Investigating the Efficacy of a Handheld Fan Intervention in Children With Dyspnea: A Randomized Controlled Study

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Contribution to Emergency Nursing Practice

- Pediatric emergency nurses are frequently tasked with providing immediate relief to children experiencing respiratory distress, which is a common and distressing problem.
- The results of this study demonstrate that a handheld electric fan intervention had a favorable impact on oxygen saturation, heart rate, and respiratory rate in children with dyspnea when implemented together with standard inhaled bronchodilator therapy.
- Including handheld fan therapy in standard emergency department care protocols offers a noninvasive and practical intervention option that even parents can easily implement. The integration of evidence-based nonpharmacological interventions such as handheld fan therapy promotes comprehensive and individualized care for pediatric patients.

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Abstract

Introduction: Dyspnea associated with acute respiratory tract infections is a common cause of emergency admissions and can be distressing for children. This study aimed to evaluate the impact of a handheld fan intervention on physiological parameters in pediatric patients with dyspnea.

Methods: A total of 59 children aged 2 to 12 years presenting to an emergency department for upper respiratory tract infection between March 2022 and March 2023 were assigned to the experimental group ($n = 32$) or control group ($n = 27$) by urn randomization. Both groups received the hospital's standard care, including 3 doses of inhaled bronchodilator at 20-minute intervals. The fan intervention consisted of parents applying a handheld electric fan to the child's face at a distance of 15 cm for 5 minutes after each inhaler treatment. Oxygen saturation, heart rate, and respiratory rate were recorded before treatment and after the 3 inhaler treatments.

Results: There were no statistical differences in descriptive characteristics between the experimental and control groups ($P > .05$). Oxygen saturation values were significantly higher in the control group before treatment but showed greater increases in the intervention group after treatment ($P < .001$). The intervention group also exhibited greater reductions than the control group in both heart rate and respiratory rate after the third treatment than pretreatment values ($P < .05$).

Discussion: The handheld fan intervention effectively supports inhaler treatment for children with dyspnea. Further studies are recommended to assess its impact across different age groups and clinical conditions.

Key words: Handheld fan; Dyspnea; Pediatric nursing

Introduction

Dyspnea is a multifaceted subjective condition that can vary in severity and affect children psychologically and socially.[1,2] Respiratory diseases are among the most common causes of deaths in those younger than 5 years worldwide.[3] Acute respiratory diseases and associated dyspnea are among the most common reasons for admission to pediatric emergency departments, which can lead to gradual deterioration of children's general condition, prolonged hospitalizations, and recurrent hospital admissions.[4] In addition to pharmacological methods for combating dyspnea, nonpharmacological methods such as breathing techniques, energy management, and psychosocial support can be used. These methods are important in relieving shortness of breath and helping patients maintain their daily life activities.[5,6] Using a handheld electric fan on the face is another nonpharmacological intervention for dyspnea. The handheld fan is a simple, inexpensive, portable, and easy-to-use device.[7] Although its mechanism of action is not fully understood, it has been suggested that cooling of the nasal or oral mucosa reduces the perception of shortness of breath by stimulating the second and third trigeminal nerve branches.[2,8,9]

Given that studies on the effectiveness of these nonpharmacological interventions are few and have generally been conducted on adults, more evidence is needed to determine their utility in children. Moreover, there is still a need to develop cost-effective, harmless, and innovative methods for the management of dyspnea in the pediatric age group especially. This study was conducted to evaluate the effect of applying a handheld fan to the faces of children presenting to the emergency department with respiratory distress on their oxygen saturation (SpO_2), respiratory rate (RR), and heart rate (HR).

Methods

DESIGN

A randomized controlled study design was used to assess the impact of a handheld fan intervention on the physiological parameters of children aged 2 to 12 years with respiratory infection and dyspnea compared with standard care with inhaled bronchodilator therapy.

SETTING AND SAMPLE

The study was conducted in the pediatric emergency department of Cerrahpaşa School of Medicine Hospital between March 2022 and March 2023. Sample size was determined using G*Power (3.1.9.2) software (Heinrich-Heine University) and using power analysis based on a similar study using the SpO_2 variable.[6] For 80% power with a 5% error margin and effect size of 0.78, the minimum necessary sample size was calculated as at least 22 children per group (44 total).

