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EFFECTIVENESS OF PLAY-BASED PINWHEEL BLOWING EXERCISE ON IMPROVING PULMONARY FUNCTION AMONG CHILDREN WITH LOWER RESPIRATORY TRACT INFECTION IN A SELECTED HOSPITAL OF WESTERN UTTAR PRADESH

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ABSTRACT

Introduction: Lower Respiratory Trat Infection (LRTIs) are one of the major causes of morbidity and hospitalization among children worldwide. Children with LRTIs commonly experience impaired pulmonary function characterized by increased respiratory rate, decreased oxygen saturation, and reduced Peak Expiratory Flow Rate (PEFR). Play-based breathing exercises are increasingly recognized as effective supportive therapies that improve respiratory function while promoting child participation and cooperation. Pinwheel blowing exercise is a simple, cost-effective, and enjoyable breathing activity that encourages deep inhalation and prolonged exhalation, thereby improving airway clearance and lung expansion.

Objectives of the study: To evaluate the effectiveness of Play-Based Pinwheel Blowing Exercise on improving pulmonary function among children with Lower Respiratory Tract Infection in a selected hospital, Western Uttar Pradesh.

Methodology: A quantitative research approach with a quasi-experimental pre-test post-test control group design was adopted for the study. The study was conducted among 80 children aged 6-12 years diagnosed with Lower Respiratory Tract Infection. Sample were selected using non-probability convenience sampling technique and divided into experimental group (40) and control group (40). The experimental group received play-based pinwheel blowing exercise along with routine care, whereas the control group received routine hospital care only. Pulmonary function parameters such as respiratory rate, oxygen saturation (SpO2), and Peak Expiratory Flow Rate (PEFR) were assessed using validated PRESS Scale before and after the intervention. Data were analysed using descriptive (Frequency, percentage, mean & standard deviation) and inferential statistics (Paired and unpaired t-tests & chi-square).

Results: In the experimental group, the mean pre-test level of pulmonary function score (9.55±2.72) was significantly higher than the mean post-test level of pulmonary function score (4.13±1.87) with a mean difference (5.42) with calculated (t-value 10.402) with (df 78) at (p-value 0.001) was statistically significant at $p<0.05$ level, indicating a marked improvement in level of pulmonary function after pinwheel blowing exercise. In control group, the mean pre-test level of pulmonary function score (8.6±3.51) was little higher than the mean post-test level of pulmonary function score (7.15±3.26) with mean difference (1.45) with calculated (t-value 7.526) with (df 39) at (p-value 0.001) was Statistically significant at $p<0.05$ level, indicating a little improvement in level of pulmonary function after hospital routine care. There is difference between mean post-test level of pulmonary function score in both experimental and control group with mean difference (3.02) with calculated (t-value 5.087) with (df 78) at (p-value 0.001) was Statistically significant at $p<0.05$ level, confirming the effectiveness of pinwheel blowing exercise on improving pulmonary function among children with LRTIs.

Conclusion: The study concluded that play-based pinwheel blowing exercise is an effective, safe, inexpensive, and child-friendly nursing intervention for improving pulmonary function among children with Lower Respiratory Tract Infection. The intervention can be incorporated into routine pediatric nursing care to promote faster recovery, enhance child cooperation, and improve respiratory outcomes.

KEYWORDS: Lower Respiratory Tract Infection, Pulmonary Function, Pinwheel Blowing Exercise, Play-Based Therapy, Respiratory Rate, Oxygen Saturation, Peak Expiratory Flow Rate, Children.

INTRODUCTION

Play-based respiratory exercises are gentle tools of pediatric care, enhancing lung function and transforming recovery into an engaging, participatory process." The respiratory system is a vital component of human physiology, responsible for gas exchange and maintaining oxygen homeostasis. Children are highly susceptible to respiratory disorders due to the anatomical and physiological immaturity of their respiratory system. The pediatric airway is narrower, with reduced airway diameter, fewer collateral ventilation channels, and underdeveloped alveoli, making children more vulnerable to airway obstruction and impaired gas exchange during infections. Additionally, the immune system in early childhood is

not fully developed, which increases susceptibility to respiratory pathogens and the severity of illness. Lower respiratory tract infections (LRTIs) are infections involving the airways and lung parenchyma below the level of the larynx, including the trachea, bronchi, bronchioles, and alveoli. These infections constitute a major cause of morbidity among children globally and significantly contribute to pediatric hospital admissions. Globally, LRTIs remain among the top causes of mortality and disability-adjusted life years (DALYs) in children. According to the WHO, pneumonia alone accounts for approximately 14% of all deaths in children under five, and continues to affect older children significantly. India bears a substantial proportion of the global LRTI burden. Reports from UNICEF indicate that pneumonia and other respiratory infections remain leading causes of pediatric hospitalization in India. LRTIs may be caused by Viral infections such as respiratory syncytial virus (RSV), influenza virus, adenovirus, and parainfluenza virus are major etiological agents. Bacterial pathogens include Streptococcus pneumoniae, Haemophilus influenzae, and Mycoplasma pneumoniae. Among these, Streptococcus pneumoniae remains the most common and severe bacterial cause of pneumonia in children globally. Risk factors include malnutrition, passive smoking exposure, incomplete immunization, overcrowding, and poor ventilation.

