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Research Article

Assessing the Impact of Online Educational Programs on Enhancing School Teachers' Knowledge and Management of Asthma in Children

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ABSTRACT

Introduction: Asthma is a prevalent chronic illness in school-aged children, affecting their academic achievement and quality of life. Teachers are important in asthma management, but most are not well-informed. This research assesses the efficacy of an online education program in enhancing teachers' knowledge and confidence in the management of childhood asthma. **Methods:** A quasi-experimental pre-post intervention trial was carried out on 100 teachers from private co-educational schools in Tamil Nadu, India. The participants received a four-week structured online training on asthma pathophysiology, symptom identification, triggers, emergency management, and management. Knowledge and confidence levels were measured using a validated questionnaire and 5-point Likert scale before and after the intervention. Paired t-tests and ANOVA were the statistical analyses employed. **Results:** After intervention, the teachers demonstrated high scores in knowledge ($p < 0.001$) and confidence ($p < 0.05$) improvements. Confidence mean Likert scores improved from 1.22–1.58 (before intervention) to 4.00–4.30 (after intervention). The most improvement was found in emergency response plans and adapting an asthma-friendly environment. **Conclusion:** The evidence proves that highly organized online training programs greatly enhance asthma management knowledge and confidence of teachers. Such training incorporated in teacher professional development may enhance asthma care in schools.

INTRODUCTION

Asthma remains one of the most prevalent chronic conditions affecting school-aged children globally, with significant impacts on academic performance, physical activity participation, and

overall quality of life.[1] Recent epidemiological studies indicate that approximately 30-35% of children worldwide are affected by allergic disorders, with asthma being the predominant condition. In India, the prevalence of childhood asthma ranges from 2% to 18.2%, highlighting the

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substantial variability in different regions and populations.[2] School teachers play a pivotal role in managing asthma in educational settings, as they spend significant time observing and interacting with students throughout the school day. Their position allows them to monitor changes in asthma control, including increased daytime symptoms, decreased physical activity participation, and reduced engagement in sports². However, Langton et al. (2019) revealed significant disparities in asthma policy awareness between school nurses and teachers (74% vs. 24%, $p < 0.001$), indicating a critical knowledge gap among teaching staff.[4]

The effectiveness of online training programs in enhancing healthcare knowledge has been demonstrated in various contexts. Luckie et al. (2018) reported significant improvements in asthma first aid knowledge scores post-online training (from 64% to 79%), though noting limitations in practical skill translation.[5] Similarly, McClure et al. (2018) observed enhanced teacher competency in asthma symptom identification and management following structured educational interventions.[6]

Despite these advancements, several critical research gaps persist. First, while previous studies have explored general asthma awareness among teachers, few have specifically examined the effectiveness of online educational interventions in improving teacher knowledge and confidence in asthma management. Second, the impact of such interventions across different teacher demographics and experience levels remains poorly understood. Third, there is limited evidence regarding the translation of online training into practical asthma management skills in school settings. This study addresses these gaps by evaluating the effectiveness of a comprehensive online training program for school teachers in

improving their asthma knowledge and management capabilities. By examining the impact across various teacher demographics and assessing both theoretical knowledge and practical confidence, this research aims to provide valuable insights into the development of effective asthma management training programs for educational settings.

METHODOLOGY

A quasi-experimental pre-post intervention study was conducted from January 2022 to December 2022 to evaluate the effectiveness of an online educational program in enhancing school teachers' knowledge and management skills regarding childhood asthma. The study was conducted in private co-educational schools in Kumarapalayam town, Namakkal district, Tamil Nadu, India, after obtaining approval from the Institutional Ethics Committee (Reference No: JKKNC/ HEC/ APCERT/0113G23)

Sample size was determined through power analysis ($\beta=0.80$, $\alpha=0.05$) to detect a minimum effect size of 0.3, yielding a required sample of 97, rounded to 100 participants to account for potential attrition. A two-stage stratified random sampling process was employed, wherein all eligible private co-educational schools ($N=24$) were first stratified by location (urban/suburban/rural), followed by random selection of two schools from each stratum using a computer-generated sequence. Teachers within selected schools were then randomized using unique identifier numbers, with stratification by experience level to ensure proportional representation.

Eligible participants included current primary school teachers (Grades 1-8) with minimum one year teaching experience, English language proficiency, and no prior formal asthma



management training. Teachers with less than one year experience or medical conditions hindering participation were excluded. Written informed consent was obtained from all participants following detailed explanation of study procedures.

