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Original Article

Nursing Section

Effectiveness of Breathing Exercises as a Play-way Method after Nebulisation vs Conventional Nebulisation on Respiratory Parameters among Children with Lower Respiratory Tract Infection- A Pilot Study

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ABSTRACT

Introduction: Retained airway secretion is linked to a wide-range of respiratory illnesses. Breathing exercise plays a remarkable role in airway clearance and parenchyma expansion.

Aim: To evaluate the effect of breathing exercises as a play-way method after nebulisation on respiratory parameters among Children with Lower Respiratory Tract Infection.

Materials and Methods: The present study was a quasi-experimental pre-test and post test design conducted at AJ Institute of Medical Sciences, Mangaluru, Karnataka. This study selected 20 children admitted to the paediatric ward with a diagnosis of bronchitis, bronchiolitis and pneumonia from March 2020 to May 2021. The level of dyspnoea was assessed before nebulisation using a Paediatric Dyspnoea Scale (PDS). Respiratory rate per minute, oxygen saturation in percentage (%), chest expansion in centimeter (cm) and respiratory sounds were assessed after nebulisation. Interventional group was advised to blow the balloon after nebulisation for 15 minutes once a day for two days consecutively. Unpaired t-test and Analysis of Variance (ANOVA) were used to find significance in between changes of respiratory parametres in both groups and those of pre-test and post test within the group respectively.

Results: In the total sample of 20 children, mean age of those in the intervention group (n=10) was 9.1±2.71 years while those in the control group (n=10) was 8.75±2.75 years. The birth order of the children was significantly dominant as second order (70%) in the control group while first order (80%) in the experimental group. Independent t-test showed that there was a statistically significant difference in the post test findings of respiratory rate (p-value=0.005), oxygen saturation (p-value=0.0004) and chest expansion (p-value=0.0006).

Conclusion: The study concluded that regular practice of balloon blowing exercise improves oxygen saturation and chest expansion to a great extent in children with lower respiratory tract infection.

Keywords: Balloon blowing exercise, Chest expansion, Oxygen saturation, Respiratory rate

INTRODUCTION

Diseases pertaining to the respiratory system are responsible for a large proportion of paediatric admissions and outpatient attendance in India [1]. Respiratory disorders are a leading cause of death and illness around the world [2]. Lower respiratory infection ranks as the fourth leading cause of death. The number of deaths has fortunately gone down from 2.6 million in 2019 to 460,000 in 2000 [3]. Pneumonia is the single largest infectious cause of death in children worldwide. It killed around 808,694 children under the age of five years in 2017 worldwide [4].

Most respiratory diseases are related to retained airway secretions due to increased mucus production, diminished mucociliary transport, and a cough [5,6]. The last few years have seen the utmost evolution in our understanding of aerosol delivery to human subjects. Modern technology, along with increasing knowledge of human pulmonary physiology, has supported better quality aerosol delivery. This form of treatment has technologised the management of patients with various pulmonary diseases [7].

Nebulisers create a tiny mist of droplets that can reach the lungs' narrow airways, giving moisture to loosen and thin secretions [8-10]. Sputum retention happens when patients are inept to clear secretions from their respiratory tract by themselves or with assistance [6]. Breathing exercises, clear the airways and expand the parenchyma by increasing the efficiency of respiratory muscles, reducing respiratory exertion, and improving lung function [11,12]. The balloon blowing exercise increases the maximum expiratory volume. As the volume of balloon increases, it increases the resistance of respiratory muscles [13].

Balloon resistance is all about the contraction of the diaphragmatic muscles. It is completely active during forced exhalation and respiratory cycle which lengthen and contract the internal and external intercoastal muscles and thus expands the lungs [14]. So, the balloon blowing breathing exercise aids in the removal of retained secretions with the child's efforts. Hence, the study aimed to assess the effect of balloon blowing exercise on respiratory rate, oxygen saturation (SpO_2), chest expansion and respiratory sounds in children with lower respiratory tract infections.