THE OBJECTIVES OF THE STUDY

1. To assess the pretest & post-test pulmonary function among children with Lower respiratory tract infection.
2. To evaluate the effectiveness of Play-Based Pinwheel Blowing Exercise on pulmonary function among children with Lower respiratory tract infection
3. To determine the association between the level of pulmonary function among children with Lower respiratory tract infection and their selected demographic variables.

METHODOLOGY

A quantitative research approach with a quasi-experimental pre-test post-test control group design was adopted for the study. The researcher selected 80 children aged 6–12 years diagnosed with Lower Respiratory Tract Infection by using non-probability convenience sampling technique who met the eligibility criteria and divided 40 children in experimental group and 40 children in control group. written informed consent was obtained from parents/guardians of all 80 participants and assent from all 80 children. Inclusion criteria, children 6-12 years with mild to moderate LRTIs, children who are clinically stable & able to follow instructions, and parent/guardian consent and child assent. Exclusion criteria, children with severe LRTIs, Children with other chronic pulmonary/neuromuscular/cardiac conditions, children participate in another breathing program, contraindications to peak flow meter, and children who are not willing to participate in the study. Study was conducted from last week of January to march 2026 at ward and OPD of SVBP hospital, Meerut, after the written permission from SIC and Head of the department of pediatrics of SVBP hospital, Meerut. The data was collected with demographic questionnaire and PRESS scale. Implementation of pinwheel blowing exercise intervention. After the implementation of intervention for 3 set (5 breath in each set & give 20 second rest after each set) for a fixed duration of pinwheel rotating for 5 second. After 20 min. of the intervention period, post-test was conducted on the same day and reassess pulmonary function in both experimental and control groups by using the same tool. Descriptive and inferential statistics were used for data analysis.

RESULTS

The findings of the study are presented according to the objectives of the study. The data is prepared under the subsequent sections: -

Section – I Finding Showing distribution of Socio- Demographic variables of children age 6-12 year with lower respiratory tract infection in a selected hospital of Western Uttar Pradesh.

Table: 1 Frequency and percentage distribution of children with LRTIs with selected demographic variables. (N=80)

S.NO	Demographic Characteristics	Experimental Group		Control Group	
		Frequency	Percentage	Frequency	Percentage
	Age (In year)				
1	a. 6-7	19	47.50%	10	25%
	b. 8-9	8	20%	18	45%
	c. 10-11	9	22.50%	10	25%
	d. 12	4	10%	2	5%
2	**Gender**				
	a. Male	22	55%	17	42.50%
	b. Female	18	45%	23	57.50%

3	**Nutritional status**				
	a. Underweight	8	20%	10	25%
	b. Normal	29	72.50%	26	65%
	c. Overweight/obese	3	7.50%	4	10%
4	**Types of family**				
	a. Nuclear	16	40%	12	30%
	b. Joint	17	42.50%	19	47.50%
	c. Extended	7	17.50%	9	22.50%
5	**Provisional diagnosis**				
	a. Pneumonia	11	27.50%	12	30%
	b. Bronchitis	4	10%	6	15%
	c. Bronchiolitis	11	27.50%	9	22.50%
	d. Asthma	7	17.50%	8	20%
	e. Broncho pneumonia	7	17.50%	5	12.50%
6	**Family history of LRTI**				
	a. Present	7	17.50%	8	20%
	b. Absent	33	82.50%	32	80%
7	**Frequency of LRTI**				
	a. Weekly	2	5%	4	10%
	b. Monthly	8	20%	5	12.50%
	c. Occasionally	30	75%	31	77.50%
8	**History of hospital admission for LRTI**				
	a. Admitted	11	27.50%	11	27.50%
	b. Not Admitted	29	72.50%	29	72.50%

Section – II Finding Showing the level of pulmonary function among children with lower respiratory tract infection before and after play based pinwheel blowing exercise.