The sample comprised children who presented to the emergency department with upper respiratory tract infection and dyspnea and met the following inclusion criteria: were between 2 and 12 years of age, were prescribed inhaled bronchodilator treatment by the physician, had no chronic upper or lower respiratory system diseases, and had an informed consent to participate provided by a parent. The 59 children included in the study were allocated to the experimental group ($n = 32$) and the control group ($n = 27$) by urn randomization (Figure).[10]

INSTRUMENTS

Information Form

This form was prepared by the researchers and included 12 items to collect introductory information about the parents and the child such as their age, sex, anthropometric measurements, diagnosis, and symptoms.

Observation Form

This form, also prepared by the researchers, was used to record SpO_2 (%), HR (beats/min), and RR (breaths/min). The parameters were measured 4 times in total, immediately before starting inhaler bronchodilator treatment and after each of 3 consecutive inhaler treatments.

Pulse Oximeter Device

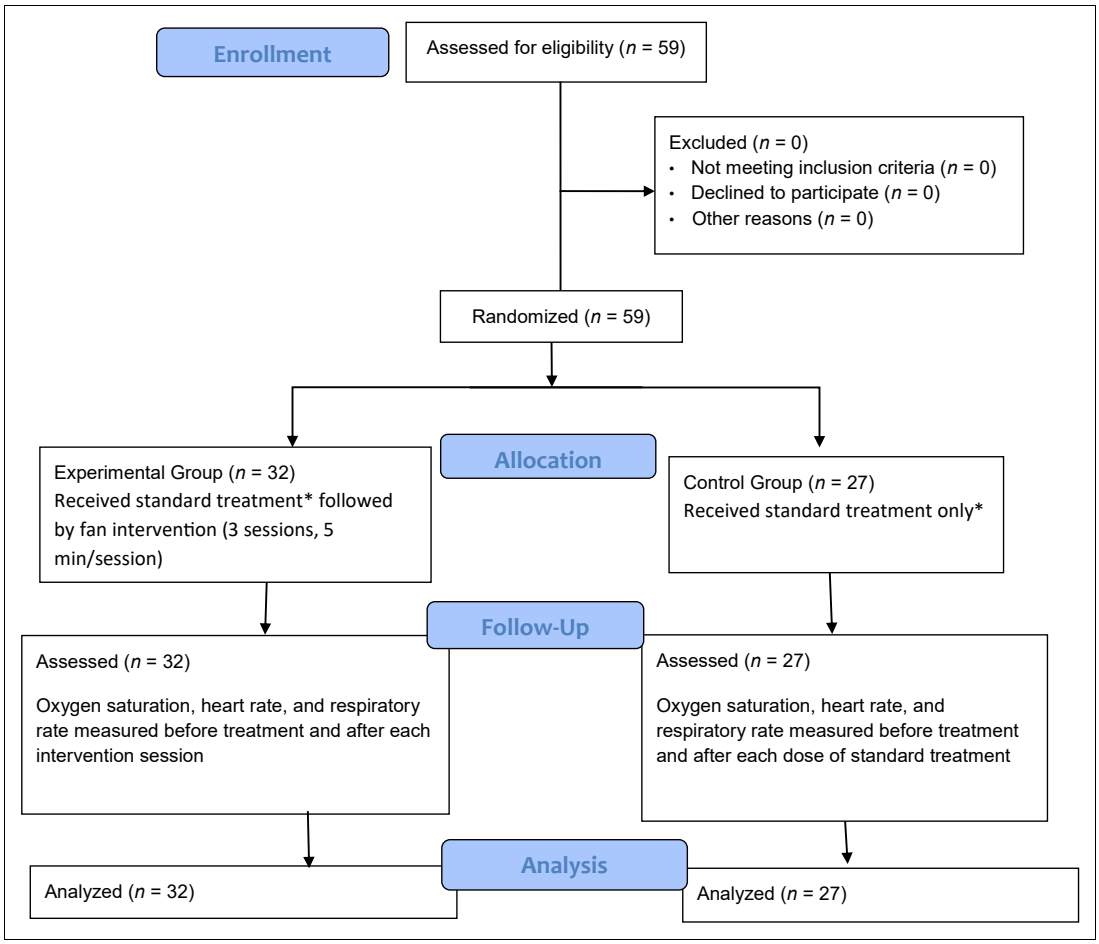
The PlusMED plus-50DL Fingertip Pulse Oximeter (Plus Medical Co, Ltd; serial no: 12.06.2012-70235) was uniformly used in both groups for SpO_2 and HR measurements.

