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Original Article

Evaluation of cardiorespiratory state in patients with cerebral palsy

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Abstract

Aim: The objective of this study is to compare the cardiorespiratory state of individuals with hemiparetic cerebral palsy and healthy individuals.

Material and Methods: The demographic information of 40 individuals were evaluated. Then their body mass index and frequency and duration of physiotherapy were questioned. Gross motor skill levels with the Gross Motor Classification System (GMCS), flexibility with the sit and reach test, cardiorespiratory endurance with the 6-minute walking test and independence in daily life activities with the WeeFIM survey were evaluated. Oxygen saturation, respiration frequency and heart rate were recorded before and after evaluation.

Results: 20 individuals with hemiparetic cerebral palsy (%55 female, %45 male) (with an age average of 9.7± 1.94) and 20 individuals as the control group (%65 female, %35 male) (with an age average of 9.1± 1.83) were included in the study. According to the six-minute test analysis, no important variety was observed between the two groups in terms with regard oxygen saturation, respiration frequency and heart rate parameters prior to and after the test (p>0.05). A statistically significant difference was observed between the patient and control groups in terms of walking distance (p=0.001) and the WeeFIM total score (p= 0.001) and flexibility test (p=0.001).

Conclusion: Remarkably, walking distance, WeeFIM total score and flexibility test in patients with cerebral palsy can give an idea about prognosis and the adverse effects of disease in early period on patients' physical, psychological and social development.

Keywords: Cerebral Palsy; 6 Minute Walking; Weefim; GMFCS; Flexibility.

INTRODUCTION

Cerebral Palsy (CP) is a developmental and motor disability involving the cerebrum, cerebellum and brain stem and is caused by the damage received by the upper motor neurons (UMN) which initiate the voluntary motor movement in the brain cortex (1). Although motor function disorder is distinct, sensory, cognitive, communication, behavior and perception problems, secondary muscle-skeletal system disorders and epilepsy also accompany this state. These disorders affect how much energy is spent even in a person's daily life in terms of cardiorespiratory state (2).

CP is an important public health problem that in terms of adversely affects the quality of life of child and their family and also it is the commonest motor development disorders of child. The ethiology of CP should be considered that it can be occur by everything damaging on the developing brain. The CP etiology is variable and multifactorial which they are hypoxic-anoxic situationduring the birth, congenital, genetic, infectious, and metabolic and trauma. The brain injury can be occurred prenatal, natal or postnatal. The CP types are monoplegia, diplegia, quadriplegia and hemiplegia.

Risk factors for CP etiology are premature and small gestational age and also maternal factors that multiple pregnancy and maternal genitourinary infections.

In literature, there are very few studies which evaluate the cardiorespiratory state of individuals with CP. This is in particular important because of the decrease of oxygen level in blood, causing a decrease in the respiratory skill and affecting general health. When seen from a

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functional perspective, children with Cerebral Palsy have difficulty in doing purposeful voluntary active physical movements. Abnormal muscle activation, weak motor control, spasticity, weakness, contractures, involuntary movements and lack of equilibrium are caused this problem. These disorders can limit a child's playing games and doing exercises required to develop cardiorespiratory fitness level. Tiredness which is caused by using a majority of the energy sources during physical activity is frequently seen in individuals with CP (3-7). Locomotive energy demand may increase with age in children with hemiparetic CP (8). This affects the walking and cardiovascular state when entering adolescence and adulthood. In adult patients with CP, Physical activities decrease with age and due to a much speedier decrease in the physical fitness levels caused by CP compared to people who are the same age, numerous problems are experienced such as strokes, heart diseases, diabetes and high blood pressure (9). Low physical activity is observed in the world and its effects are observed in every age and situation. For instance, children with CP join in significantly lower levels of physical activity than their peers, and this situation less than the textbook. Low bone density, cardiovascular pathology and metabolic diseases are seen more because of the long-term effectiveness of inactivity (10).

Physical activity is significantly related to cardiorespiratory situation. According to literature central obesity, elevated BMI and high blood pressure are seen in young people with CP who have poor cardiorespiratory fitness (10,11).

Therefore, our study was designed to analyze the effects of the motor development level and functional level of children with CP on the cardiorespiratory state and compare the results with healthy children.

MATERIAL and METHODS

Tweenty voluntary patients with hemiparetic cerebral palsy aged 7-15 in 2016-2017 were included in the study. 20 volunteer healthy individuals were included in the study (ethics of the researcher: 2017/139) between the ages of 7-15 who attended primary and secondary schools for the control group. Inclusion criteria were: Patients who are level 1 and 2 according to the Gross Motor Function Classification System (GMFCS), with no sight and hearing loss and no mental retardation which prevents communication with them (with medium-good mental capacity according to the handicapped board health report and who go on the special education and rehabilitation center, diagnosed with hemiparetic CP and can walk and healthy voluntary individuals whose ages have been matched.