The intervention comprised a four-week comprehensive program delivered through multiple modalities. The core component consisted of twelve one-hour online sessions delivered thrice weekly via a secure learning management system, covering asthma pathophysiology, symptoms, triggers, and management. Content was validated by pediatric pulmonologists (n=3) and educational experts (n=3). This was supplemented by twice-weekly live demonstration sessions conducted by certified asthma educators, featuring standardized case scenarios. Additional support included digital reference materials, instructional videos, and regular telephonic guidance.

Two validated instruments were employed for assessment: a 25-item knowledge questionnaire (Content Validity Index=0.89; Cronbach's α =0.86) and a confidence assessment scale using 5-point Likert responses (Cronbach's α =0.82). Both instruments underwent rigorous validation including expert review (n=8), pilot testing (n=15), and psychometric analysis. Data collection occurred at baseline (T0), immediate post-intervention (T1), and one-month follow-up (T2). Response rates were monitored weekly, with standardized reminder protocols for non-responders.

Statistical analysis was performed using SPSS version 25.0. Descriptive statistics included frequencies, percentages, means, and standard deviations with 95% confidence intervals for primary outcomes. Pre-post comparisons utilized paired t-tests for normally distributed data and

Wilcoxon signed-rank tests for non-parametric data. Gender comparisons were analyzed using independent t-tests, while age and experience group comparisons employed ANOVA with Bonferroni corrections for multiple comparisons

RESULTS

Participant Characteristics

The study included 100 teachers with equal gender distribution (50% male, 50% female). The majority of participants were aged 26-35 years (31.0%) and 36-45 years (27.0%), with fewer participants in the 18-25 (22.0%), 46-55 (15.0%), and ≥ 56 years (5.0%) age groups. Teaching experience was predominantly 11-15 years (30.0%) and 6-10 years (26.0%), while 18.0% had 0-5 years, 16.0% had 16-20 years, and 10.0% had ≥ 21 years of experience. Regarding educational qualifications, 42.0% held bachelor's degrees, 30.0% had master's degrees, and 28.0% completed teacher training. School characteristics showed equal distribution across education boards (State Board, CBSE, ICSE; 33.3% each) and locations (urban, suburban, rural; 33.3% each).

Table 1: Demographic Characteristics of Study Participants (N=100)

Characteristic	n	%
Gender		
Male	50	50.0
Female	50	50.0
Age (years)		
18-25	22	22.0
26-35	31	31.0
36-45	27	27.0
46-55	15	15.0
≥ 56	5	5.0
Teaching Experience (years)		
0-5	18	18.0
6-10	26	26.0
11-15	30	30.0
16-20	16	16.0
≥ 21	10	10.0
Education Level		



Teacher Training	28	28.0
Bachelor's Degree	42	42.0
Master's Degree	30	30.0
Education Board		
State Board	2	33.3
CBSE	2	33.3
ICSE	2	33.3
School Location		
Urban	2	33.3
Suburban	2	33.3
Rural	2	33.3

Knowledge Assessment Outcomes

Pre-intervention knowledge scores showed comparable baseline levels between male (mean=25.76 correct responses) and female teachers (mean=26.04 correct responses). Post-intervention, both groups demonstrated significant improvements (male=43.76, female=44.12; $p<0.001$). The mean improvement was 36.0% for male teachers and 36.16% for female teachers, with no significant gender difference ($p=0.627$).

Analysis by knowledge domains revealed significant improvements across all areas. In the Asthma Pathophysiology domain, understanding of chronic respiratory nature improved from 50.0% to 88.0% in males and 54.0% to 94.0% in females ($p<0.001$). Emergency Response Protocol showed substantial enhancement, with acute asthma attack intervention knowledge increasing from 60.0% to 100.0% in males and 58.0% to 96.0% in females ($p<0.001$).

The highest post-intervention scores were observed in physical activity modification (100% for both genders) and acute asthma attack intervention (100% for males, 96% for females). The lowest post-intervention scores were in complex case management (70% for both genders) and environmental risk assessment (74% for males, 76% for females). All improvements within groups were statistically significant ($p<0.001$), with no significant gender differences in improvement rates across domains ($p>0.05$).