Handheld Fan

The experimental group received a Vkusra brand rechargeable portable handheld fan (Shenzhen Anny Tech Co, Ltd). The CE-certified device operates silently and does not produce heat.

DATA COLLECTION

Parents in both groups received comprehensive information regarding the study's objectives, after which their verbal and written consent was obtained. In addition, the families of



FIGURE

CONSORT flow diagram. *Standard treatment consisted of inhaled bronchodilator therapy. CONSORT, Consolidated Standards of Reporting Trials.[10]

children in the experimental group received instructions from the researcher on how to use the handheld fan. Information collected from parents was recorded on the information form, and the physiological parameters of the children in both groups were measured by the researcher and recorded on the observation form. Immediately after the pretreatment assessment, all children received inhaled bronchodilator treatment 3 times at 20-minute intervals as per the hospital's standard care and treatment protocol. Immediately after treatment, children in the experimental group received the handheld fan intervention, in which parents used the fan to direct air toward the child's face at a distance of 15 cm for 5 minutes.[7] The parents performed the handheld fan intervention under the supervision of the researchers. Physiological parameters were measured again after the intervention (posttreatment 1). The same procedure was repeated after the second and third inhaled bronchodilator treatments (posttreatment 2 and 3). The control group received standard care and was assessed at the same intervals.

DATA ANALYSIS

SPSS Statistics version 22 program (IBM Corp, Armonk, NY) was used for statistical analysis to assess the results obtained in the study. The Shapiro-Wilk test was used to assess whether the data were normally distributed. In addition to descriptive statistical methods (mean, SD, and frequency), the chi-square test was used for categorical variables, the Mann-Whitney U test for comparisons of independent groups, and Wilcoxon test for comparison of repeated measures within groups. Statistical significance was evaluated at the level of $P < .05$.

TABLE 1
Characteristics of the children ($N = 59$)

Characteristic	Intervention group	Control group	Test statistics	
	Mean (SD)	Mean (SD)	*Z*	*P* value
Age (y)	5.64 (2.59)	5.35 (2.17)	−.237	.81
Height (cm)	105.45 (18.25)	103.33 (17.06)	−.365	.72
Weight (kg)	23.15 (18.40)	17.69 (8.16)	−1.058	.29

Values have been rounded to 2 decimal places.

ETHICAL CONSIDERATIONS

Before starting the study, necessary approval was obtained from the Clinical Trials Ethics Committee of İstanbul Kent University Hospital (IRB number: 10420511-050-15841). An informed consent was obtained from the parents of all children included in the study. In addition, parents were informed that they could withdraw from the study at any stage and the health service they received from the hospital would not be affected because of the study.

Results

The mean (SD) ages of the children in the intervention and control groups were 5.64 (2.59) and 5.35 (2.17), respectively. There were no statistically significant differences in descriptive characteristics between the experimental and control groups ($P > .05$). Comparisons of descriptive characteristics between the groups are presented in Table 1.

In the pretreatment assessment, SpO_2 was significantly lower in the experimental group than the control group. However, measurements made after the second and third inhaler treatments showed that saturation levels were significantly higher in the experimental group ($P < .05$). The experimental group demonstrated significantly greater increases in SpO_2 from pretreatment level in all 3 posttreatment measurements (Table 2).

