Emergency Nursing Based on PEWS can Improve the Condition of Children with Acute Asthma

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ABSTRACT

Objective • The objective of this study is to investigate the effects of emergency nursing interventions, specifically those based on the Pediatric Early Warning Score (PEWS), on children diagnosed with acute asthma, to promote the recovery of children with asthma and improve the quality of care for children with asthma.

Methods • A total of 80 children, Acute asthma attacks under the age of 12, diagnosed with acute asthma and admitted to the Emergency Department of Hebei Children's Hospital between June 2018 and June 2019 were selected as participants for this study. They were randomly assigned to either the control group or the PEWS group. There was no significant statistical difference in age, gender, course of disease, and disease severity between the two groups of children. In the control group, children received standard emergency nursing interventions, while in the PEWS group, children received emergency nursing interventions based on the Pediatric Early Warning Score (PEWS). To evaluate the effectiveness of these interventions, several outcome measures were compared between the two groups. This included assessing the duration for symptoms to disappear, analyzing pulmonary function indicators and respiratory dynamics indicators, measuring scores from the Pediatric Asthma Quality of Life Questionnaire (PAQLQ), and evaluating nursing satisfaction.

Results • Following the implementation of the nursing interventions, 1. The average cough disappearance time of children in the PEWS group was 1.97 days shorter than that in the control group, the average wheezing disappearance time was 0.97 days shorter, the average dyspnea disappearance time was 0.64 days shorter, and the average lung wheezing disappearance time was 1.19 days shorter, which indicated that emergency care based on PEWS shortened the duration of symptoms in children with asthma. 2. The average FEV1 of children in the PEWS group was 9.87% higher than the control group, the average FVC was 0.62L higher, the average PEF was 9.84% higher, the average V70 was 0.91% higher, the average V50 was 0.43% higher , and the average V25 was 0.37% higher, when compared with control group. These results indicates that emergency care based on PEWS enhances the lung function of children with asthma. 3. The average respiratory rate of children in the PEWS group was 8.05 times/min lower, and the average dynamic respiratory system compliance was 6.91 mL/cmH2O higher, than that in the control group, which indicated that emergency care based on PEWS improved respiratory dynamics indicators in children with asthma. 4. The average PAQLQ symptom dimension score of children in the PEWS group was 0.84 points higher, the average activity dimension score was 0.34 points higher, and the average emotional dimension score was 0.47 points higher when compared with the control group. This indicated that emergency care based on PEWS improves the quality of life of children with asthma. 5. The nursing satisfaction of children in the PEWS group was 95%, higher than 72.5% in the control group, indicating that emergency care based on PEWS improved the satisfaction of asthma children with the nursing process.

Conclusion • The implementation of PEWS based emergency care in pediatric asthma patients has important clinical significance in promoting recovery and improving the quality of care for asthma patients. The implementation of emergency nursing interventions based on the Pediatric Early Warning Score (PEWS) for children with acute asthma has been found to be effective in promoting the recovery of their condition, enhancing their quality of life, and improving nursing satisfaction. (*Altern Ther Health Med.* [E-pub ahead of print.])

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INTRODUCTION

Asthma is a prevalent chronic respiratory disease affecting children worldwide.[1] According to data from the International Study on Asthma and Allergy in Children (ISAAC), the global incidence of acute asthma in adolescents is 6.9%, ranging from 3.8% in the Asia Pacific region, Northern and Eastern Europe, to 11.3% in North America.[2] When it comes to seeking emergency care and hospitalization, acute asthma ranks among the top causes among children.[3] Unfortunately, acute asthma can be fatal for children and can occur at any time

throughout the year.[4] If acute asthma in children is not effectively controlled, its mortality rate exceeds 3%.[5] It is characterized by persistent symptoms, the decline in lung function, and an increased risk of future exacerbations.[6] Additionally, acute asthma can lead to reduced quality of life, impaired cardiovascular health, increased school absenteeism, and reduced caregiver efficiency.[7]