Table: 2.1 Frequency and percentage distribution of level of pulmonary function among children with lower respiratory infection in the experimental groups during pre-test and post-test.(N=40)

FREQUENCY AND PERCENTAGE DISTRIBUTION OF PULMONARY FUNCTION AMONG CHILDREN WITH LOWER RESPIRATORY TRACT INFECTION			
S.NO		**Experimental Group**	
		Pre-Test	**Post-Test**

	Level of pulmonary function	Frequency	Percentage%	Frequency	Percentage%
1	**Mild**	1	2.50	31	77.50
2	**Moderate**	31	77.50	9	22.50
3	**Severe**	8	20	0	0
Total		40	100	40	100

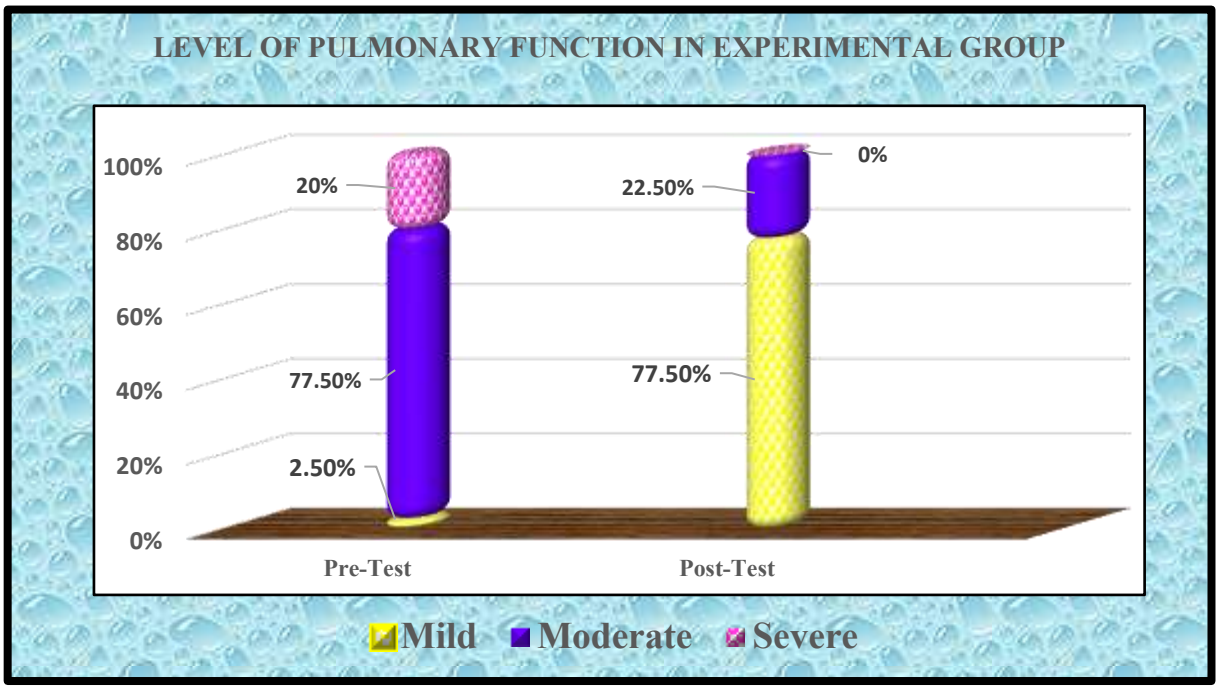

Figure 1- Distribution of the cumulative percentage of children with LRTIs according to level of pulmonary function in experimental group

Table: 2.2 Frequency and percentage distribution of level of pulmonary function among children with lower respiratory infection in the control groups during pre-test and post-test.(N=40)

FREQUENCY AND PERCENTAGE DISTRIBUTION OF PULMONARY FUNCTION AMONG CHILDREN WITH LOWER RESPIRATORY TRACT INFECTION					
S.NO	**Level of pulmonary function**	**Control Group**			
		Pre-Test		**Post-Test**	
		Frequency	**Percentage %**	**Frequency**	**Percentage %**
1	**Mild**	7	17.50	15	37.50
2	**Moderate**	25	62.50	19	47.50
3	**Severe**	8	20	6	15
Total		40	100	40	100