No significant intergroup difference in HR was observed pretreatment ($P > .05$). After the first treatment, HR did not change in the experimental group but decreased in the control group, resulting in a significant difference between the groups ($P < .05$). After the second treatment, HR

TABLE 2
Within-group and between-group comparisons of oxygen saturation (SpO_2) levels ($N = 59$)

Measurements	Intervention group	Control group	Test statistics	
	Mean (SD)	Mean (SD)	*Z*	*P* value*
SpO_2 (%)				
Pre-T	93.59 (2.22)	95.25 (2.15)	−3.216	.001
Post-T1	97.31 (1.51)	97.11 (1.69)	−.327	.74
Post-T2	98.59 (0.97)	97.96 (1.37)	−1.993	.046
Post-T3	99.40 (0.75)	98.74 (1.05)	−2.529	.01
Difference				
Pre-T vs post-T1	3.71 (2.27)	1.85 (1.79)	−3.309	< .001
Z/*P*†	−4.954/<.001	−3.999/<.001		
Pre-T vs post-T2	5.00 (2.18)	2.70 (2.38)	−4.277	< .001
Z/*P*†	−4.956/<.001	−4.422/<.001		
Pre-T vs post-T3	5.81 (2.30)	3.48 (2.17)	−3.987	< .001
Z/*P*†	−4.950/<.001	−4.562/<.001		

post-T, posttreatment; pre-T, pretreatment.
Values have been rounded to 2 decimal places.
* Mann-Whitney U test.
† Wilcoxon test.

TABLE 3
Within-group and between-group comparisons of heart rate ($N = 59$)

Measurements	Intervention group	Control group	Test statistics	
	Mean (SD)	Mean (SD)	Z	*P* value*
Heart rate (beats/min)				
Pre-T	127.00 (21.53)	116.77 (16.77)	−1.934	.053
Post-T1	127.56 (18.52)	112.33 (27.83)	−2.300	.02
Post-T2	110.59 (16.32)	108.29 (19.45)	−.937	.35
Post-T3	100.40 (13.48)	102.33 (15.39)	−.190	.85
Difference				
Pre-T vs post-T1	0.56 (22.16)	−4.44 (20.79)	−1.630	.10
Z/*P*†	−1.647/>.99	−.661/.51		
Pre-T vs post-T2	−16.40 (19.83)	−8.48 (12.02)	−1.569	.12
Z/*P*†	−4.626/<.001	−3.083/.002		
Pre-T vs post-T3	−26.59 (21.34)	−14.44 (14.72)	−2.474	.01
Z/*P*†	−4.826/<.001	−3.677/<.001		

post-T, posttreatment; pre-T, pretreatment.
Values have been rounded to 2 decimal places.
* Mann-Whitney U test.
† Wilcoxon test.

was significantly reduced in both groups ($P < .05$) and again showed no statistical difference between the groups ($P > .05$). In the third posttreatment measurement, HR was significantly lower in the experimental group than in the control group ($P < .05$) (Table 3).

Before treatment, children in the experimental group had a significantly higher RR than the control group ($P < .05$). There were significant reductions in RR after the first treatment in both groups and RR remained lower in the control group ($P < .05$). However, in the experimental group, RR was lower after the second and third interventions relative to pretreatment levels than the control group ($P < .05$) (Table 4).

Discussion

This study aimed to evaluate the use of a handheld fan as a nonpharmacological intervention to alleviate dyspnea in children. Respiratory distress is a common problem in children, and it is important to develop appropriate interventions.[11] In the literature, the use of handheld fans has generally been examined in adults with terminal-stage cancer, chronic obstructive pulmonary disease, and cardiac disease. The literature data demonstrate the safety and efficacy of fan intervention during both rest and exertion.[12-15] Given the paucity of data from the pediatric population, the findings of this study are an important contribution to the literature. Our results showed that the handheld fan intervention played a positive role in alleviating respiratory distress in children. In their study on adult patients, Galbraith et al[7] evaluated the effect of fan interventions in a crossover design. In the intervention group, fan interventions were performed first to the face from a distance of 15 cm for 5 minutes, followed by a 10-minute rest period, and then applied to the leg for 5 minutes. The control group received fan interventions to the leg first and then the face. The authors reported that fanning the face was more effective in reducing dyspnea scores than fanning the leg. Although our study sample comprised children, the results were similar. Our findings are also consistent with those of Kako et al,[16] who reported that a handheld fan intervention applied to the face of patients with advanced cancer provided cooling of the facial skin and significant improvement in parameters such as dyspnea, RR, and SpO_2.