Emergency nursing plays a crucial role in managing children with acute asthma.[8] Every year, acute asthma accounts for over 700 000 pediatric emergency visits, accounting for 2% to 5% of all pediatric hospitalizations.[9] Rational emergency nursing has numerous advantages, such as reducing treatment costs and duration and improving patient outcomes.[10] However, current nursing practices have limitations, including a lack of focused effectiveness, long waiting times, and inadequate delivery of high-quality and comprehensive services.[11] In addition, the global healthcare system is facing the problem of overcrowding in emergency rooms, which leads to the inability to provide timely medical care to patients, dissatisfaction with the medical process, and other adverse consequence. Without timely care can increase the risk of subsequent hospitalization for children.[13] It is crucial to make changes in the care of children with acute asthma in the emergency department.

Pediatric Early Warning Systems, PEWS is a bedside assessment tool that used for scoring tools and action algorithms to early identify clinical deterioration.[14] Currently, the Pediatric Early Warning Score (PEWS) is being increasingly utilized for the early recognition of clinical deterioration in pediatric patients.[15] Early identification and intervention not only contribute to the recovery of asthma in children, but may also reduce the risk of long-term onset.[16] In PEWS, includes monitoring vital signs and clinical data such as heart rate, respiratory rate, blood pressure, nervous system status, respiratory effort, and body temperature of patients for evaluation.[17] PEWS has seen international adoption, with growing evidence supporting its benefits.[18] In the emergency department, PEWS not only predicts the duration of hospitalization but also assists physicians in making informed decisions.[19] Therefore, the purpose of this study is to analyze whether emergency care based on PEWS can improve the condition of children with acute asthma.

DATA AND METHODS
General Information of Patients

A total of 80 children with acute asthma who were admitted to the Emergency Department of Hebei Children's Hospital between June 2018 and June 2019 were selected for this study. The patients were assigned a number based on their admission order and were evenly divided into two groups: the control group and the PEWS group. The inclusion criteria for the study were as follows: (1) Children over 2 years old but under 12 years old, (2) those who exhibited varying degrees of symptoms such as dyspnea, chest tightness, difficulty in breathing, and coughing, and met the diagnostic criteria for acute asthma, and (3) those who were conscious

and did not have any language or intellectual disabilities. The exclusion criteria for the study were (1) patients with impaired consciousness, (2) those who had severe physical illnesses, or (3) those who had mental illnesses. These patients are unable to cooperate effectively with this study and may have an impact on the results of this study, The study protocol was approved by the Ethics Committee of Hebei Children's Hospital, (Medical Research Ethics Approval Number 56) and informed consent was obtained from the families of all participating patients.

Methods

The control group received conventional emergency nursing intervention, which included systematic examination upon admission, assessment of symptoms, administration of symptom-targeted medication, monitoring of vital signs, development of treatment plans, and provision of diet and medication guidance.

In contrast, the PEWS group received emergency nursing based on the Pediatric Early Warning Score (PEWS) system. The nursing staff in this group were trained in PEWS-related knowledge and utilized the system to identify children with acute asthma (as shown in Table 1). Nursing staff use the PEWS scale to score the children at 8 AM and 17 PM every day, PEWS was categorized into four grades: 0-1 score: No immediate treatment was necessary, but continuous observation continued. 2 score: The responsible nurse was notified to use PEWS for continuous monitoring. If the patient's symptoms worsened, such as difficulty in breathing or coughing, the nurse appraised the situation and increased the frequency of PEWS assessments. 3score: In addition to the actions taken for 2 score, the frequency of PEWS assessments was further increased. When increase to once every 2 hours, the nursing team leader and physician were notified for dynamic assessment and appropriate intervention. The use of the PEWS system aimed to provide more targeted and timely intervention for children with acute asthma, ensuring that their symptoms were closely monitored and appropriate

