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Research Article

Evaluating the Impact of Modified Play Activities versus Conventional Respiratory Exercises on Pulmonary Function in Female Children with Cerebral Palsy

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ABSTRACT

Introduction: Respiratory diseases are a common cause of morbidity and mortality in children with cerebral palsy (CP).

Method: Forty female children with CP participated in this study, selected based on specific inclusion and exclusion criteria. They were randomly divided into three groups: Group A (n = 14), which received conventional respiratory exercise; Group B (n = 13), which received modified play activities; and Group C (n = 13), which received conventional physiotherapy. Pulmonary function tests were conducted before and after the training to assess the effects of the interventions.

Result: The intra-group analysis showed that all three groups were effective in terms of improvement in the pulmonary function measured using the pulmonary function test ($p < 0.05$). Comparison of all the three groups by ANOVA test showed (FVC: $f = 2.212$, FEV1: $f = 0.493$, FEV1/FVC: $f = 0.013$, PEF: $f = 0.127$, $p > 0.05$) insignificant effect in pulmonary function.

Conclusion: This study showed that both methods were effective in improving pulmonary function. However, modified play activities were more feasible and engaging for female children with CP when compared to conventional respiratory exercise.

Keywords: Forced Expiratory Volume in 1 sec, Forced Vital Capacity, Peak Expiratory Flow, Cerebral Palsy

Introduction

Cerebral palsy (CP) is a group of permanent but not unchanging disorders that affect movement, posture, and motor function. These disorders result from non-progressive interference, lesions, or abnormalities in the developing or immature brain.[1-4] The worldwide incidence of CP is approximately 2 to 2.5 per 1000 live births. In India, the overall pooled prevalence of CP among children surveyed is 2.95 per 1000 (95% CI 2.03–3.88). Sub-group analysis across rural, urban, and mixed rural-urban populations showed pooled prevalence rates of 1.83 (95% CI 0.41–3.25), 2.29 (95% CI 1.43–3.16), and 4.37 (95% CI 2.24–6.51), respectively.[5] CP is one of the most common conditions that lead to disability in childhood. Respiratory diseases are a frequent cause of both mortality and morbidity in children with CP.[6] A cross-sectional survey of 551 participants aged 1 to 26 years found that 46% of individuals with CP reported experiencing respiratory symptoms, including wheezing, sneezing, coughing, regurgitation, and vomiting after meals.[7]

Respiratory illness in children with CP may be caused by multiple factors.[8] The motor deficits associated with it can reduce physical fitness, alter breathing mechanics, impair effective coughing, and lead to conditions such as scoliosis. Although these children do not typically have primary lung problems, the reduced strength of respiratory muscles due to neurological lesions can decrease thoracic cage compliance, cause ventilatory issues, and reduce airway clearance capacity. These factors can impair lung volumes and contribute to respiratory complications.[9] As reported by Kwon and Lee, pulmonary function tests revealed a significant difference in forced vital capacity (FVC) and forced expiratory volume in the first second (FEV1) between typically developing children and children with spastic CP.[10]

Developed countries are progressing rapidly in this area of pulmonary rehabilitation. In India, most rehabilitation focuses on neuromuscular and musculoskeletal rehabilitation like conventional physiotherapy, neurodevelopment therapy, proprioceptive neuromuscular facilitation, constrained induced movement therapy, etc when compared to pulmonary rehabilitation. Evidence for most respiratory interventions in young people with CP is absent or weak.[11] Conventionally this training is given in therapeutic settings in a few specialised rehabilitation centres since these kinds of facilities are not available in small towns and rural areas of India. The impact of CP on pulmonary function, particularly in female patients, is a topic of growing interest and significance. This study aims to compare the efficacy of conventional respiratory exercises with modified play activities on the pulmonary function of female children with CP.