Table 2: Impact of Educational Intervention on Knowledge Improvement in Asthma Management

Knowledge Assessment Domain & Items	Pre-Intervention (Male)	Pre-Intervention (Female)	Post-Intervention (Male)	Post-Intervention (Female)	Improvement (%) (Male)	Improvement (%) (Female)	p-value (Male)	p-value (Female)
Understanding chronic respiratory nature	25	27	44	47	37	38	<0.001*	0.642
Clinical signs and manifestations	29	28	48	49	38	42	<0.001*	0.821
Peak flow monitoring principles	24	22	42	41	38	38	<0.001*	0.749
Acute asthma attack intervention	30	29	50	48	40	38	<0.001*	0.583
Asthma action plan implementation	21	21	38	37	34	34	<0.001*	0.892



Continuous monitoring strategies	26	27	48	47	40	40	<0.001*	0.916
Proper patient positioning techniques	26	25	48	47	40	36	<0.001*	0.843
Asthma trigger recognition	29	30	49	46	36	36	0.774	0.774
Symptom progression assessment	30	30	48	41	34	34	0.865	0.865
Allergen management strategies	28	28	49	49	40	40	0.708	0.708
Spacer device application	25	25	44	38	38	38	<0.001*	1
Emergency medication protocols	25	25	44	38	38	38	<0.001*	1
Device maintenance procedures	31	32	49	50	36	36	<0.001*	0.882
Exercise adaptation procedures	22	22	39	39	34	34	<0.001*	1
Activity monitoring documentation	29	30	48	39	38	38	<0.001*	0.847
Emergency first aid implementation	23	23	40	34	34	34	<0.001*	1
Inhaler administration timing	27	27	45	45	36	36	<0.001*	1
Severe symptom recognition protocols	30	31	50	49	36	36	<0.001*	0.763
Inhaler technique optimization	20	21	36	37	32	32	<0.001*	0.884
Clinical follow-up procedures	27	28	45	46	36	36	<0.001*	0.829
Environmental risk assessment	21	22	37	38	32	32	<0.001*	0.856
Student case management	25	26	43	44	36	36	<0.001*	0.812



Physical activity modification	32	32	50	50	36	36	<0.001*	1
Complex case management	20	25	35	30	30	30	<0.001*	1
Overall Mean	25.76	26.04	43.76	44.12	36.16	36.16	<0.001*	0.627

Confidence Levels

Teachers' confidence levels, measured on a 5-point Likert scale, showed significant improvement across all five dimensions. The mean confidence score increased from 1.22 (SD=0.61) to 4.20 (SD=0.45) for recognition of asthma symptoms ($p=0.031$), and from 1.58 (SD=0.75) to 4.00

(SD=0.40) for understanding asthma triggers ($p=0.025$). The highest post-intervention confidence was reported in creating asthma-friendly environments (mean=4.30, SD=0.35), while the lowest, though still substantial, improvement was in implementing management strategies (mean=4.00, SD=0.40).

Table 3: Comparison of Pre-intervention and post intervention Likert scale Confidence levels questionnaire answers of teachers

Question	Pre-intervention Mean score	Pre-intervention SD	Post-intervention Mean score	Post-intervention SD	p-value
1	1.22	0.61	4.20	0.45	0.031
2	1.58	0.75	4.00	0.40	0.025
3	1.10	0.45	4.15	0.37	0.037
4	1.35	0.54	4.08	0.42	0.029
5	1.42	0.58	4.30	0.35	0.033

All improvements in confidence levels were statistically significant ($p<0.05$), with mean differences ranging from 2.42 to 2.98 points. The overall confidence improvement showed strong effect sizes (Cohen's d ranging from 0.82 to 0.89) across all dimensions.

DISCUSSION

This study provides compelling evidence for the effectiveness of structured online educational interventions in enhancing school teachers' knowledge and confidence regarding asthma management. The comprehensive analysis of pre- and post-intervention outcomes reveals several significant findings with important implications for school-based asthma care.

The baseline assessment revealed moderate initial understanding of asthma management (mean correct responses: male=25.76, female=26.04), which aligns with findings from Bruzzese et al. (2010), who reported variable asthma knowledge levels among elementary school teachers¹. This initial knowledge gap underscores the pressing need for structured educational interventions, particularly given the increasing prevalence of childhood asthma in educational settings. The comparable baseline scores between genders support Langton et al.'s (2019) observations of similar initial knowledge levels among school personnel, regardless of gender, suggesting that knowledge deficits in asthma management transcend demographic characteristics.[3]



The significant post-intervention improvements across all domains ($p < 0.001$) demonstrate the robust effectiveness of the comprehensive training program. The observed 36% increase in mean knowledge scores substantially exceeds the 15% improvement reported by Luckie et al. (2018) following their one-hour online training.[4] This enhanced effectiveness can be attributed to our intervention's multi-modal approach, incorporating structured online modules, live demonstrations, and regular support mechanisms. This finding strongly supports McClelland et al.'s (2019) assertion that sustained, comprehensive educational programs yield superior outcomes in healthcare knowledge transfer.[5]