Table 1. PEWS scoring criteria

Project	Scoring criteria	Score
Consciousness	Normal	0 points
	Drowsy, can be awakened by external stimuli	1 point
	Irritable, agitated, responsive to painful stimuli	2 points
	Stupor, coma, reduced or no response to stimuli	3 points
Respiratory function	Respiration rate (RR) of 9-14 breaths per minute, no retractions during inhalation.	0 points
	Decrease in RR by ≥5 breaths per minute compared to normal level; obvious retractions during inhalation or groaning; FiO2 is 0.5 or oxygen flow rate is >8 L/min.	1 point
	Increase in RR by ≥10 breaths per minute compared to normal level; FiO2 is 0.3 or oxygen flow rate is 4 L/min.	2 points
	Increase in RR by ≥20 breaths per minute; presence of retractions; FiO$_2$ is 0.4 or oxygen flow rate is >4 L/min.	3 points
Cardiovascular function	Pink skin color; systolic blood pressure range of 101-199 mmHg; heart rate (HR) of 51-100 beats per minute (for body temperature <38°C); capillary refill time (CRT) of 1-2 seconds.	0 points
	Pale skin color; systolic blood pressure ≥200 mmHg or 81-100 mmHg; HR of 101-110 beats per minute or 41-50 beats per minute (for body temperature <38°C); CRT of 3 seconds.	1 point
	Ashen skin color; systolic blood pressure ≥200 mmHg or 71-80 mmHg; HR ≤40 beats per minute or 111-130 beats per minute (for body temperature ≥38.4°C or <35.0°C); CRT of 4 seconds.	2 points
	Dusky skin color, cool and clammy extremities; systolic blood pressure ≥200 mmHg or ≤70 mmHg; HR ≥130 beats per minute or ≤40 beats per minute.	3 points

treatment was administered promptly when necessary. When the child's PEWS score is ≥ 4 points, or the score increases by >2 points, or if a single score is 3 points, the nursing staff in the department will promptly assess the child's facial expression, mental state, and vital signs. They will then notify the specialist and PICU doctors about the child's condition. Upon the arrival of the specialist and PICU doctors, they will assist in resuscitation and symptom management for the child. Additionally, they will contact a higher-level hospital to inform them of the child's condition and arrange for a timely transfer to another facility if necessary.

Outcome Measures

General Information: Statistical analysis was conducted on patient demographics, including age, gender, duration of illness, and illness severity. Main outcome criteria: Symptom Disappearance Time: After the start of the intervention, The time it took for symptoms such as coughing, wheezing, difficulty breathing, and findings from lung auscultation to disappear was observed in the patients. Pulmonary Function Indicators: Forced Expiratory Volume in 1 second (FEV1), Forced Vital Capacity (FVC), Peak Expiratory Flow (PEF), as well as the 75%, 50%, and 25% of the maximum expiratory flow at different lung volumes (V75, V50, V25) were measured in the patients before and after the intervention. During acute asthma attacks, the FEV1, FVC, PEF, V75, V50, and V25 levels of the child are reduced, and this decrease is closely related to the severity of the child's asthma.[20] After appropriate treatment, the lung function of the child is restored, and the severity of asthma in the child is reduced. Respiratory Dynamics Indicators: The respiratory frequency and dynamic respiratory system compliance of the child were assessed before and after the intervention. To measure the child's respiratory rate, the method involved observing the chest undulation while the child was lying on their back. A stopwatch was used to record the complete breaths of the child within one minute. This measurement was repeated two or three times, and the average value was taken as the child's respiratory rate. The method for detecting dynamic respiratory system compliance involved using a lung function testing instrument to measure the child's tidal volume, peak airway pressure, and positive end-expiratory pressure while in a relaxed state. The dynamic respiratory system compliance was then calculated using the formula: dynamic respiratory system compliance = tidal volume / (peak airway pressure - positive end-expiratory pressure). Secondary outcome criteria: Quality of Life: The Pediatric Asthma Quality of Life Questionnaire (PAQLQ) was utilized to evaluate the patient's quality of life before and after the intervention. This questionnaire encompassed three domains: symptoms (10 items), activities (5 items), and emotions (8 items). Each item was scored on a scale ranging from 1 (worst) to 7 (best) points. Higher scores indicated a better quality of life for the patients. Nursing Satisfaction: On the day after the intervention, a self-designed questionnaire on nursing satisfaction for asthma patients was distributed to parents to assess their satisfaction with the service attitude, emergency response, and other aspects. The questionnaire was scored on a scale of 0 to 100 points, with higher scores indicating higher satisfaction. Based on the scores, nursing satisfaction in this study was categorized into three levels: very satisfied (75-100 points), satisfied (50-74 points), and dissatisfied (<50 points). The overall satisfaction rate was calculated as the sum of the very satisfied rate and the satisfied rate.

