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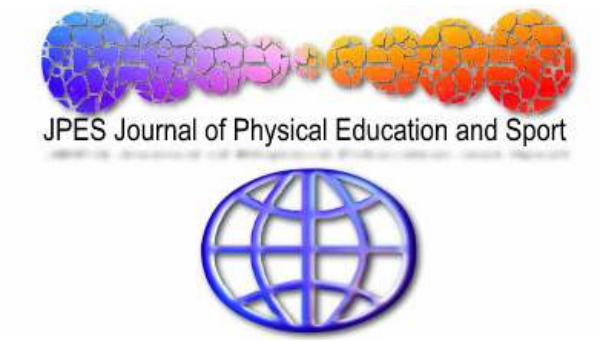

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ORIGINAL RESEARCH

THE EFFECT OF A 12-WEEK PHYSIOTHERAPY PROGRAM WITH RESPIRATORY EXERCISES ON THE VITAL CAPACITY AND FORCED VITAL CAPACITY IN ADULT MALES AND FEMALES WITH CEREBRAL PALSY

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The purpose of this study was to determine if breathing exercises can improve specific respiratory parameters in adult males and females with cerebral palsy. 18 adults (11males/7 females) with spastic cerebral palsy consisted the experimental group and 18 (11males/7 females) serving as control group took part in the study. A spirometer was used to measure vital capacity (VC) and the forced vital capacity (FVC) before and after the exercising protocol. The breathing exercises selected, emphasized strengthening of the muscles of inspiration and the muscles of expiration. The study revealed that a breathing exercise program can increase the VC and FVC in people with cerebral palsy. The pre-test and post-test examined variables of both groups were within normal limits The VC of the experimental group was increased by 0.20 litres and this of FVC increased by 0,25 litres after exercising for five to seven minutes each day for a period of twelve weeks. The mean increase of the VC and FVC was 6% and 7% respectively over the baseline values. The control group showed no change in VC neither in FVC. The results support application and development of the treatment concept with respiratory exercises and highlight that physical activity at its simple status can improve function and quality of life in adults with cerebral palsy when added to standard care.

Key words: celebral palsy, vital capacity, respiratory exercises

INTRODUCTION

Cerebral palsy (CP) is a "group of no progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising early in development" (1). It occurs 2–2.5 times per 1000 live births (2). Describes a group of disorders that affect the development of movement and posture, causing activity limitation and in some occasions respiratory problems (3). Adults with CP have distinctly subnormal aerobic and anaerobic capacity in comparison with typically developing peers (4,5,6). Studies of the effects of

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lower limb exercises in young population with CP have demonstrated an increase in aerobic capacity (7). We, therefore, decided to perform a therapeutic program in a group of well- defined adult patients with CP. The hypothesis is that there are changes in respiratory parameters such as vital capacity (VC) and forced vital capacity (FVC) after this program in this category of patients. It is already well known, from basic research and clinical studies that physiotherapy may be effective in improving many respiratory deficits in CP (8,9). However, there are few studies measuring VC and FVC in adult people with CP after an intervention program. The aim of this randomized controlled study was to evaluate the effects of a 12-week low-impact physiotherapy program in respiratory muscles, on respiratory parameters in patients with CP. The program was home based to achieve maximum compliance and consisted of site-specific low-impact exercises.

METHODS

Patients and controls

Eighteen patients (seven women and eleven men) with traumatic tetraplegia were chosen. They all voluntarily consented to participate in the study. The criteria of participants in this study included people with kinetics and respiratory mainly disorders as tetraplegia can promote. In addition, 18 sex and age matched (7 women and 11 men) healthy adult controls, randomly selected from the regional population register of the same geographical area were also included. All subjects were required to sign an informed consent document approved by the Aristotle University of Thessaloniki. The age of the cerebral palsy (CP) patients was 30.5± 6 years (mean± SD) and of the controls 28.2± 2.5 years.

All participants were living independently in their own homes, without any difference in civil status between patients and controls. The inclusion criteria for the study were the following: diagnosis of CP within 3 years of study participation, 18 years of age or older, medical clearance from the primary care physician to participate in an exercise program and ability to walk. Potential participants were excluded if there were physician-determined major medical problems such as cardiac dysfunction, musculoskeletal impairments or excessive pain in any joint, depression, gastrointestinal or endocrine disease, and if they had insufficient endurance to participate in exercise program 3 times a week for at least 30-minute session. The criteria were the same for the CP patients and the controls, with the exception of CP symptoms.

Procedures

All subjects with CP (18) completed the intervention program which lasted 12weeks. Two patients with CP were excluded from the study after randomization. Both of them stopped the program due to personal reasons. So, people who participate finally to the intervention program were 18 from 20.