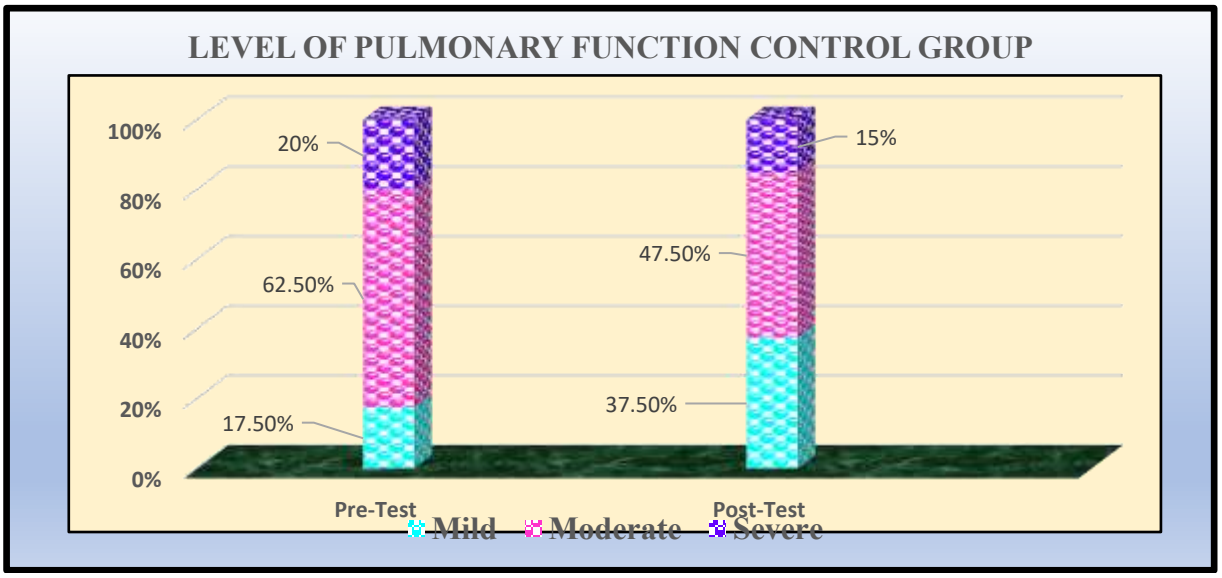

Figure 2 - Distribution of percentage of children with LRTIs according to level of pulmonary function in control group

Section – III To compare the level of pulmonary function across pre-test and post- test measurement to determine the effectiveness of play-based pinwheel blowing exercise.

Table 3.1: - Difference between the mean pre-test and post-test score of level of pulmonary function in experimental group among children with lower respiratory tract infection.(N=40)

MEAN, STANDARD DEVIATION, MEAN DIFFERENCE & 't" VALUE OF LEVEL OF PULMONARY FUNCTION AMONG CHILDREN WITH LOWER RESPIRATORY TRACT INFECTION IN EXPERIMENTAL GROUP								
S.NO	**TEST**	**MEAN**	**STANDARD DEVIATION**	**MEAN DIFFERENCE**	**t-Value**	**df**	**p-Value**	**Remark**
1	**PRE-TEST**	9.55	2.72	5.42	10.402	39	0.0001	Statistically significant
2	**POST-TEST**	4.13	1.87					

Statistically significant at p<0.05 level

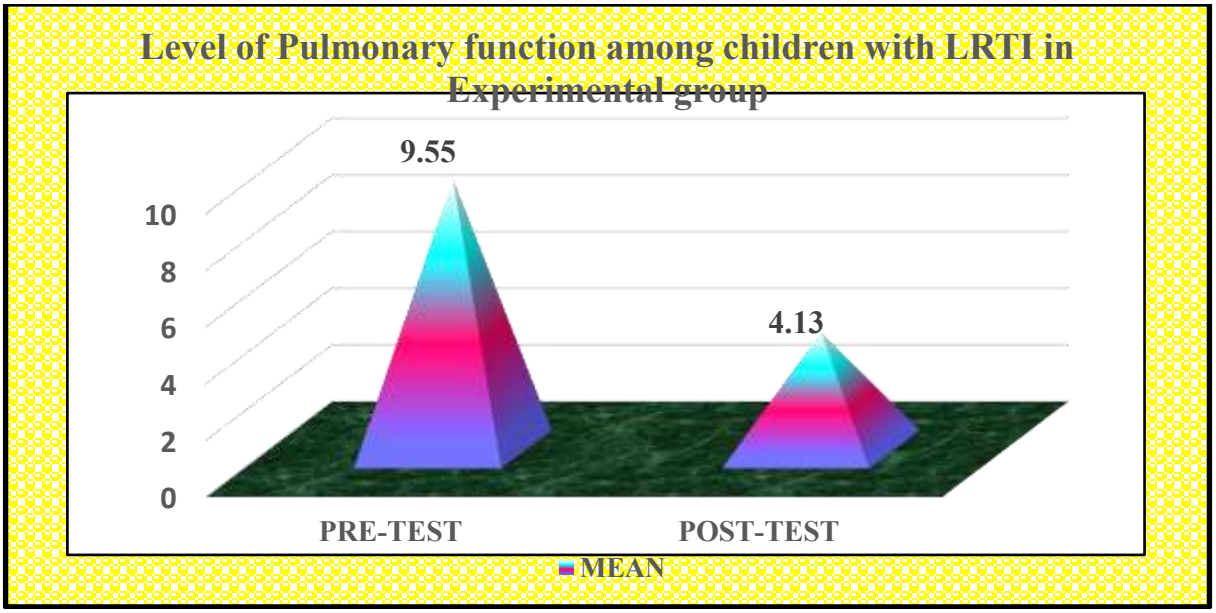

Figure: - 3 Difference between the mean pre-test and post-test score of level of pulmonary function among children with LRTIs in experimental group

Table 3.2: - Difference between the mean pre-test and post-test score of level of pulmonary function in control group among children with lower respiratory tract infection.