Statistical Analysis

The data were analyzed using SPSS 23.0 software for processing and GraphPad Prism 9.0 software for data analysis and graphing. Continuous variables were expressed as mean ± standard deviation (SD) and analyzed using t tests. Categorical variables were analyzed using the chi-square test and presented as n (%) values. $P < .05$ was considered statistically significant, indicating the presence of significant differences.

RESULTS
Comparison of General Information of Patients

No significant differences were found between the two patient groups in terms of age ($P = .3742$), gender ($P = .4912$), duration of illness ($P = .5635$), and severity of illness ($P = .4123$) ($P > .05$) (Table 2). These results suggest that the baseline characteristics of patients in each group were comparable and meet the standards for research comparability.

Comparison of Disappearance Time of Symptoms in Patients

The PEWS group showed a significantly shorter duration for the disappearance of coughing ($P < .001$), wheezing ($P < .001$), difficulty in breathing ($P < .001$), and abnormal lung sounds ($P < .001$) compared to the control group ($P < .05$) (Table 3). The intervention for patients was implemented for a period of 7 days. These results indicated that emergency care based on PEWS effectively shortens the duration of symptoms in children with asthma.

Table 2. Comparison of general information between two groups of patients

Category	age	gender		duration of illness	severity of illness		
		Male	Female		Mild	Moderate	Severe
PEWS group (n = 40)	8.45±1.82	26(65.0)	14(35.0)	15.65±3.84	10(25.0)	18(45.0)	12(30.0)
Control group (n = 40)	8.10±1.68	23(57.5)	17(42.5)	15.14±4.02	7(17.5)	19(47.5)	14(35.0)
t/χ^2	0.8937	0.4740		0.5802	0.6723		
P value	.3742	.4912		.5635	.4123		

Note: The data is presented as (mean ± standard deviation).

Table 3. Comparison of symptom disappearance time between two groups of patients

Category	Cough disappearance time (Days)	Wheezing disappearance time (Days)	Dyspnea disappearance time (Days)	Lung wheezing sound disappearance time (Days)
PEWS group (n = 40)	2.65±0.54	0.65±0.22	2.48±0.40	3.37±0.62
Control group (n = 40)	4.62±1.16	1.62±0.41	3.12±0.57	4.56±0.85
t	9.7375	13.1848	5.8128	7.1536
P value	<.05	<.05	<.05	<.05

Note: The data is presented as (mean ± standard deviation).

Table 4. Comparison of pulmonary function indicators between two groups of patients

Category	FEV1 (%)		FVC (L)		PEF (%)		V70 (%)		V50 (%)		V25 (%)	
	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
PEWS group (n = 40)	74.87±20.00	94.15±16.22[a]	2.02±0.51	3.55±0.32[a]	74.35±18.22	95.23±18.67[a]	2.01±0.83	3.55±1.27[a]	1.29±0.51	2.47±0.83[a]	0.80±0.48	1.50±0.39[a]
Control group (n = 40)	74.39±18.76	84.28±21.34[a]	2.00±0.44	2.93±0.35[a]	73.15±17.40	85.39±17.59[a]	1.97±0.62	2.64±0.49[a]	1.26±0.32	2.04±0.55[a]	0.76±0.42	1.13±0.52[a]
t	0.1107	2.3288	0.1878	8.2685	0.3012	2.4262	0.2442	4.2280	0.3151	2.6142	0.3966	3.6001
P value	.9121	.0225	.8515	<.05	.7640	.0176	.8077	<.05	.7535	.0107	.6927	<.05

[a]Compared to before intervention, $P < .05$.

Note: The data is presented as (mean ± standard deviation).