Particularly noteworthy is the dramatic improvement in emergency response protocols, where knowledge of acute asthma attack intervention increased to 100% among male teachers and 96% among female teachers. This enhancement directly addresses the critical gap identified by Reznik et al. (2020), who emphasized that emergency response competency represents a fundamental requirement for school-based asthma management[6]. The achievement of perfect scores in physical activity modification knowledge aligns with Hughes et al.'s (2014) findings regarding the effectiveness of targeted education in improving teachers' understanding of exercise-induced asthma management.[7]

The intervention's impact on teachers' confidence levels represents another significant achievement, with mean scores increasing from 1.22-1.58 to 4.00-4.30 across different dimensions ($p < 0.05$). This substantial enhancement in self-efficacy mirrors findings from Nowakowski et al. (2016), who reported significant improvements in teachers' confidence following structured asthma education.[8] The highest post-intervention confidence in creating asthma-friendly

environments (mean=4.30) suggests successful internalization of environmental control strategies, a crucial aspect emphasized by Rothstein LG et al. (2019).[9]

The absence of significant gender differences in both knowledge acquisition and confidence improvement ($p > 0.05$) demonstrates the intervention's universal effectiveness. This finding supports Kintner et al.'s (2015) observation that well-designed asthma education programs can achieve consistent outcomes across demographic groups.[10] The consistency in improvement patterns suggests that the intervention successfully addressed diverse learning needs and preferences.

Analysis of domain-specific improvements reveals particularly strong outcomes in practical management areas. The perfect scores achieved in physical activity modification and high scores in acute intervention (96-100%) indicate successful bridging of the theory-practice gap, a common challenge identified in previous studies. Everhart RS et al. (2020) emphasized the importance of this practical competency in their analysis of school-based asthma management programs.[11]

The intervention's success can be attributed to several key factors. First, the comprehensive four-week duration allowed for adequate knowledge assimilation and skill development, addressing the limitations of shorter programs noted in previous studies. Second, the combination of synchronous and asynchronous learning components provided flexibility while maintaining engagement, a strategy supported by current educational research. Third, the inclusion of case-based learning and practical demonstrations facilitated the translation of theoretical knowledge into practical competency.

From a broader perspective, these findings have significant implications for school health policies



and teacher professional development programs. The demonstrated effectiveness of online education in improving both knowledge and confidence suggests a scalable approach to enhancing school-based asthma management. The high post-intervention scores across all domains indicate that comprehensive online programs can effectively address multiple aspects of asthma management simultaneously.

Moreover, the strong improvement in confidence levels suggests enhanced preparedness for managing asthma-related situations in educational settings. This increased self-efficacy is particularly important given the critical role teachers play in early recognition and management of asthma symptoms in school environments. The consistently high scores in emergency response protocols indicate improved capacity for handling acute situations, a crucial factor in ensuring student safety. The findings also suggest implications for curriculum development in teacher training programs. The successful outcomes across different knowledge domains support the integration of structured asthma management modules into regular professional development curricula. The effectiveness of the online format demonstrates the viability of remote learning for healthcare-related professional development, particularly relevant in current educational contexts.

Despite the robust findings, the study's quasi-experimental design without a control group and relatively short follow-up period (one month) may limit causal inference and assessment of long-term knowledge retention, suggesting the need for future randomized controlled trials with extended follow-up periods to validate the intervention's sustained effectiveness in real.

CONCLUSION

This study provides compelling evidence for the effectiveness of structured online educational interventions in enhancing school teachers' asthma management capabilities. The comprehensive four-week program yielded significant improvements in knowledge scores (from 52% to 85.08%) and confidence levels across all measured domains, with comparable benefits observed between male and female teachers. Particularly notable were the improvements in emergency response protocols and physical activity modification knowledge, where participants achieved near-perfect scores post-intervention, demonstrating the program's success in bridging critical knowledge gaps in school-based asthma management.

The findings have important implications for educational policy and professional development in school health management. The demonstrated effectiveness of online education in improving both knowledge and confidence suggests a scalable approach to enhancing school-based asthma care. The significant improvements across different demographic groups indicate the broad applicability of such interventions, supporting their integration into regular teacher professional development programs. These outcomes suggest that well-designed online educational programs can effectively address the complexities of asthma management in educational settings, potentially leading to improved health outcomes for students with asthma.

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AUTHOR CONTRIBUTIONS

Surya Ramesh: Conceptualization, Literature Review, Methodology Design, Data Collection, Statistical Analysis, and Drafting of the Manuscript.

Venkateswaramurthy Nallasamy: Supervision, Review and Editing of Manuscript, Validation of Research Instruments, and Final Approval of the Version to be Published.

All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this research.

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DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request. All data used in the analysis are anonymized to ensure participant confidentiality.

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