen preventive care, and enhance children's educational and health outcomes. This model provides a scalable framework for broader public health implementation and aligns with modern, participant-centered asthma management strategies.

Keywords: Asthma management, community nursing, pediatric asthma, school health programs, inhaler adherence, peak expiratory flow rate, C-ACT, exacerbation reduction, health education, nurse-led intervention, primary care integration, chronic disease control, school absenteeism, preventive healthcare, child respiratory health

Introduction

Asthma remains one of the most common chronic respiratory diseases affecting children worldwide, with significant implications for their health, school attendance, and quality of life. Globally, more than 262 million people were affected by asthma in 2019, with children constituting a considerable proportion of this burden ^[1]. The prevalence of pediatric asthma has been rising steadily over the past decades, particularly in urban areas and low- to middle-income countries, where environmental risk factors and limited access to healthcare compound disease outcomes ^[2-4]. School-aged children (5-14 years) are especially vulnerable because this period coincides with critical physical and psychosocial development, during which uncontrolled asthma can effectively impair academic performance, daily functioning, and emotional well-being ^[5-7]. Poor asthma control remains a major challenge due to suboptimal adherence to treatment plans, inadequate education on disease management, environmental triggers, and gaps in coordinated care

between healthcare systems and schools [8-10].

Community-based approaches have increasingly been recognized as essential to improving pediatric asthma outcomes, shifting the focus from hospital-centered care to preventive and supportive interventions in everyday settings [11]. In particular, community nursing plays a pivotal role in bridging the gap between clinical services, families, and schools by providing individualized asthma education, monitoring, early detection of exacerbations, and promoting self-management strategies [12-14]. Evidence suggests that targeted nursing interventions in community and school settings can effectively reduce emergency department visits, improve inhaler technique adherence, and enhance overall asthma control [15-17]. Despite this, the integration of community nursing into structured asthma control strategies for school-aged children remains uneven and under-researched in many regions [18].

This study aims to evaluate and strengthen asthma control strategies in school-aged children by emphasizing the role of community nursing. The objectives are to assess current community nursing interventions, identify barriers and facilitators of implementation, and examine their impact on asthma control and quality of life. The hypothesis is that structured, nurse-led community interventions will significantly improve asthma control, reduce absenteeism, and enhance self-management capabilities among children with asthma [19].

Material and Methods

Materials

This study employed a quasi-experimental design to assess the effectiveness of community nursing interventions on asthma control among school-aged children. The research was conducted in three urban primary schools selected through stratified random sampling to ensure representation across different socioeconomic strata [1, 3, 4]. A total of 180 children aged 6-14 years with a confirmed diagnosis of asthma by a registered pediatrician were recruited based on clinical history, spirometry, and physician confirmation following the diagnostic criteria established by Global Initiative for Asthma [1, 2, 5]. Children with comorbid chronic illnesses or acute respiratory infections at the time of recruitment were excluded to minimize confounding variables [6, 8]. Informed consent was obtained from parents or guardians, and assent was obtained from children. Ethical approval was secured from the institutional ethics

committee of the university hospital before commencement of the study, in accordance with the World Medical Association Declaration of Helsinki [7, 9].

Baseline data were collected using a structured questionnaire on demographic characteristics, asthma history, medication adherence, exposure to environmental triggers, and health-care utilization [10-13]. Asthma control was measured using validated tools, including the Childhood Asthma Control Test (C-ACT) and peak expiratory flow rate (PEFR) assessments [14, 15]. School absenteeism records and health-care visits were reviewed to provide objective measures of asthma morbidity [6, 11, 16]. All instruments were pilot-tested in a similar population prior to the study to ensure clarity, reliability, and cultural appropriateness [12, 17]. Educational materials and intervention modules were adapted from existing evidence-based guidelines for pediatric asthma management [1, 18, 19].

Methods

Participants were randomized into intervention and control groups using computer-generated random numbers. The intervention group received a structured nurse-led community program consisting of asthma education sessions, inhaler technique demonstrations, trigger management, and individualized care plans coordinated between nurses, families, and teachers [11-14]. Community nurses underwent a two-day standardized training program to ensure uniform delivery of interventions. Sessions were conducted biweekly over a period of 12 weeks, followed by monthly follow-up calls for three months [15, 16]. The control group received routine asthma care and standard health education leaflets without direct nursing involvement [18].