Table 5. Comparison of respiratory dynamic indicators between two groups of patients

Category	Respiratory rate (breaths/min)		Dynamic compliance of the respiratory system (mL/cmH$_2$O)	
	Before intervention	After intervention	Before intervention	After intervention
PEWS group (n = 40)	25.11±3.31	15.44±2.02[a]	18.12±2.79	28.14±3.13[a]
Control group (n = 40)	25.89±3.44	23.49±2.15[a]	17.23±3.00	21.23±4.19[a]
t	1.0334	17.2581	1.3740	8.3561
P value	.3046	<.05	.1734	<.05

[a]Compared to before intervention, $P < .05$.

Note: The data is presented as (mean ± standard deviation).

Table 6. Comparison of scoring for various indicators in PAQLQ between two groups

Category	Symptom dimension		Activity dimension		Emotional dimension	
	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
PEWS group (n = 40)	4.48±1.25	6.18±0.59[a]	5.25±0.13	6.33±0.17[a]	5.07±1.08	6.47±0.39[a]
Control group (n = 40)	4.38±1.01	5.84±0.26[a]	5.20±0.11	5..99±0.32[a]	5.02±0.95	6.00±0.46[a]
t	0.3936	3.3352	1.8570	5.9344	0.2199	4.9290
P value	.6950	<.05	.0671	<.05	.8266	<.05

[a]Compared to before intervention, $P < .05$.

Note: The data is presented as (mean ± standard deviation).

Table 7. Comparison of nursing satisfaction between two groups of patients

Category	Very satisfied	Satisfied	Dissatisfied	Satisfaction level
PEWS group (n = 40)	22(55.0%)	16(40.0%)	2(5.0%)	38(95.0%)
Control group (n = 40)	15(37.5%)	14(35%)	11(27.5%)	29(72.5%)
χ^2	7.4397			
P value	.0064			

Note: The data is presented as n(%).

Comparison of Pulmonary Function Indicators in Patients

Prior to the intervention, there were no significant differences in FEV1 ($P = .9121$), FVC ($P = .8515$), PEF ($P = .7640$), V75 ($P = .8077$), V50 ($P = .7535$), and V25 ($P = .6927$) between the two patient groups ($P > .05$). However, following the intervention, both groups demonstrated an increase in FEV1, FVC, PEF, V75, V50, and V25. PEWS FEV1 ($P = .0225$), FVC ($P < .001$), PEF ($P = .0176$), V75 ($P < .001$), V50 ($P = .0107$), and V25 ($P < .001$), which were higher than control group (Table 4), These specific parameters for respiratory functions were selected to provide a clearer assessment of the treatment effects between the PEWS group and the control group.

Comparison of Respiratory Dynamics Indicators in Patients

Prior to the intervention, no significant differences in respiratory rate ($P = .3046$) and dynamic respiratory system compliance ($P = .1734$) were found between the two patient groups ($P > .05$). However, after the intervention, both groups showed a decrease in respiratory rate, with the PEWS group demonstrating a lower respiratory rate compared to the control group ($P < .001$). Additionally, both groups exhibited an improvement in dynamic respiratory system compliance, with the PEWS group showing superior dynamic respiratory system compliance compared to the control group ($P < .001$) (Table 5). These indices, including respiratory rate (breaths/min) and dynamic compliance of the respiratory system (mL/cmH$_2$O), were in line with the findings in Table 4. The results from both Table 4 and Table 5 provided a clear assessment of the therapeutic effects of PEWS, highlighting the positive impact of the intervention.

Comparison of Quality of Life of Patients

Prior to the intervention, there were no statistically significant differences in the PAQLQ scores for the symptom ($P = .6950$), activity ($P = .0671$), and emotion dimensions ($P = .8266$) between the two patient groups ($P > .05$). However, after the intervention, both groups showed an improvement in the PAQLQ scores for these dimensions, Symptom dimensions of the PEWS group ($P < .001$), activity dimension ($P < .001$) And emotional dimension scores ($P < .001$), which were higher than control group ($P < .05$) (Table 6). These indicators for assessing emotions were in accordance with the findings in Tables 4 and 5. These results clearly demonstrated the improved effects of PEWS in enhancing mood and emotions for patients.