Subjects and Methodology

Study Designs and Participants

The quasi-experimental study was conducted after getting approval from the National Institute for Empowerment of Persons with Multiple Disabilities (D), GoI, Chennai, Tamil Nadu, India. 6-16 years ambulating and non-ambulating female spastic CP children with functional communication and moderate IQ were included. Those who had cardiac and renal issues, used epileptic drugs, or had other associated disabilities were excluded. All the participants were screened by the other therapist blinded to this study based on above said inclusion and exclusion criteria. After providing written informed consent to the parents/ caregiver, 40 individuals participated in the treatment session at the Department of Physiotherapy, NIEPMD (D) Govt. of India, ECR, Muttukadu, Tamil Nadu, India. The recruited individuals were divided into three groups by simple randomisation – Group A (Experimental group 1 treated with respiratory exercise (n = 14)), Group B (Experimental group 2 treated with modified play activities (n = 13)), and Group C (Control group with no treatment (n = 13)).

Intervention

- **Group A:** The conventional respiratory group was explained and taught the general exercise along with diaphragmatic breathing, segmental breathing, pursed–lip breathing, thoracic wall mobilisation exercises, and shoulder–girdle mobilisation exercises. All children were made to sit or be in a lying position as comfortable. Exercises were given with an adequate rest period for each repetition in every session which was continued for twelve weeks, four days a week for 30 minutes. All precautionary measures were taken before, in between, and after the session to prevent giddiness or any other changes in the vitals.
- **Group B:** The modified play activities group received all the general exercises along with overhead ball throwing, ball–lifting and keeping down, ball receiving and passing, balloon blowing, candle blowing, blowing of thermal balls/ paper balls/ glitters, sucking with straw/ drinking water/ liquids with straw for 30 minutes with a proper rest period. There were no additional exercises given during this session. All the sessions were continued for 12 weeks four days a week.
- **Group C:** The control group was explained about the exercises to be done. General exercise was taught to the participants and was performed during the treatment session for a duration of 30 minutes. No other exercise had been given during the session for the patient in this group.

Outcome Measures

Pulmonary Function Test: Forced Vital Capacity (FVC), Forced expiratory volume – 1st second (FEV1), FEV1/FVC ratio and Peak Expiratory Flow (PEF)

Statistical Analysis

Statistical analysis was performed using SPSS version 20. Since the data did not meet the assumption of normality, the Wilcoxon signed-rank test and one-way ANOVA were employed. The Wilcoxon signed-rank test was used to assess the effect within each group—Experimental Group A (conventional respiratory group), Experimental Group B (modified play activities), and Group C (control group). A

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one-way ANOVA was applied to evaluate the effect between the three groups: Experimental Group A, Experimental Group B, and Group C.

Result

The Wilcoxon signed rank test (Table 1) result revealed that there was a statistically significant difference in pre- and post-test values of pulmonary function test within Group A (FVC: -2.858, p = 0.004; FEV1: -2.668, p = 0.008; FEV1/FVC: -2.731, p = 0.006; PEF: -2.605, p = 0.009) Group B (FVC: -3.181, p = 0.001; FEV1: -3.180, p = 0.001; FEV1/FVC: -3.181, p = 0.001; PEF: -2.937, p = 0.003) and Group C (FVC: -3.180, p = 0.001; FEV1: -3.181, p = 0.001; FEV1/FVC: -3.180, p = 0.001; PEF: -3.180, p = 0.001). One-way ANOVA test (Table 2, Figure 1) results revealed that there was no statistically significant difference between the groups (FVC: f = 2.212, p = 0.124; FEV1: f = 0.493, p = 0.615; FEV1/FVC: f = 0.013, p = 0.987; PEF: f = 0.127, p = 0.881).

Table 1.Comparison of Pre- and Post-Treatment Values of FVC, FEV1, FEV1/FVC, and PEF Within Group A, Group B and Group C Treated with Conventional Respiratory Exercise, Modified Play Activities and General Physiotherapy, Respectively