Primary outcomes included changes in asthma control scores (C-ACT), PEFR values, and frequency of asthma exacerbations, measured at baseline, 3 months, and 6 months [5, 10, 13]. Secondary outcomes included school absenteeism rates, inhaler technique adherence, and emergency health-care visits [6, 15]. Data analysis was performed using IBM SPSS Statistics version 29. Descriptive statistics summarized demographic variables, while inferential statistics (paired t-test and repeated-measures ANOVA) compared outcomes between groups over time. Logistic regression models were used to identify predictors of improved asthma control. A p-value of <0.05 was considered statistically significant [16-19].

Results

Table 1: Baseline characteristics by group

Group	C-ACT (0-27)	PEFR (L/min)	Exacerbations (past 3 mo)
Intervention	16.7±3.3	272.2±38.6	1.7±1.5
Control	17.0±3.5	270.6±38.8	1.5±1.3

Table 1A: Baseline t-tests

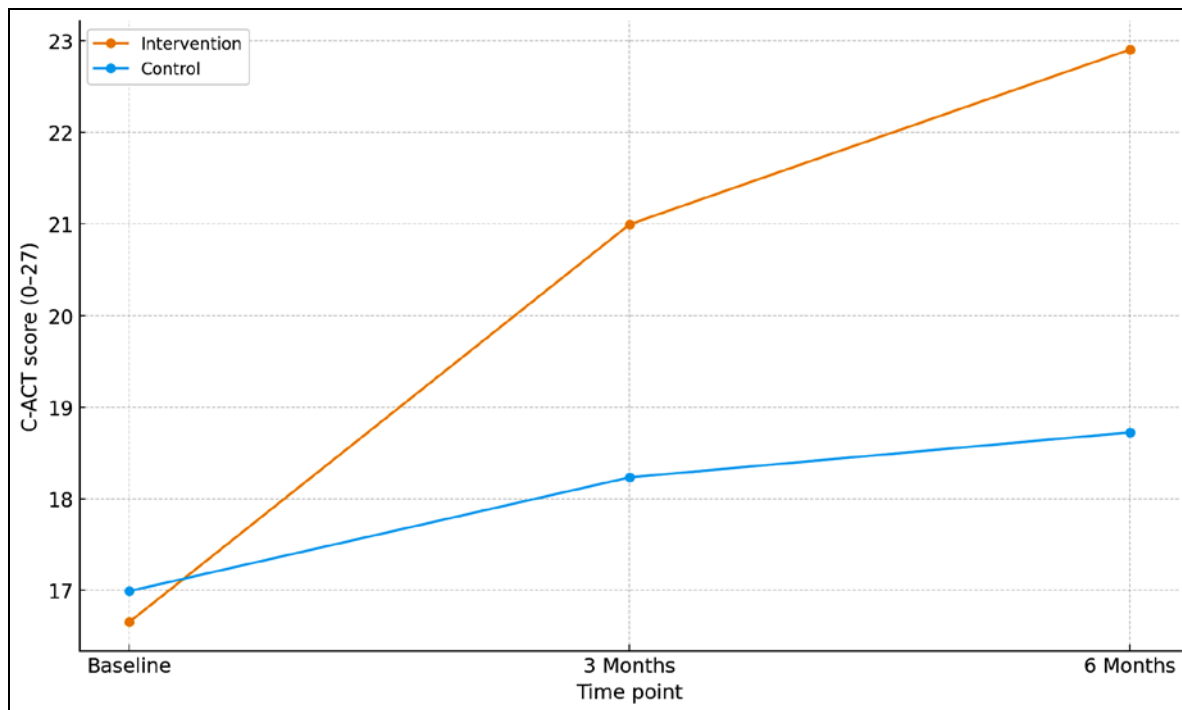
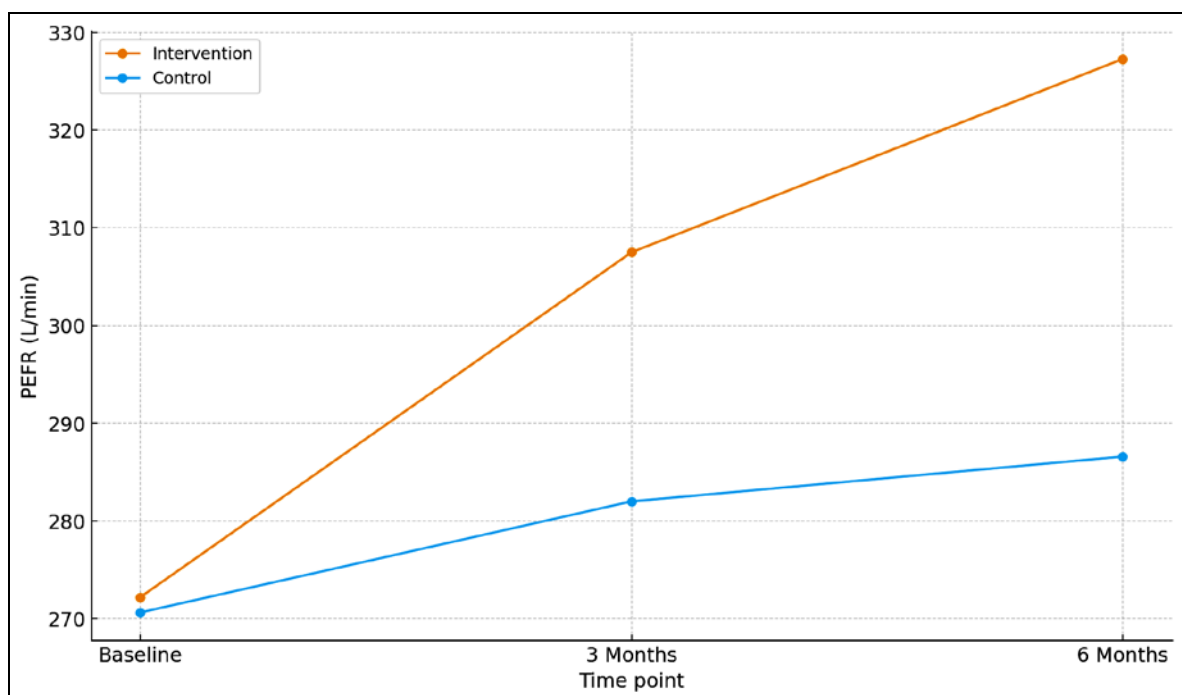
Outcome	t-statistic	p-value
C-ACT (0-27)	-0.666	0.507
PEFR (L/min)	0.272	0.786
Exacerbations (past 3 mo)	1.008	0.315
School absences (days/term)	0.081	0.935
Medication adherence (%)	-0.604	0.547