MEAN, STANDARD DEVIATION, MEAN DIFFERENCE & 't" VALUE OF LEVEL OF PULMONARY FUNCTION AMONG CHILDREN WITH LOWER RESPIRATORY TRACT INFECTION IN CONTROL GROUP								
S.NO	**TEST**	**MEAN**	**STANDARD DEVIATION**	**MEAN DIFFERENCE**	**t-Value**	**df**	**p-Value**	**Remark**
1	**PRE-TEST**	8.6	3.51	1.45	7.526	39	0.0001	Statistically significant
2	**POST-TEST**	7.15	3.26					

(N=40)

Statistically significant at p<0.05 level

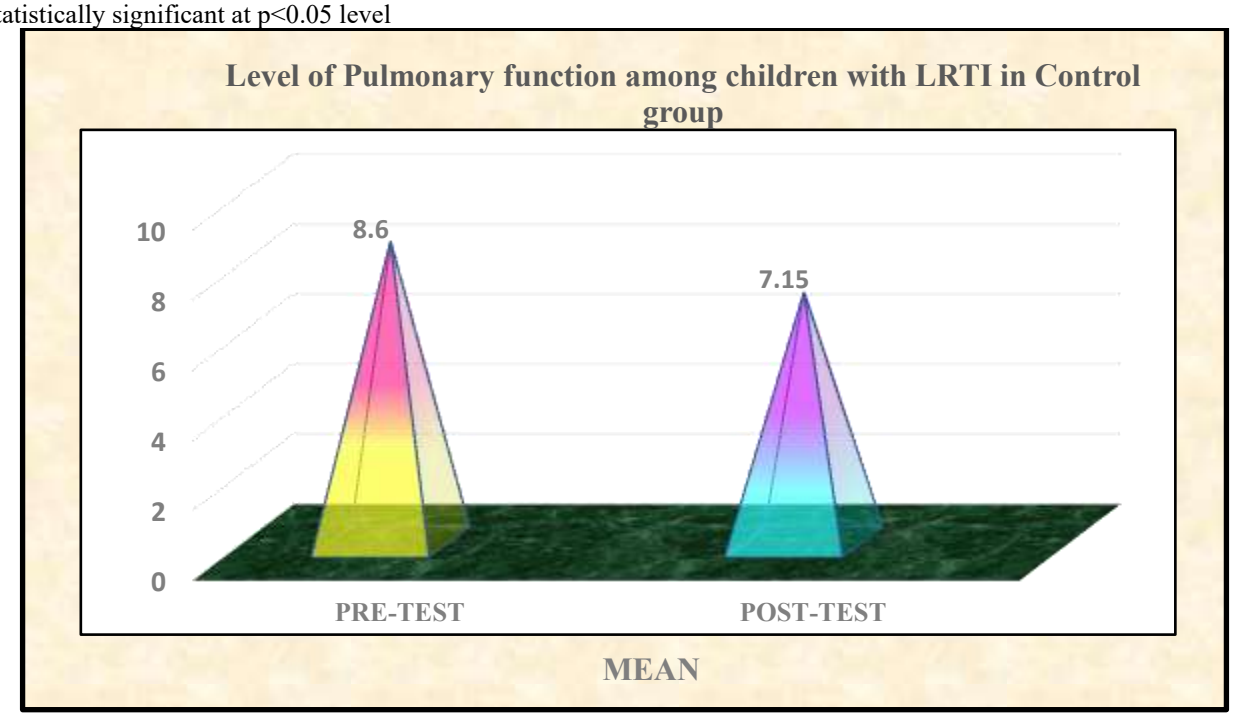

Figure: - 4 Difference between the mean pre-test and post-test score of level of pulmonary function among children with LRTIs in control group.