Group	Scale	Mean ± SD		z Value	p Value
		Pre-Test	Post-Test		
Group A (conventional respiratory exercise)	FVC	1.103 ± 0.86	1.394 ± 1.02	-2.858	0.004*
	FEV1	0.822 ± 0.59	1.242 ± 0.86	-2.668	0.008*
	FEV1/FVC	76.23 ± 30.9	89.44 ± 16.6	-2.731	0.006*
	PEF	1.482 ± 0.99	2.032 ± 1.05	-2.605	0.009*
Group B (modified play activities)	FVC	0.626 ± 0.35	1.212 ± 0.62	-3.181	0.001*
	FEV1	0.438 ± 0.27	1.022 ± 0.68	-3.180	0.001*
	FEV1/FVC	73.59 ± 26.5	85.78 ± 26.3	-3.181	0.001*
	PEF	2.200 ± 3.51	2.791 ± 3.66	-2.937	0.003*
Group C (general physiotherapy)	FVC	1.073 ± 0.53	1.560 ± 0.52	-3.180	0.001*
	FEV1	0.633 ± 0.47	1.213 ± 0.57	-3.181	0.001*
	FEV1/FVC	64.39 ± 33.1	77.17 ± 25.5	-3.180	0.001*
	PEF	1.510 ± 0.40	2.001 ± 0.49	-3.180	0.001*

p < 0.05* (Statistically significant), p > 0.05** (Statistically insignificant)
FVC: Forced Vital Capacity, FEV1: Forced Expiratory Volume in 1 sec, PEF: Peak Expiratory Flow

Table 2.Comparison of Pre- and Post-Treatment Values of FVC, FEV1, FEV1/FVC, and PEF between Group A, Group B, and Group C Treated with Conventional Respiratory Exercise, Modified Play Activities and General Physiotherapy, Respectively

Scale	Grouping	Mean Difference	Standard Error	Sig	f Value	p Value
FVC	A and B	0.29491	0.14333	0.113	2.212	0.124**
	A and C	0.19691	0.14333	0.365		
	B and C	0.09800	0.14596	0.781		
FEV1	A and B	0.16489	0.19032	0.665	0.493	0.615**
	A and C	0.16043	0.19032	0.679		
	B and C	0.00446	0.19381	1.000		
FEV1/FVC	A and B	1.02090	6.39472	0.986	0.013	0.987**
	A and C	0.43292	6.39472	0.997		
	B and C	0.58798	6.51206	0.996		
PEF	A and B	0.04030	0.19291	0.976	0.127	0.881**
	A and C	0.05832	0.19291	0.951		
	B and C	0.09862	0.19645	0.871		

p < 0.05* (Statistically significant), p > 0.05** (Statistically insignificant)
FVC: Forced Vital Capacity, FEV1: Forced Expiratory Volume in 1 sec, PEF: Peak Expiratory Flow

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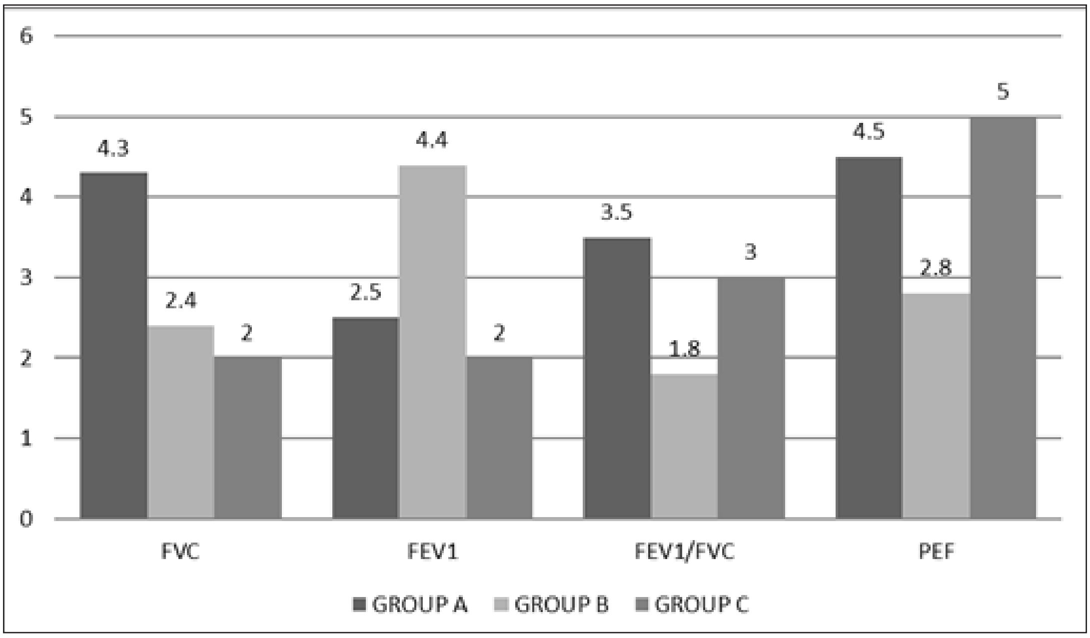