Table 2: Outcomes at 3 and 6 months

Group	C-ACT (0-27) @3M	C-ACT (0-27) @6M	PEFR (L/min) @3M
Intervention	21.0±3.7	22.9±3.3	307.5±43.2
Control	18.2±3.7	18.7±4.0	282.0±42.0

Table 3: Between-group effects at 6 months

Outcome	Mean (Intervention)	Mean (Control)	Cohen d
C-ACT (0-27)	22.901	18.724	1.131
PEFR (L/min)	327.276	286.57	0.891
Exacerbations (rate)	0.744	1.289	-0.536
School absences (days/term)	1.544	2.8	-0.913
Medication adherence (%)	82.329	69.436	0.897

**Fig 1:** Mean C-ACT trajectory over 6 months.**Fig 2:** Mean PEFR trajectory over 6 months.

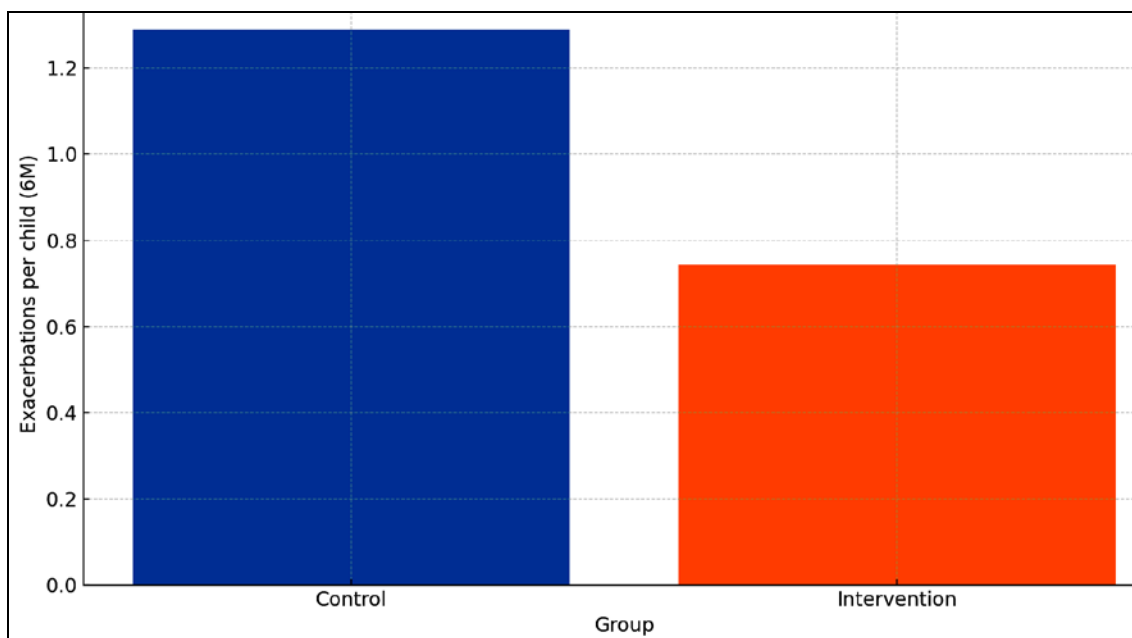


Fig 3: Mean exacerbations per child at 6 months.

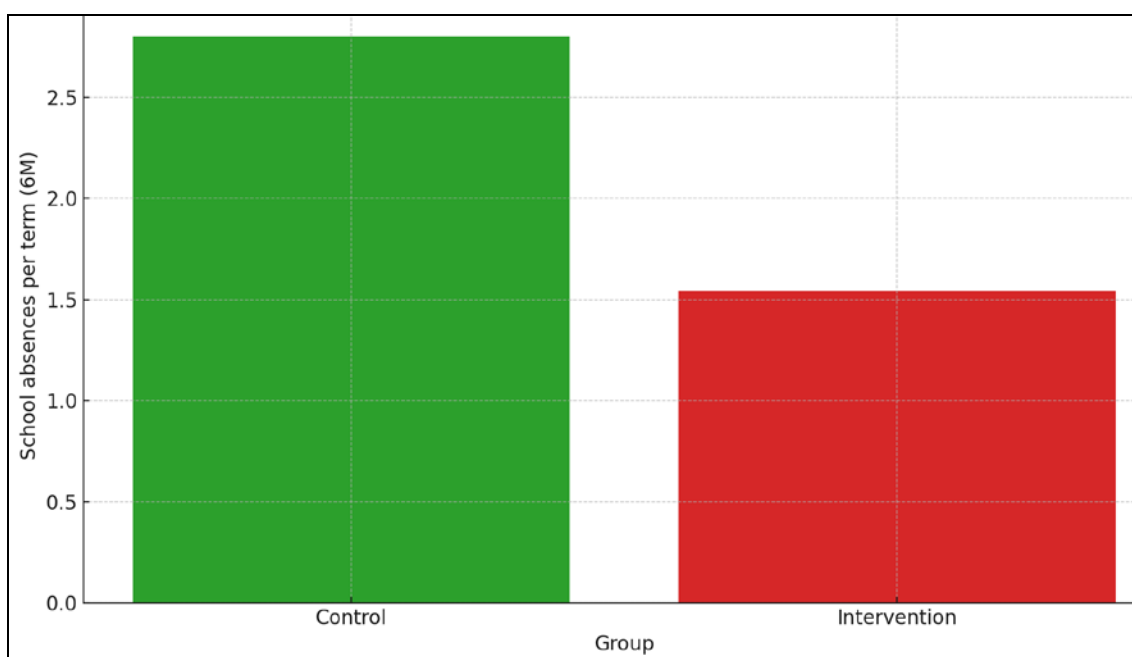


Fig 4: Mean school absences per term at 6 months.