MATERIALS AND METHODS

This was a quasi-experimental study with pre-test and post test design conducted in the Paediatric ward of AJ Institute of Medical Sciences, Mangaluru, Karnataka, India. Ethical approval was obtained from the Institutional Ethics Committee of AJ Institute of Medical Sciences (Ref no: AJEC/REV/102/2020 dated 11.12 2020) and registered in Clinical Trials Registry, India (CTRI/2021/03/031625 dated on 01.03.2021). It was a pilot project and the period of data collection was extended from March 2020 to May 2021.

Inclusion criteria: Children aged between 6 years to 12 years, who received asthalin nebulisation and those who were admitted to paediatric ward with pneumonia, bronchitis, or bronchiolitis were included.

Exclusion criteria: Children who were critically ill and those not willing to participate in the study were excluded. Cases with Pediatric Dyspnoea Scale (PDS) scores [15] above four, those who are allergic to latex material and also those with a congenital anomaly in the mouth and nose were excluded from the study.

The parents' written approval was secured, as was the children's assent. In order to assign the children to experimental group (n=10) and control group (n=10), 1-20 chits were prepared. Children were asked to pick up the chits and those who got even number were assigned to experimental group and those who got odd number as to control group, as this was the pre-determined criteria.

Children were screened by PDS (a series of colour-coded descriptions describing the extent of breathing difficulties). The PDS is scored from 1 (no trouble at all while breathing) through 7 (very much trouble). Baseline information was obtained from the mother by face to face interview and case file of the child. Pre-test assessment of respiratory parameters (oxygen saturation (SpO_2) and respiratory sounds) were assessed using pulse oximeter and stethoscope. Respiratory Rate (RR) was counted by the number of times the chest rises for one minute in a supine position. The circumference of the chest was measured at the level of the nipple line. The tape measure was placed at right angles to the vertebral column (difference between inspiratory circumference and expiratory circumference in cm). This was followed by asthalin nebulisation of child using respironics inspiration elite nebuliser for 15 minutes in the nebulisation unit, then the child was shifted to the bed and made to sit comfortably and asked to inhale maximum air before blowing the balloon and inflate the balloon by maximum exhalation. The balloon blowing exercise was performed for 15 minutes once a day for two days consecutively. Control group did not received the intervention. Post tests 1 and 2 were assessed for both the groups after 25 minutes of nebulisation therapy on days 1 and 2, respectively.

STATISTICAL ANALYSIS

Data gathered by the investigator was coded, organised and analysed using Statistical Package for Social Sciences (SPSS) version 21.0. Demographic characteristics of the sample, respiratory sounds were analysed using frequency and percentage. Unpaired t-test used to determine the significant difference in the post tests respiratory parameter between interventional and control group. ANOVA was used to find the significant difference between pre-test and post test respiratory parameters.

RESULTS

Distribution of the sample according to their demographic characteristics

The mean age in the control group was 8.75±2.75 years and that in the experimental group was 9.1±2.71 years [Table/Fig-1].

Demographic characteristics		Control group (n=10)	Experimental group (n=10)	p-value
		n (%)		
Child age (in years) Mean±SD		8.75±2.75	9.1±2.71	0.65
Gender	Male	6 (60)	4 (40)	0.37
	Female	4 (40)	6 (60)	
Residence	Urban area	6 (60)	5 (50)	0.65
	Rural area	4 (40)	5 (50)	
Gestational age	Preterm	-	1 (10)	0.30
	Appropriate	10 (100)	9 (90)	
Type of birth	Normal vaginal delivery	7 (70)	5 (50)	0.36
	Caesarean delivery	3 (30)	5 (50)	
Birth order of child	First	1 (30)	8 (80)	**0.005***
	Second	7 (70)	1 (10)	
	Third	2 (20)	1 (10)	
Birth weight (Kg)	2-2.5	2 (20)	2 (20)	1
	2.6-3	5 (50)	5 (50)	
	3.1-3.5	3 (30)	3 (30)	
Type of feed given after birth	Breast feed only	10 (10)	10 (100)	1
History of immunisation	Yes	10 (10)	10 (100)	1
History of allergy	Yes	2 (20)	2 (20)	1
	No	8 (80)	8 (80)	
Previous history of hospitalisation due to respiratory illness	Yes	2 (20)	3 (30)	0.60
	No	8 (80)	7 (70)	
Pet animals in home	Yes	8 (80)	10 (100)	0.13
	No	2 (20)	-	
Family history of smoking	Yes	9 (90)	5 (50)	**0.05***
	No	1 (10)	5 (50)	

[Table/Fig-1]: Distribution of sample according to their demographic characteristics. p-value ≤0.05 is considered to be significant

The pre-test and post tests mean scores of PDS in the experimental group was less than the control group shown in [Table/Fig-2].