Comparison of Nursing Satisfaction of Patients

The ratio of nursing satisfaction (very satisfied: 55%; satisfied: 40%; dissatisfied: 5%; satisfaction level: 90%) in the PEWS group was better than that in the control group (very satisfied: 37.5%; satisfied: 35%; dissatisfied: 27.5%; satisfaction level: 72.5%) ($P = .0064 < .05$) (the results were shown in table 7). These results indicated that emergency care based on PEWS significantly improves nursing satisfaction for children with asthma.

DISCUSSION

Pediatric acute asthma is a common and reversible disease seen in emergency departments.[22] It can be triggered

Figure 1. Compared to the control group, the PEWS group had lower age, male proportion, and duration of illness, with no statistical significance ($P > .05$). Among the three stages of illness severity, the moderate severity was the most common in both the PEWS group and the control group, and there was no statistical difference between the two groups in terms of illness severity. **: $P < .01$.
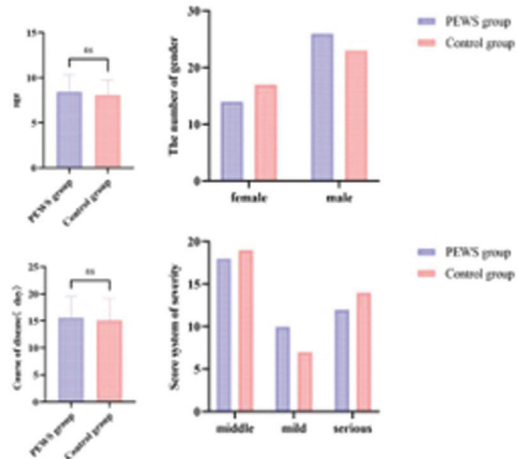