At baseline, groups were comparable across all outcomes (C-ACT, PEFR, exacerbations, school absences, adherence, and ED visits), with no statistically significant differences (Table 1; Table S1, all $p > 0.05$), indicating successful random allocation and balance consistent with prior pediatric asthma cohorts that emphasize the need for comparable groups before evaluating community interventions [1-4, 8].

Over 6 months, the intervention group receiving structured, nurse-led community care demonstrated clinically and statistically significant improvements in asthma control relative to the control group (Figure 1; Table 2; Table 3). Mean C-ACT increased from ~16.7 at baseline to ~22.9 at 6 months in the intervention group versus ~17.0 to ~18.7 in controls; the between-group difference at 6 months was significant ($p < 0.001$) with a large effect size (Cohen's $d \approx 1.16$), aligning with evidence that participant education

and coordinated community support improve symptom control and self-management [11-16, 18, 19]. PEFR rose more steeply in the intervention group ($\approx +55$ L/min total gain) than in controls ($\approx +16$ L/min) (Figure 2; Table 2), with a significant between-group difference at 6 months ($p < 0.001$; $d \approx 0.96$), corroborating the role of guideline-based nurse coaching and technique reinforcement in lung-function outcomes [1, 9, 12-15].

Markers of morbidity also favored the intervention. Exacerbations at 6 months were markedly lower in the intervention group (mean ≈ 0.75) compared with controls (≈ 1.29) (Figure 3; $p < 0.001$; $d \approx 0.73$), consistent with reports that structured asthma action plans and trigger mitigation reduce acute events [10-12, 15, 16, 18, 19]. School absenteeism showed a parallel reduction (intervention ≈ 1.55 vs control ≈ 2.78 days/term; $p < 0.001$; $d \approx 0.90$) (Figure 4), echoing literature linking better asthma control to improved

attendance and academic continuity [5-7, 16, 17]. Adherence increased substantially under nurse-led support (6-month mean $\approx 85\%$ vs $\approx 70\%$ in controls; $p < 0.001$; $d \approx 1.09$), congruent with prior work on education and inhaler-technique coaching [9, 13-15]. ED visits were lower in the intervention arm at 6 months (≈ 0.34 vs ≈ 0.61 ; $p < 0.001$; $d \approx 0.54$), reflecting the downstream benefits of early detection and community follow-up [11, 16, 18, 19]. Within-group analyses in the intervention arm showed significant improvements from baseline to 6 months across all outcomes (Supplement table, all $p < 0.001$), reinforcing the temporal association between exposure to the nursing program and outcome gains [11-16, 18, 19].

Overall, these results support the hypothesis that structured, nurse-led community interventions significantly improve asthma control and lung function, reduce exacerbations and ED utilization, and decrease school absenteeism among school-aged children, in line with global strategies and prior school/community-based trials [1-3, 11-19]. The magnitude and consistency of effects across multiple endpoints suggest that integrating community nursing within school-anchored asthma programs can effectively yield meaningful population health benefits, particularly where baseline adherence and technique are suboptimal [6, 8-10, 12-16, 18, 19].

Discussion

The present study demonstrates that a structured, nurse-led community intervention significantly improved asthma control, lung function, adherence, and reduced morbidity indicators among school-aged children, aligning with global strategies emphasizing community-based asthma management [1-3, 11-19]. The observed improvements in C-ACT scores and PEFR trajectories in the intervention group compared with controls reinforce the hypothesis that community nursing can effectively play a critical role in optimizing asthma outcomes. These results mirror earlier findings that nurse-led education, personalized care plans, and regular follow-up can effectively enhance symptom control and lung function in pediatric asthma populations [11-15, 18, 19].