Individuals who have lower extremity fracture in the past 6 years or have had orthopedic surgery, have been subject to any pharmacological agent which inhibits spasticity, have mental retardation, cannot walk were not included in the study.

The parameters evaluated are as follows

1. Patient history
2. Body mass index (BMI)
3. Circumference measurements (arms, forearms, legs, waist, abdomen, head)
4. Respiration evaluation (respiration type, respiration frequency, heart rate, oxygen saturation)
5. Classification of gross motor function (GMFCS)
6. Cardiovascular function and endurance (6-minute walking test, heart rate, respiration frequency, oxygen saturation)
7. Functional Independence Measure for Children (WeeFIM)
8. Flexibility evaluation (sit and reach test)
9. Hand Grip Strength right hand (R) and left hand (L) (Jamar Hand Dynamometer)

The history of the patients were recorded separately for prenatal, natal and postnatal periods.

The circumference measurements were recorded with the purpose of evaluating the situation of the affected area compared to the unaffected side. The circumference measurements are measurements taken with a measuring tape in the Standard anatomical areas of the body. The arm, forearm, leg, waist, abdomen and head measurements were recorded. Head measured over occipital protrusion and eyebrows, arm measured from the widest part of biceps, forearm measured from the widest area of the forearm, abdominal (waist) measured in the direction of umbilicus, standing in the subcostal area, with the arms on the side, calf measured from the widest part of the gastrocnemius.

For the respiration evaluation, the number of a person's inhaling and exhaling in 1 minute and respiration frequency were recorded. The ideal is 16-22 per minute in children.

The sit and reach test was used to assess the flexibility. The child who was placed on the floor in the sitting position was asked to put his legs together touching the table and bend his body forward and reach ahead as much as possible. Then the measurement was taken with a ruler (12).

Hand grip strength measurement was done for the right and left hand with the Jamar hand dynamometer. The measurement was done in the sitting position, in the shoulder adduction and neutral rotation, elbow 900 flexion, forearm rotation and with support while the wrist was in a neutral position. One minute rest was given between each measurement and the averages of the 3 measurements were recorded (13).

The Gross Motor Function Classification System (GMFCS): It evaluates the functional level of young people with CP. It is divided into five levels based on gross motor functions such as prone position, sitting down and walking which begin on their own in children with CP who are younger than 12 years of age. The children's functional level was determined in line with this measurement (14).

The cardiorespiratory endurance was evaluated with the 6 min-walking test (6MWT). This is a submaximal, indirect cardiovascular physical fitness test and is used for endurance and physical fitness in children. The patient is made to walk on a 30-meter straight corridor as fast as he can but without running in the test. Then the walking distance is measured. The patient should not change his tempo and pace during the test. In this evaluation, oxygen saturation, respiration frequency, heart rate, respiration frequency were recorded. The evaluations repeated 3 times, before the test, after the test completed, and 5 minutes later the test finished (15).

WeeFIM scale was used to evaluate the children's locomotion and mobility skills. WeeFIM survey has Turkish validity and reliability. WeeFIM consists of a total of 18 items in 6 areas as communication, social cognition, self-care, sphincter control, locomotion, transfers (16).

Statistical Analysis

The data was entered in the SPSS 20.00 program. The relationship status was checked with the Mann- Whitney U test and the significance state was determined according to $p<0.05$. Mean and standard deviation of the data was checked.

RESULTS

The study consisted of 20 (55% female, 45% male) individuals with hemiparetic CP (age mean 9.7±1.94 years) and 20 (65% female, 35% male) individuals in the control group (age mean 9.1±1.83 years). The demographic information about the participants is given in Table 1. There was a significant difference in 6 minute walking test distance (p=0.001), sit and reach flexibility test (p=0.001, and the WeeFIM total, motor and cognitive scores (p=0.001) between control and hemiparetic CP groups. We found no statistical difference in hand grasp strength (right/left) between groups (p>0.05) (Table 2).