FVC: Forced Vital Capacity, FEV1: Forced Expiratory Volume in 1 sec, PEF: Peak Expiratory Flow

Figure 1.Comparison of Pre- and Post-Treatment Values of FVC, FEV1, FEV1/FVC, and PEF Between Group A, Group B And Group C Treated with Conventional Respiratory Exercise, Modified Play Activities and General Physiotherapy, Respectively

Discussion

In this study, 40 children with spastic CP were divided into three treatment groups: conventional respiratory exercise (Experimental Group 1; n = 14), modified play activities (Experimental Group 2; n = 13), and conventional physiotherapy (Control Group; n = 13). The objective was to determine which therapy most effectively improved pulmonary function in these children. Pulmonary function was assessed using FVC, FEV1, FEV1/FVC, and PEF. The pre- and post-test results showed significant improvements in pulmonary function in all three groups, indicating that each intervention was effective in improving respiratory function. However, there were no significant differences in FVC, FEV1, FEV1/FVC, and PEF values between the groups.

The contribution of this study will be significant for the children with CP because pulmonary function was less focused when compared to motor impairments by the therapist. Due to improper posture, reduced co-activation of thoracic muscles, and activation of diaphragm, their respiration was affected. The immature diaphragm leads to compromised FVC and FEV1 and delay in the timing of diaphragm contraction, maintenance of Maximum Inspiratory Pressure (MIP) was challenged, which leads to rapid and shallow breathing in the spastic CP. PEF and maximum expiratory pressure are also compromised due to irregular respiration periods with repetition affecting inspiration for a longer time.

Playing is a natural and essential activity in childhood, offering numerous opportunities for children with CP to enhance their motor skills. In this study, children showed interest and active participation in therapy sessions involving modified play activities. After 12 weeks of engaging in these modified play activities, significant improvements were observed in their pulmonary function, including FVC, FEV1, FEV1/FVC, and PEF, when compared to the control group. Peres et al., in their systematic review, emphasised that the inclusion of play-based activities in the treatment of children with CP, when used effectively, plays a crucial role in enhancing motor skills and strengthening the therapist-patient relationship, thus making the therapy more dynamic and effective.[12]

Similarly, after 12 weeks of conventional respiratory exercise therapy, the test result showed that there was a significant improvement in the FVC, FEV1, FEV1/FVC, and PEF values of the pulmonary function test when compared to the control group. Kim et al. showed significant improvement in thorax size and pulmonary function in the treatment group which is in combination with diaphragm resistance training and pursed lip breathing in the other group.[13] Other studies done on spinal cord injury patients showed improvements in respiratory muscle strength, endurance, breathlessness, cognition, FVC, and FEV1.[14,15]

Previous studies have been done on pulmonary function using conventional respiratory exercise, and costly

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biofeedback equipment. We have compared the modified play activities with conventional respiratory exercise to improve pulmonary function. Modified play activities are one of the easy and motivated methods of training for children with CP. From this study, it is clear that modified play activities will improve pulmonary function in homes, and schools without professional supervisors and without any special equipment and infrastructure to perform these activities. The study has several limitations such as a small sample size, inclusion of only female children, and lack of follow-up assessment.

Conclusion

This study was done to compare the difference between the effects of respiratory exercise versus modified play activities in improving pulmonary function among female CP children. The results revealed that the pre-post-test values of the pulmonary function test of respiratory exercise and modified play activities showed significant differences within the groups and no significant effect between the groups trained with respiratory exercise, modified play activities, and general exercise. So, all three exercises were equally effective and were not superior to one another. Even though pulmonary function was improved in all the groups, it was found that modified play activities were more feasible and engaging for female children with CP when compared to conventional respiratory exercise which requires structured setup and supervision.

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Conflict of Interest: None

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