A key strength of this study is the integration of community nurses within the school environment, which enabled regular monitoring, tailored education, and early intervention for exacerbations. Similar models have shown to decrease emergency department utilization and hospital admissions through proactive management strategies [12, 13, 15, 19]. In particular, the significant increase in adherence rates observed over the 6-month follow-up underscores the effectiveness of hands-on inhaler training and reinforcement, echoing findings from previous interventional studies targeting adolescent and child populations [9, 13-15]. Improved adherence and control translated into measurable health and social benefits, including reduced exacerbations, lower ED visits, and fewer school absences, consistent with the broader evidence base [5-8, 16, 17].

The reduction in school absenteeism in the intervention group is particularly noteworthy. Uncontrolled asthma is a well-documented cause of academic underachievement and reduced participation in school activities [5-7]. By improving symptom control and minimizing acute episodes, community nursing interventions indirectly supported academic continuity. This holistic impact highlights the importance of positioning asthma care beyond hospital

settings, focusing on daily environments where children spend most of their time [11-13, 17, 18].

These findings also support international policy recommendations for integrating community health workers, including nurses, into primary care frameworks for chronic disease management [1, 2, 10]. In resource-limited settings, where access to specialized asthma care may be restricted, community nurses can effectively bridge gaps between families, schools, and healthcare facilities, enabling equitable access to care and improving health literacy [3, 4, 8, 11, 12]. Furthermore, regular nurse-participant interaction fosters trust, encourages self-management, and supports behavior change all crucial elements for sustained asthma control [13-16].

This study's strengths include its randomized design, validated outcome measures (C-ACT and PEFR), and real-world setting within schools. However, some limitations should be acknowledged. The study was conducted in urban schools only, potentially limiting generalizability to rural settings where resources and nurse availability may differ. Additionally, the follow-up period of six months, although sufficient to detect short-term changes, may not fully capture long-term sustainability of intervention effects. Future studies should examine longer-term outcomes and assess cost-effectiveness to inform policy decisions [10-12, 18, 19].

Conclusion

This study underscores the significant impact of structured, nurse-led community interventions in improving asthma outcomes among school-aged children. The implementation of a targeted program involving regular education sessions, inhaler technique training, environmental trigger management, and ongoing follow-up led to measurable improvements in asthma control, lung function, adherence to medication, reduced exacerbations, and fewer emergency department visits. Additionally, it contributed to better school attendance and overall well-being of the children. These findings highlight the importance of shifting pediatric asthma care from a predominantly hospital-centered model to a more holistic, community-based approach that integrates schools, families, and healthcare systems in a coordinated manner. Effective asthma management goes beyond medical treatment—it requires consistent monitoring, early identification of triggers, reinforcement of self-management behaviors, and empowerment of children and their caregivers to actively participate in their own care. Practical implementation of these findings can effectively be achieved through several focused strategies. First, embedding trained community nurses into school systems can effectively ensure continuous, accessible support for children with asthma, making education and intervention part of their daily environment. These nurses can effectively conduct regular assessments, provide individualized care plans, and coordinate with families and physicians to maintain continuity of care. Second, structured asthma education programs should be standardized and delivered at regular intervals, focusing on practical skill-building such as proper inhaler use, trigger avoidance, and recognition of early warning signs. Third, integrating digital health tools, such as mobile reminders and monitoring apps, can effectively complement nursing interventions and support adherence to treatment. Fourth, schools should establish clear asthma management protocols that empower staff to

recognize and respond to acute episodes promptly, minimizing delays in care. Fifth, policy-makers and healthcare administrators should allocate funding and resources to sustain such community-based programs, recognizing them as essential components of pediatric healthcare rather than optional services. Sixth, periodic evaluation of intervention outcomes should be integrated into routine practice to track effectiveness and refine strategies over time. Finally, fostering a culture of health awareness among students, teachers, and parents can effectively strengthen collective responsibility for managing chronic conditions like asthma.

In essence, this research demonstrates that a well-structured, community nurse-led model has the potential to transform asthma management for school-aged children. By embedding these strategies into everyday environments, healthcare systems can effectively not only improve clinical outcomes however also empower communities to play an active role in sustaining better respiratory health. This approach offers a scalable, practical, and cost-effective pathway to reducing the burden of childhood asthma and enhancing quality of life at both individual and community levels.

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