Table 3.3: - Difference between the mean post-test score of level of pulmonary function between experimental and control group among children with lower respiratory infection. (N=80)

MEAN, STANDARD DEVIATION, MEAN DIFFERENCE & 't" VALUE OF LEVEL OF PULMONARY FUNCTION AMONG CHILDREN WITH LOWER RESPIRATORY TRACT INFECTION IN EXPERIMENTAL AND CONTROL GROUP								
GROUP	**TEST**	**MEAN**	**STANDARD DEVIATION**	**MEAN DIFFERENCE**	**t-Value**	**df**	**p-Value**	**Remark**
EXPERIMENTAL GROUP	**POST-TEST**	4.13	1.87	3.02	5.087	78	0.0001	Statistically significant
CONTROL GROUP	**POST-TEST**	7.15	3.26					

Statistically significant at p<0.05 level

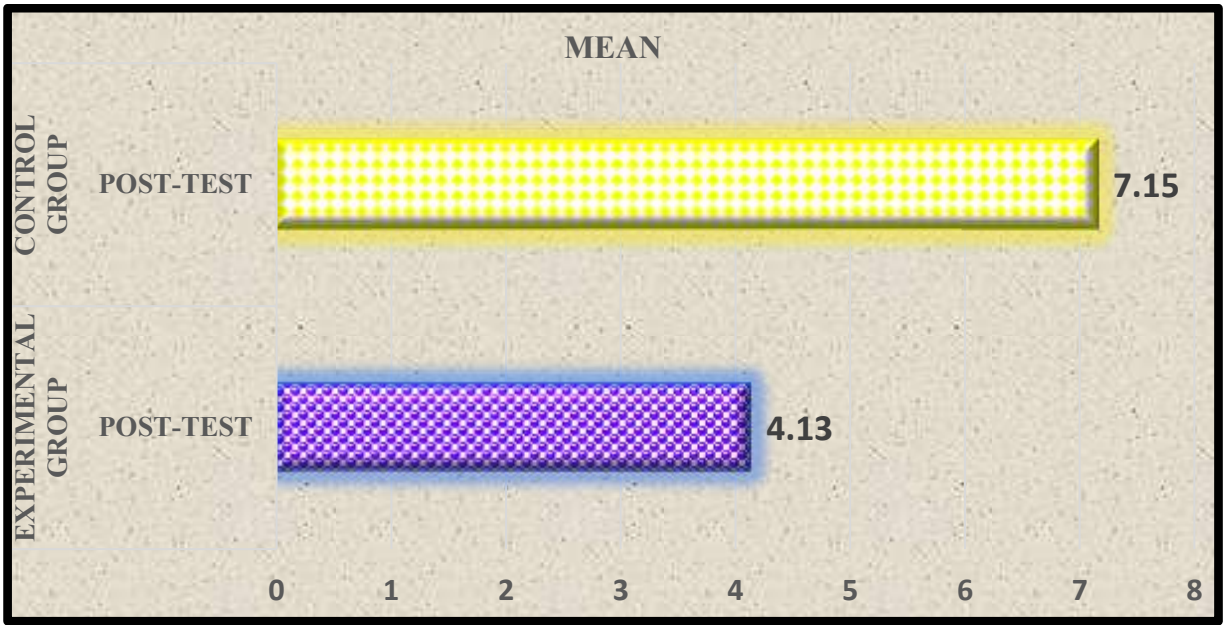

Figure: 5 Difference between the mean post-test score of level of pulmonary function among children with LRTIs between experimental and control group

Section – IV Data showing association of pre-test level of pulmonary function with selected demographic variables among children age 6-12 year with lower respiratory tract infection.

Table: 4.1 Association Between Pre-Test level of Pulmonary function with selected Demographic variables in experimental group (N=40)

Association between level of pulmonary function among children with lower respiratory tract infection and their selected demographic variables								
S.NO	**Demographic Characteristics**	**Mild**	**Moderate**	**Severe**	**Chi-square**		**P Value**	**Inference**
					df	**χ^2**		
		EXPERIMENTAL GROUP						
1	Age (In year)							
	a. 6-7	1	16	2	6	5.523	0.478	NS
	b. 8-9	0	5	3				
	c. 10-11	0	6	3				
	d. 12	0	4	0				
2	Gender							
	a. Male	0	17	5	2	1.404	0.495	NS
	b. Female	1	14	3				
3	Nutritional status							
	a. Underweight	0	4	4	4	6.218	0.183	NS
	b. Normal	1	24	4				
	c. Overweight/obese	0	3	0				
4	Types of family							
	a. Nuclear	0	13	3	4	4.021	0.403	NS
	b. Joint	1	14	2				
	c. Extended	0	4	3				

5	Provisional diagnosis							
	a. Pneumonia	0	11	0	8	19.01	0.014	S
	b. Bronchitis	0	4	0				
	c. Bronchiolitis	1	9	1				
	d. Asthma	0	2	5				
	e. Broncho pneumonia	0	5	2				
6	Family history of LRTI							
	a. Present	0	3	4	2	9.639	0.008	S
	b. Absent	1	29	3				
7	Frequency of LRTI							
	a. Weekly	0	2	0	4	28.59	0.000009	S
	b. Monthly	0	1	7				
	c. Occasionally	1	28	1				
8	History of hospital admission for LRTI							
	a. Admitted	0	5	6	2	11.44	0.003	S
	b. Not Admitted	1	26	2				