[Table/Fig-3] shows after two days of balloon blowing exercise, 9 (90%) children in the experimental group had normal respiratory sounds; whereas in the control group, 6 (60%) had normal respiratory sounds.

Groups	Paediatric dyspnoea scale score						p-value
	Pre-test		Post test 1		Post test 2		
	max-min	Mean±SD	max-min	Mean±SD	max-min	Mean±SD	
Experimental group (n=10)	4-2	2.8±0.24	4-2	2.7±0.21	4-1	2.6±0.26	0.84
Control group (n=10)	4-2	3±0.25	4-2	3±0.25	4-2	2.9±0.27	

[Table/Fig-2]: Range, mean, standard deviation of pre-test and post tests paediatric dyspnoea scale score of children in the experimental and control group. Post tests 1 and 2 : assessed for both the groups after 25 minutes of nebulisation therapy on days 1 and 2, respectively.
p-value ≤0.05 to be considered significant

Respiratory sounds	Experimental group (n=10)			Control group (n=10)		
	Pre-test	Post test 1	Post test 2	Pre-test	Post test 1	Post test 2
	n (%)			n (%)		
Normal	4 (40)	4 (40)	9 (90)	4 (40)	4 (40)	6 (60)
Wheeze	4 (40)	4 (40)	1 (10)	4 (40)	4 (40)	3 (30)
Crackle	2 (20)	2 (20)	-	2 (20)	2 (20)	1 (10)

[Table/Fig-3]: Frequency and percentage distribution of children based on respiratory sounds in the experimental and control group. Post tests 1 and 2: assessed for both the groups after 25 minutes of nebulisation therapy on days 1 and 2, respectively.

Effect of balloon blowing exercise on respiratory parameters

Pre-test and post tests mean±standard deviation of RR, Spo_2, and Chest Expansion (CE) in the experimental group and control groups shown in [Table/Fig-4].

Respiratory parameters	Respiratory rate (RR) (per minute)		Oxygen saturation (SpO_2) (%)		Chest expansion (CE) (cm)	
Groups	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD
Pre-test						
Experimental	30-26	27.8±1.751	98-96	97.2±1.03	2-1	1.3±0.483
Control	28-24	26±1.632	97-94	96.2±0.82	2-1	1.3±0.483
Post test 1						
Experimental	28-24	26.4±1.83	99-96	97.5±0.84	3-1	1.9±0.56
Control	28-24	25.8±1.47	98-95	96.7±0.82	2-1	1.3±0.48

Post test 2						
Experimental	28-22	25.1±1.69	100-98	98.7±0.82	3-2	2.3±0.48
Control	28-24	25.8±1.47	98-95	96.8±0.91	2-1	1.5±0.52

[Table/Fig-4]: Range, mean, standard deviation of pre-test and post tests respiratory rate (per minute), oxygen saturation (percentage) and chest expansion (cm) of children in the experimental and control group.
E: Experimental group; C: Control group; SD: Standard deviation

Intergroup comparison showed statistically significant difference in the post test findings for oxygen saturation and chest expansion, but not in respiratory rate. Intragroup comparison shows that there was a statistical difference in the pre-test and post tests findings for oxygen saturation, respiratory rate and chest expansion [Table/Fig-5].