Although the patients in our intervention group had lower SpO_2 levels than the control group before treatment, they also exhibited a significantly greater increase in the SpO_2 after treatment, resulting in higher levels at the second

TABLE 4
Within-group and between-group comparisons of respiratory rate ($N = 59$)

Measurements	Intervention group	Control group	Test statistics	
	Mean (SD)	Mean (SD)	Z	*P* value*
Respiratory rate (breaths/min)				
Pre-T	33.96 (7.48)	30.48 (6.68)	−1.994	.046
Post-T1	32.34 (6.17)	28.67 (5.96)	−2.465	.01
Post-T2	27.15 (4.39)	25.51 (6.92)	−1.118	.26
Post-T3	25.21 (2.87)	25.11 (3.74)	−.516	.61
Difference				
Pre-T vs post-T1	−1.62 (4.18)	−1.81 (3.00)	−.629	.53
Z/*P*†	−2.087/.04	−2.848/<.004		
Pre-T vs post-T2	−16.40 (19.83)	−8.48 (12.02)	−1.569	.12
Z/*P*†	−4.559/<.001	−4.180/<.001		
Pre-T vs post-T3	−8.75 (6.30)	−5.37 (4.45)	−2.335	.02
Z/*P*†	−4.903/<.001	−4.313/<.001		

post-T, posttreatment; pre-T, pretreatment.
Values have been rounded to 2 decimal places.
* Mann-Whitney U test.
† Wilcoxon test.

and third posttreatment measurements. This indicates that the handheld fan intervention was more effective in improving saturation levels than standard care.

Similarly, HR decreased steadily in both groups in the posttreatment assessments. This decrease can be primarily attributed to the use of inhaled bronchodilator therapy. In the intervention group, pretreatment HR was higher than that of the control group and changed little after the first treatment. Combined with the slight decrease in the control group, this resulted in a significant difference between the groups at the first posttreatment measurement. The lack of a significant decrease in HR after the first treatment session may have been related to their initial excitement related to the novel intervention. However, after the second and third treatments, the intervention group showed greater reductions in HR from pretreatment values, resulting in a significantly lower HR than in the control group after the third treatment. This indicates that fan intervention was more effective than inhaler therapy.

A similar pattern was observed in the patients' respiration. Despite the intervention group having a higher RR before treatment and both groups showing significant decreases in RR after treatment compared with pretreatment values, this change was more pronounced in the intervention group than the control group. This supports the more favorable effect of the fan intervention on children's physiological parameters.

Limitations

This study was conducted in a single pediatric emergency department, which may limit the generalizability of the findings to other settings or populations. In addition, we excluded children with chronic respiratory diseases and those with physical abnormalities that could affect respiratory function.

Implications for Emergency Nurses

Dyspnea is a common and distressing symptom encountered in emergency care settings, particularly among pediatric patients. Although pharmacological interventions such as bronchodilators and oxygen therapy are commonly used, nonpharmacological interventions such as distraction techniques and breathing exercises have also shown promise in managing dyspnea in pediatric populations. Although previous studies have explored the use of handheld fan therapy in various clinical settings, including adult populations and certain pediatric conditions, this randomized controlled trial

offers new evidence supporting the effectiveness of handheld fan therapy as a nonpharmacological adjunct intervention for managing dyspnea in pediatric emergency care settings. The main implication for clinical emergency nursing practice stemming from this paper is that handheld fan therapy can be integrated into standard care protocols for the management of dyspnea in pediatric patients. Emergency nurses play a crucial role in assessing and managing respiratory distress in children, and the incorporation of evidence-based nonpharmacological interventions such as handheld fan therapy offers a valuable tool to enhance symptom management and improve patient comfort during acute care encounters.

Conclusion

Children with dyspnea who received a handheld fan intervention to the face showed significantly greater improvement in SpO_2 and larger decreases in HR and RR after than the control group. These more favorable changes in physiological parameters than standard care with inhaled bronchodilator therapy provide evidence of the effectiveness of the fan intervention.

Author Disclosures

Conflicts of interest: none to report.

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