Table: - 4.2 Association Between Pre-Test level of Pulmonary function with selected Demographic variables in control group (N=40)

Association between level of pulmonary function among children with lower respiratory tract infection and their selected demographic variables								
S.NO	**Demographic Characteristics**	**Mild**	**Moderate**	**Severe**	**Chi-square**		**P Value**	**Inference**
					df	**χ^2**		
CONTROL GROUP								
1	Age (In year)							
	a. 6-7	5	5	0	6	12.795	0.046	S
	b. 8-9	2	11	5				
	c. 10-11	0	7	3				
	d. 12	0	2	0				
2	Gender							
	a. Male	3	10	4	2	0.248	0.883	NS
	b. Female	4	15	4				
3	Nutritional status							
	a. Underweight	1	5	4	4	3.956	0.411	NS
	b. Normal	5	17	4				
	c. Overweight/obese	1	3	0				
4	Types of family							
	a. Nuclear	3	9	0	4	7.125	0.129	NS
	b. Joint	4	9	6				
	c. Extended	0	7	2				

5	Provisional diagnosis							
	a. Pneumonia	3	9	0	8	24.999	0.001	S
	b. Bronchitis	1	5	0				
	c. Bronchiolitis	3	6	0				
	d. Asthma	0	2	6				
	e. Broncho pneumonia	0	3	2				
6	Family history of LRTI							
	a. Present	0	3	5	2	14.484	0.0007	S
	b. Absent	7	23	2				
7	Frequency of LRTI							
	a. Weekly	0	1	3	4	14.371	0.006	S
	b. Monthly	0	3	2				
	c. Occasionally	7	22	2				
8	History of hospital admission for LRTI							
	a. Admitted	1	4	6	2	14.425	0.0007	S
	b. Not Admitted	6	22	1				

A total of 80 children with LRTIs participated in the study, with 40 children each in the experimental and control groups. In the experimental group during the pre-test, the majority of participants (77.5%) were in the moderate category, followed by 20% in the severe category, and only 2.5% in the mild category. However, in the post-test, there was a marked improvement, with 77.5% of participants shifting to the mild category and 22.5% remaining in the moderate category, while no participants were found in the severe category. In the control group, during the pre-test, 62.5% of participants were in the moderate category, 20% in the severe category, and 17.5% in the mild category. In the post-test, there was a slight improvement, with 37.5% of participants in the mild category, 47.5% in the moderate category, and 15% still remaining in the severe category. the mean pre-test score in experimental group was 9.55 with a standard deviation of 2.72, indicating that participants initially had higher levels of the measured variable (e.g., symptoms, severity, or problem level). After the intervention, the post-test mean score reduced to 4.13 with a standard deviation of 1.87, showing a noticeable decrease. The mean difference of 5.42 indicates a substantial improvement between pre-test and post-test scores. The calculated t-value (10.4025) with 78 degrees of freedom is very high. The p-value (0.0001) is much lower than the standard significance level (0.05), which means the result is statistically highly significant. The mean pre-test score in experimental group was 8.6 (SD = 3.51), which decreased to 7.15 (SD = 3.26) in the post-test. The mean difference of 1.45 indicates a reduction in scores after the intervention. The calculated t-value (7.5265) with 39 degrees of freedom (df) is statistically significant, as the p-value (0.0001) is much lower than the standard level of significance ($p < 0.05$). comparison of post-test means scores of pulmonary functions among children with lower respiratory tract infection in the experimental group was 4.13 with a standard deviation of 1.87, whereas in the control group it was 7.15 with a standard deviation of 3.26.

The mean difference between the two groups was -3.02, indicating that the experimental group showed a greater improvement in pulmonary function compared to the control group. Regarding the association between demographic variables and pre-test level of pulmonary function, provisional diagnosis, family history of LRTI, frequency of LRTI, and history of hospital admission were significantly associated with pulmonary function levels in both groups, while age showed significance only in the control group. In contrast, gender, nutritional status, and type of family were not found to have any significant association with pulmonary function among children with LRTI.