The emphasis of the exercise program was to dynamically load respiratory muscles and muscles of diaphragm using low-impact exercises. At baseline, subjects in the exercise group attended a series of induction meetings during which the correct exercise techniques were demonstrated and a supporting resource package was provided.

Each exercise session involved a 5-minute warm-up consisting of general whole body pulse-raising and mobility-promoting activities, followed by preparatory stretching of muscles being worked during the main session. A 5-minute period of pulse-lowering activity and stretching was performed after the exercises were completed. The main section of the program was comprised of 8 to 10 low-impact exercises. Exercises were focused on muscles of diaphragm and inspirations muscles and asking from patients to execute specific breathing techniques. Subjects were asked to exercise at least twice a week, with a minimum of 10 sessions per month considered necessary for full compliance. Additional meetings were held at 4^{th} and 8^{th} 9 week to provide motivation and support for exercising individuals and to supervise the increase in training intensity. Intensity of exercise was increased by developing the core exercises, increasing the number of repetitions of each exercise and advancing body positions to increase resistance to movement (lever principles). The program was intentionally flexible to allow individuals of different fitness levels to reach an exercise overload effect.

Subjects in all groups were allowed to continue their customary exercise routines. They were asked, however, not to change their exercise routines. Below, is depicted the main physiotherapist with a CP patient during the application of respiratory exercises.

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Picture 1. Application of respiratory exercises into a CP patient during the 12-week physiotherapy program.

Data collection

Data were collected before intervention and immediately after completion of exercise physiotherapy program. Subjects began exercise within 1 to 2 weeks after the baseline assessment. All subjects took their customary medications at the same time relative to each assessment.

Assessments

Vital capacity and forced vital capacity

Spiro metric tests were performed using a precision calibrated 10l spirometer (Collins Survey, Braintree, MS, USA). Predicted normal values for forced vital capacity (FVC) and vital capacity (VC) were those of Knudson et al. (4). Values were recorded in l/min.Three trials were recorded with a rest of 1 minute between both in VC and FVC. The average value of these three trials of each person was selected for further analysis. The examined parameters were measured at baseline and after 12 weeks of the respiratory protocol. All measurements were performed by a single trained operator.

Body weight and height

Body weight was assessed in all participants before and after the intervention program, when lightly dressed and without shoes, using a calibrated analogue scale. The assessments were made in the morning. The participant's height was assessed when they were in a standing position without shoes.

Table 1. Characteristics of Celebral Palsy (CP) patients and control group.

	CP	**Controls**
Characteristics		
Patients	18	18
Sex(male/female)	11/7	11/7
Age (years)	30.5± 6	28.2± 2.5
Body weight (kg)	70.6± 12.5	67.9± 10.7
Height (cm)	172± 10.6	171.8± 9.3

Statistical analysis

The results are presented as mean and standard deviation (mean± SD). Changes during the 12 weeks were calculated and compared between groups using Student's unpaired *t* tests with 95% confidence intervals (CIs). The Mann–Whitney *U* test was used when the data were not normally distributed. Two-tailed significance tests were used in all the statistical analysis. The Statistical Package for Social Sciences (SPSS 16 Inc., Chicago, IL) was used for the analysis.

RESULTS

Vital Capacity, Forced Vital Capacity (litres/min)

The VC and FVC was almost the same at baseline both in CP patients and control group. In contrast, VC increased from baseline to the last visit in the case of CP patients ($p<0.001$) but this did not occur in control group. The same was surprisingly found for FVC for the two groups ($p<0.05$, ns respectively). Generally, both

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respiratory parameters such as VC and FVC were increased in the CP population as a result of the intervention program about 7% but this did not occurred for their age matched control counterparts. All the available data are presented below in table 2.

Table 2. Vital capacity (VC) and forced vital capacity (FVC) in patients with CP and in controls at the two investigated periods.

Variable	Baseline	After			Baseline	After		
	CP n=18, mean ± SD		***p***	***%Diff***	**Controls n=18, mean ± SD**		***p***	***%Diff***
Vital capacity (l/min)	3.56±0.88	3.78±0.8	<0.01 ***	+6	3.33±0.47	3.39±0.46	ns	+1.7
Forced vital capacity (l/min)	3.59±0.47	3.84±0.72	<0.05 *	+7	3.76±0.4	3.73±0.37	ns	-0.5

NOTE. At baseline there were no significant differences between the two groups. Results are presented as mean (SD). Each value expresses the average value of the three (3) trials to each examined variable.