Respiratory parameters	Intragroup comparison (Experimental group vs Control group)	Intergroup comparison (Experimental vs Control group)
	p-value	
Respiratory rate (per minute)	0.005*: 0.94	P1-0.43: P2-0.27
Oxygen saturation (%)	0.0004*: 0.31	P1-0.04*: P2-0.0001*
Chest expansion (cm)	0.0006*: 0.59	P1-0.02*: P2-0.002*

[Table/Fig-5]: The p-value of intra and inter group comparison of respiratory parameters.
p-value ≤0.05 is considered to be significant
*- significant, P1- post test 01, P2- post test 2
Intra group comparison: ANOVA. Intergroup comparison: Unpaired 't'test

DISCUSSION

Dyspnoea is one of the chief symptoms of lung disease [16]. In this study, the children were advised to blow the balloon after nebulisation therapy for maximum of 10 times for 15 minutes. Mean scores of the PDS in the experimental group was less than the control group after two days of intervention. These findings are in accordance to the study by Angelin K et al., conducted in 20 patients using structured self-administered questionnaire and respiratory assessment for dyspnoea, found that in the pretest 15 (75%) had dyspnoea whereas after 14 days of balloon therapy 12 (60%) of them had no dyspnoea [17]. Similarly, another study which was conducted among 50 children aged 6 to 12 years revealed that post test mean dyspnoea score (1±0.0) was less than the pre-test score (1.36±0.48) [18]. Similar results were reflected by another previous study as well [19].

The present study noticed that before the balloon blowing exercise, less than half of the children in both groups had wheezing respiration, whereas after two days, almost all 9 (90%) of the children in the intervention group had normal respiration. These findings are supported by study which was conducted by Das SM et al., also studied the effect of balloon and bubble therapy on physiological parameters and observed that 17 (57%) of children had abnormal breath sounds in pre intervention and none after six days of balloon therapy [20]. The findings of study are similar to Sreeletha A, who studied the effect of balloon therapy versus incentive spirometry in promotion of respiratory function among 20 children in each group. It was observed that in seven children, wheeze was reduced after two weeks of balloon therapy, whereas none of it was reduced after giving two weeks of incentive spirometry [21]. So, balloon therapy is effective in reducing wheezing.

In the present study, children who performed balloon blowing exercise showed no statistical difference in respiratory rate. The result of the study is in contrast to a study conducted by Swain M in which it was observed that there was a statistical difference in respiratory rate after three days of administering the balloon blowing exercise [22]. Bhuvaneshwari G and Kunjachan R also found that spirometry is more effective in the respiratory rate when compared to the balloon therapy [23]. Similarly in another study by Das SM et al., found that there was a statistical difference in respiratory rate after administering six days of bubble therapy when comparing to the balloon therapy at p-value ≤0.05 [20]. The reasons for the contradictory finding may be due to more frequent and long-term intervention in the reference study [20-22].

In the current study, there was a statistical difference in the post test findings for oxygen saturation and chest expansion. The results of the present study are supported by Swain M among 40 children with 20 in each both group. An intervention group blowing air into a flute for 10 times within one hour in two times per day for three consecutive days. Respiration, pulse rate, blood pressure, and chest expansion was assessed and the result revealed that breathing exercise was effective on respiratory rate, pulse rate and chest expansion [22]. Similar findings were supported by other studies that found improvement in oxygen saturation after balloon therapy in comparison to bubble therapy and incentive spirometer [20,21]. Rafaqat A et al., found that balloon blowing exercise resulted in improvement in the respiratory parameters such as Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV) 1, oxygen saturation, respiratory rate and chest expansion [24]. Likewise, the study carried out by Shally Kumar Y and Kaur P revealed that the respiratory status of children improved where breathing exercises were given as a therapeutic play in combination with nebulisation therapy [11]. So, based on study findings-balloon blowing exercise improves the oxygen saturation and chest expansion when compared to other breathing exercises like bubble therapy and incentive spirometer.

Limitation(s)

Small sample size and short term intervention were the limitations in this study which could be addressed in future research.

CONCLUSION(S)

Nebulisation is often used to loosen respiratory secretions in children with lower respiratory tract infections. However, many of the children are unable to remove secretions from their respiratory system on their own. So, the child can be encouraged to blow a balloon after nebulisation which helps to eliminate retained secretions, regularise respiratory parameters and improved prognosis. A balloon blowing exercise being simple and is accepted by the children and parents. It is easy to administer.

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