DISCUSSION

The findings from the frequency and percentage distribution reveal a remarkable improvement in the experimental group following the intervention. During the pre-test, the majority of children (77.5%) had moderate pulmonary dysfunction, 20% had severe dysfunction, and only 2.5% had mild dysfunction. However, in the post-test, a substantial shift was observed, with 77.5% of children improving to mild level, 22.5% remaining in the moderate category, and no children in the severe category. This clearly indicates a significant enhancement in pulmonary function after the intervention. In

contrast, the control group showed only minimal improvement. In the pre-test, 62.5% of children were in the moderate category, 20% in severe, and 17.5% in mild. In the post-test, although there was some improvement, only 37.5% reached mild level, 47.5% remained moderate, and 15% still continued in the severe category. This suggests that routine care alone was less effective in improving pulmonary function compared to the intervention. These findings are comparable with previous similar studies such as Allenidekania, Nurhaeni Nani, et al. (2021), where respiratory illness was mainly associated with post-pneumonia status and clinical condition rather than hereditary factors. Similar observations were noted in Kaur Parvinder, Shally, et al. (2017), where environmental and therapeutic factors were emphasized more than family history. Similar findings were reported by James Mary Jiss and S. Wilson Phebe Leana (2023) reported that the post-test Mean respiratory parameter score of the experimental group improved to 31 compared to 23.35 in the control group, with a statistically significant difference ($t = 4.21$, $p < 0.001$). This finding supports the present study results, where the majority of children in the experimental group shifted from moderate pulmonary dysfunction 31 (77.5%) during pre-test to mild pulmonary dysfunction 31 (77.5%) during post-test, while no child remained in the severe category after intervention. The findings are also supported by Mahalakshmi B, Chiragkumar Darji Deep, et al. (2025), who reported significant improvement in respiratory rate and oxygen saturation among children receiving balloon blowing exercises, with $p < 0.001$. Their study demonstrated that the intervention group showed greater respiratory improvement compared to the control group receiving routine care. Similarly, in the present study, the control group showed only minimal improvement, where 19 (47.5%) children remained in the moderate category and 6 (15%) continued in the severe category during post-test, indicating that routine care alone was less effective.

NURSING IMPLECATIONS

NURSING PRACTICE

Staff nurses working in pediatric wards should incorporate play-based pinwheel blowing exercise as a routine supportive therapy for children with LRTI, the intervention is simple, low-cost, and does not require specialized equipment, making it feasible in both hospital and community settings. The play-based approach enhances cooperation in children, thereby improving adherence to treatment. Creating a child-friendly and supportive environment during intervention can further enhance outcomes.

NURSING EDUCATION

Nursing curriculum should include training on play therapy and breathing exercises as part of pediatric nursing care. Students should be encouraged to use innovative, evidence-based, non-pharmacological interventions in clinical practice. Demonstrations and return demonstrations of pinwheel blowing exercise should be included in skill labs.

NURSING ADMINISTRATION

Hospital administrators should develop protocols to include breathing exercises like pinwheel blowing in standard pediatric respiratory care. In-service education programs and workshops should be organized to train nursing staff on the implementation of such interventions. Policies should promote the use of cost-effective and non-invasive interventions to improve quality of care.

NURSING RESEARCH

The study provides a foundation for further research on play-based interventions in pediatric respiratory conditions. Researchers can explore the effectiveness of similar techniques in different age groups and clinical conditions. Comparative studies can be conducted between pinwheel blowing and other breathing exercises like balloon blowing or pursed-lip breathing. Long-term studies can be undertaken to assess sustained effects on pulmonary function.

RECOMMENDATIONS

Similar studies can be conducted with a larger sample size to increase the reliability of findings. The study can be replicated in different hospital settings and community areas. Longitudinal studies can be carried out to assess long-term benefits of the intervention. Studies can be conducted to evaluate the psychological benefits such as reduction in anxiety and improvement in child cooperation. Development of structured guidelines or protocols for implementing play-based breathing exercises is recommended.

LIMITATIONS OF THE STUDY

The study was conducted on a relatively small sample size, which may limit the generalization of the findings to a larger population. The study was confined to a single hospital setting, which restricts the applicability of the results to other clinical or community settings. The duration of the intervention was short, and long-term effects of the pinwheel blowing exercise on pulmonary function were not assessed. The study included only selected age groups of children, limiting its applicability to all pediatric age categories. The level of cooperation and understanding among children might have influenced the effectiveness of the intervention. The study did not include follow-up assessment to evaluate the sustainability of the intervention outcomes. Possible observer bias and participant-related bias could not be completely eliminated.

CONCLUSION

There was a statistically significant difference noted in the mean level of pulmonary function between experimental group & control group among children with LRTIs. This shows that play-based pinwheel blowing exercise intervention is an effective intervention in improving level of pulmonary function among children with lower respiratory tract infections.

How to cite this article: Singh S., "Effectiveness of Play-Based Pinwheel Blowing Exercise on Pulmonary Function among Children with Lower Respiratory Tract Infection in a Selected Hospital of western Uttar Pradesh".

Source of support: Nil

Conflict of interest: None

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