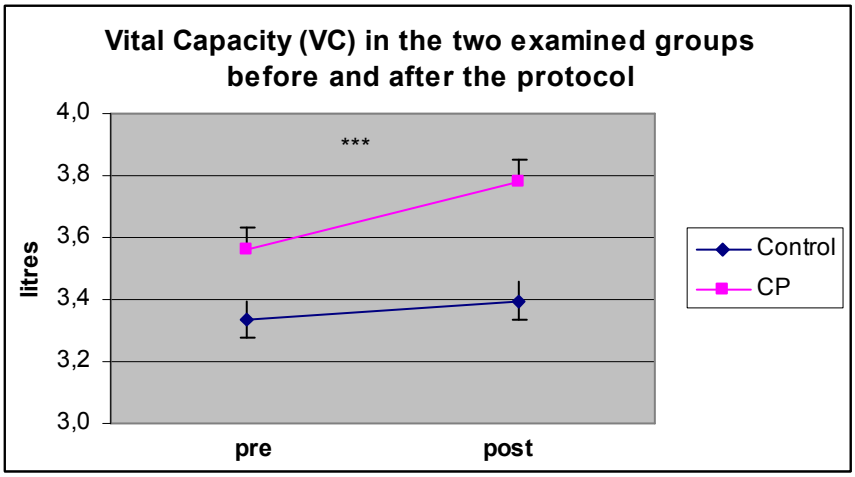

Figure 1. Vital capacity (litres/min) before and after the respiratory exercising protocol in the two groups.

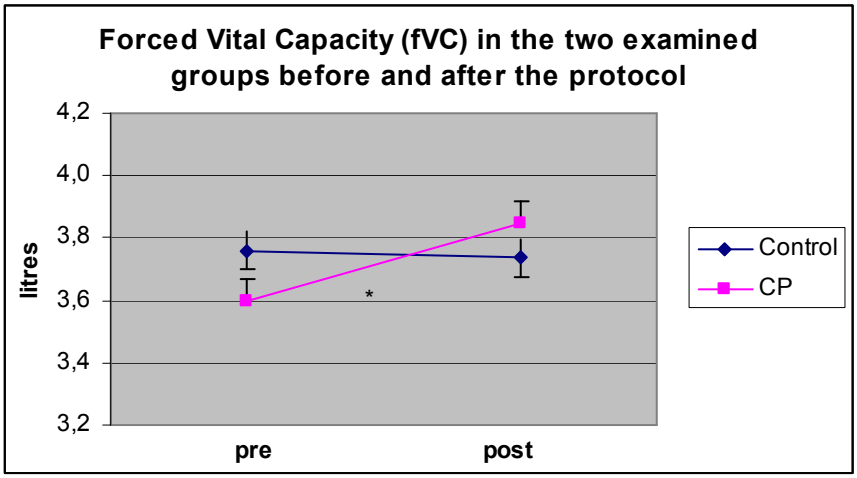

Figure 2. Forced vital capacity (litres/min) before and after the respiratory exercising protocol in the two groups.

DISCUSSION

The limitation of the current study is the relatively small number of CP patients. On the other hand, there is a well-matched design for age and group and in addition to this all participants were investigated by the

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same team and by well-defined instructions. We measured respiratory parameters of both groups before and after a 12-week physiotherapy program. Significant increments (6-7% respectively) of these two parameters as a result of intervention program were found in CP patients compared with age matched controls. Our results show that a 12-week low-impact exercise program may have a positive effect on VC and FVC in patients with CP.

Interventions attempting to strengthen respiratory muscles include incentive spirometry, positive pressure trainers (10-12). Among the different respiratory training devices or modes, physiotherapy is relatively inexpensive, simple, effective, and appropriate for home training. The optimum frequency and type of exercise required to increase respiratory parameters has not yet been established, but in a tetraplegia group have been reported improvements of maximal and sustainable inspiratory pressure after 8 weeks of treatment and respiratory exercises (13). In a same study, Gross et al. (14) reported that inspiratory muscle strength training program on a daily basis can increase significantly many respiratory parameters in chronic tetraplegic patients. This could happen not due to the training program and its effect but rather as a result of different adjustments and modifications in the inspiration-expiration strategy of patients.

However, a low-impact program was chosen for our study because it could be performed readily at home without special equipment or supervision and was unlikely to lead to training injuries or fracture in our patients. The exercises were site specific for muscles of diaphragm. In view of our results, we conclude that prescription of a low-impact exercise program is feasible in patients with cerebral palsy at its slight level and is a potentially effective method of increasing vital capacity. The exercises were simple to perform by people of varying levels of fitness and required only minimal instruction, supervision, and monitoring. Future studies should address methods of increasing uptake and compliance with exercise in this high-risk group and study the effect of more intense modes of exercise training along with evaluation of their aerobic-anaerobic levels.

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