Figure 2. Compared to the control group, the PEWS group had shorter duration of cough, wheezing, difficulty breathing, and disappearance of pulmonary wheezing, and the differences were statistically significant. **: $P < .01$.
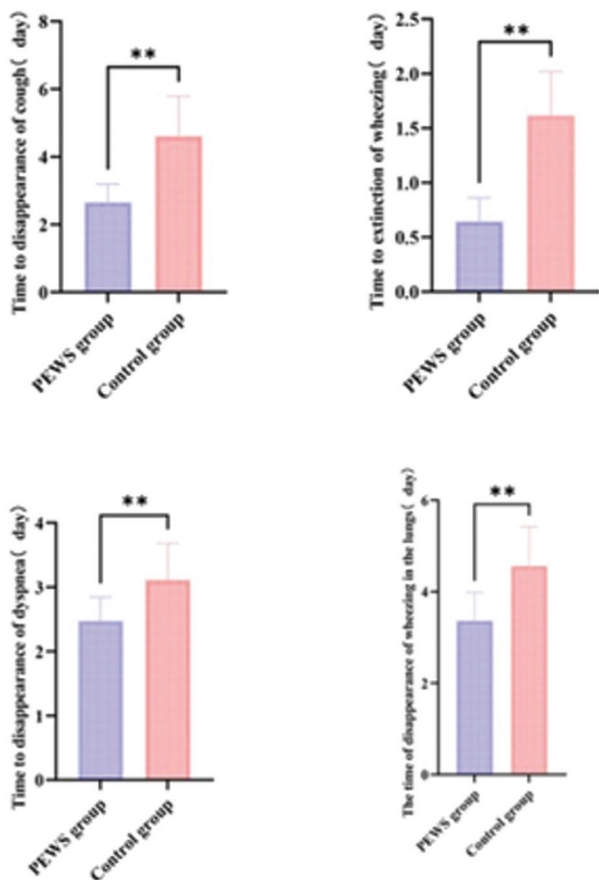
Figure 3. After intervention, the FEV1, FVC, PEF, V75, V50, and V20 of patients in both the control group and the PEWS group were increased compared to before intervention, and the differences were statistically significant. **: $P < .01$.
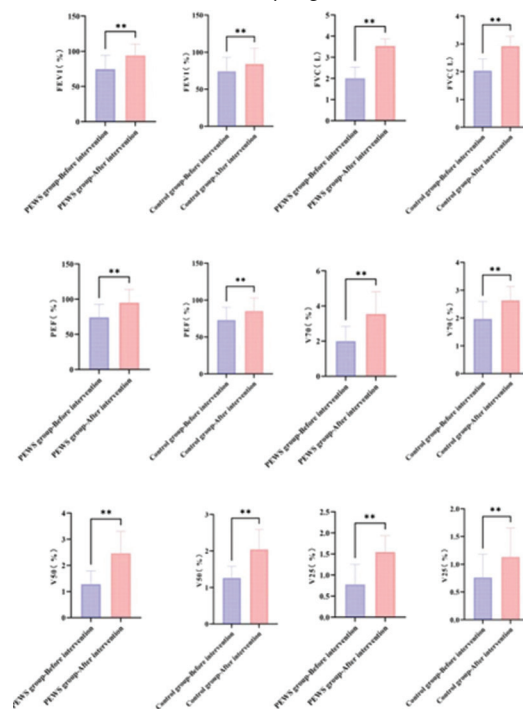
Figure 4. After intervention, the respiratory rate of patients in both the control group and the PEWS group decreased, and the dynamic compliance of the respiratory system increased compared to before intervention, and the differences were statistically significant. **: $P < .01$.
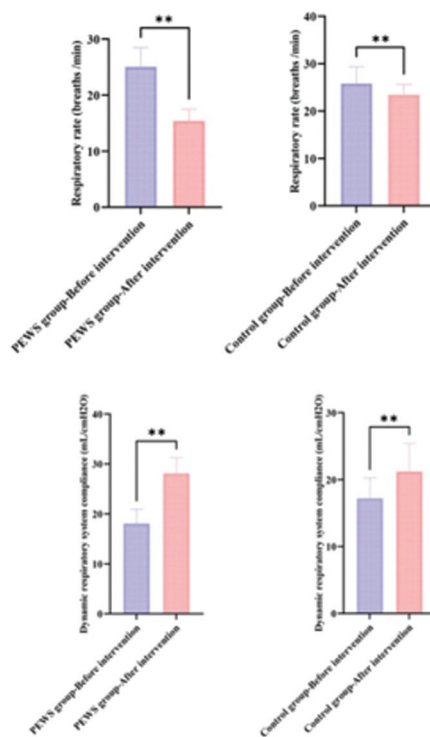
Figure 5. After intervention, the scores of symptom dimension, activity dimension, and emotional dimension in the PAQLQ of patients in both the control group and the PEWS group increased, and the differences were statistically significant. **: $P < .01$.
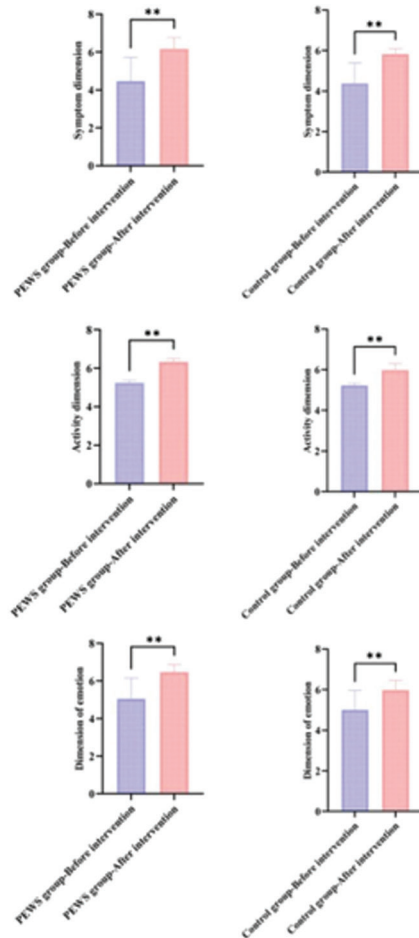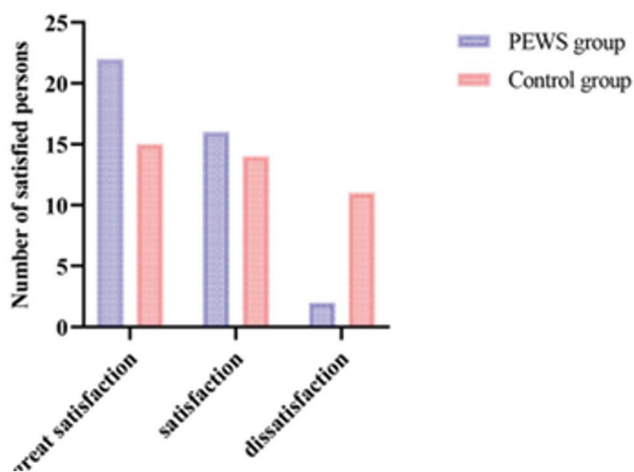

Figure 6. The number of patients in the PEWS group and the control group who were very satisfied with the nursing process was higher, while the number of patients in the control group who were dissatisfied with the nursing process was higher than that in the PEWS group.

by various factors such as respiratory viruses, allergens, smoking, air pollutants, and cold or dry air.[23] Children with acute asthma often experience symptoms like wheezing, difficulty breathing, and coughing, which can vary in frequency and intensity over time.[24] These symptoms are often accompanied by limited expiratory airflow.[25] Acute asthma can negatively impact lung function and hinder a child's growth.[26] This ultimately affects the quality of life for both the child and their family.[27] Therefore, it is crucial to effectively manage and control symptomatic exacerbation in children with acute asthma.[28]

Patient Early Warning Systems (PEWS) are valuable clinical tools used in nursing management.[29] PEWS utilizes bedside parameters for scoring without the need for complex and expensive equipment. It is a user-friendly, objective, and efficient tool that can predict outcomes and facilitate medical communication.[30] Moreover, it serves as an effective quality improvement measure, enhancing the conditions and recovery of patients.[31,32] This is because the implementation of PEWS improves patient prognosis by promoting interdisciplinary communication between nurses and doctors, allowing for faster identification of clinical deterioration and timely intervention to address complications.[33] PEWS also contributes to improving the quality of hospital nursing.[34] This is because PEWS shifts the attention of nursing team members to patients at risk, while nurses can elevate care to the hierarchical structure of the nursing team and provide standardized language when upgrading care. Both can improve patient treatment efficiency and comfort.[35]

Our study found that children with acute asthma who received emergency nursing based on PEWS demonstrated a significantly shorter disappearance time of clinical symptoms compared to those receiving conventional emergency nursing intervention. Their pulmonary function and respiratory dynamics indicators also significantly improved. This suggests that emergency nursing based on PEWS effectively promotes the recovery of children with acute asthma. This is consistent with the promoting effect of correct and reasonable nursing on the recovery of children with asthma in relevant studies,[36] Additionally, the study revealed increased PAQLQ scores (Pediatric Asthma Quality of Life Questionnaire) and nursing satisfaction among the children who received emergency nursing based on PEWS. This indicates that this approach efficiently improves the quality of life for children with acute asthma and increases their satisfaction with nursing care. This is consistent with the research that correct and reasonable care can effectively improve patients' quality of life and nursing satisfaction.[37]

In conclusion, emergency nursing based on PEWS for children with acute asthma is an effective approach that promotes recovery, improves their quality of life, and enhances nursing satisfaction. In the care of children with acute asthma attacks, emergency department nursing staff can promote the recovery of children and improve nursing satisfaction by combining PEWS with the nursing process.

This study has the following limitations: 1. This study is limited to the emergency department, and children with acute asthma attacks who visited other departments were not included in this study. 2. This study did not investigate the long-term results of PEWS based emergency care for children after the end of care. 3. All data was collected in Chinese and analyzed in English, which may affect the interpretation of the original statement. 4. This study was only conducted in a certain hospital in a certain region of China, which may limit the universality of the research results for other regions and patient groups.

AUTHOR CONTRIBUTIONS

ETHICAL STATEMENT AND CONSENT

CONFLICTS OF INTEREST

FUNDING

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