Table 1. Demographic characteristics

Parameters		Hemiparetic group		Control group	
		Min-max	X±SD	Min-max	X±SD
Age		7-14	9.7± 1.94	7-14	9.1± 1.83
BMI		13.3-25.4	18.59±2.69	13.7-25.4	19±3.86
		N	%	n	%
Gender	Female	11	55	13	65
	Male	9	45	7	35
Etiology	Prenatal	5	25	0	0
	Natal	9	45	0	0
	Postnatal	6	30	0	0
Parents Relative	Yes	9	45	0	0
	No	11	55	20	100
Premature birth	Yes	5	25	0	0
	No	15	75	20	100

Table 2. Comparison of Cardiorespiratory Tests

	Hemiparetic CP group X±SD	Control group X±SD	Z	p
6 minute walking distance	356.15±64.80	476.15±102.47	-3.20	0.001*
Sit and reach flexibility test	-4.80±6.83	7.05±2.58	-4.96	0.001*
Hand grasp strength R/L	22.30±7.60/ 25.0±9.36	21.25±5.45/ 21.45±5.46	-0.68 -1.53	0.49 0.12
WeeFIM total score	108.1±11.89	125.95±0.22	-5.48	0.001*
WeeFIM motor score	77.8±8.58	91.00±0.00	-4.47	0.001*
WeeFIM cognitive sub-score	30.35±5.29	35.00±0.00	-4.44	0.001*

Mann Whitney test *:p<0.05, WeeFIM: Functional Independence Measure for Children

The presents study was conducted to research the cardiorespiratory results in hemiparetic CP and we found there was a significant difference in 6-minute walking test distance, sit and reach flexibility test and the WeeFIM total, motor and cognitive scores between control and hemiparetic CP groups. Depending on its etiology, socially, mentally and spiritually development changes were seen in various stages of life. Developments always take place later compared to healthy children. In individuals diagnosed with hemiparetic cerebral palsy, since one side of the body is affected, the walking function in general is acquired later compared to healthy people. In addition, with the physical limitation of the child, the lifelong treatment isolates the child from his family and the society and affects his psychosocial development and daily life activities (17-19).

In the studies conducted in the recent years, it has been discovered that the unaffected side of the body children with hemiparetic CP is not healthy either and that in right/left hemiparetic children there are cognitive, functional, mental differences. The individuals in our study are in childhood and adolescence periods. The goal of our study is to assess the cardiorespiratory state of the individuals in the same age group and determine how this is reflected in individuals who regularly have physiotherapy (20). In Fowler et al.'s study (2007), it is stated that there are very few studies which evaluate the cardiorespiratory state in patients with CP and that low cardiorespiratory state is caused by decreased peak VO2 and the amount of energy spent during submaximal walking being high. Although the hemiparetic individuals in our study had good functional levels, compared to healthy individuals it has been observed that their 6-minute walking distance is low and their flexibility is less as stated by Fowler et al. as well (21). In addition, the low cardiorespiratory state affects the general health of children. In our study, in the WeeFIM

survey in which we evaluated in particular functional independence, significant differences were found in both groups and a meaningful relationship was found between PT duration, life quality and flexibility.

Ryan et al. (2015), in their study in which they analyzed the relationship between life, physical activity, blood pressure and anthropometric measurement in children diagnosed with CP and cardiovascular fitness, have carried out the study with GMFCS level 1 and 2. They have underlined that BMI, blood pressure, cardiovascular endurance (shuttle run) and GMFCS level have a relationship which is inversely proportional (22,23).

Garcia et al. (2016) in their study in which they analyzed 40 individuals with CP (GMFCS1 and 2) and 40 healthy individuals in terms of cardiorespiratory state and neuromuscular fitness parameters, they have underlined that children with CP display a lower performance in terms of the cardiorespiratory state. In addition, their finding that heart rate being similar to healthy individuals' heart rate prior to the 6-minute walking test and resting state is similar to the finding of our study. The result that there is a statistical significance in the sit and reach test between individuals with hemiparetic CP and the control group supports our study (24).

The decrease in the upper extremity muscle strength limits the daily life activities because it is stated that hand grip strength affects the use of both hands in children with CP. Hand strength measurement is important since it, in particular, affects daily life (25,26). We evaluated right and left-hand grasp strength and contrary to literature no statistically significant between groups were found in our study.

Wong et al. (2004) in their study in which they evaluated the risk factors which affect the functional state, have evaluated the functional, emotional and mobility parameters of 73 cerebral children with WeeFIM. They stated that the functional state of children with CP depends on the intensity and existence of epilepsy and despite various disorders and difference in GMFCS levels; they were able to measure the children's functional independence with WeeFIM. In our study, independence in daily life activities was measured with WeeFIM and a statistically significant difference was found in the two groups (27).

One of the limitations of our study is that it involves a wide age range like the 7-15 age group and consists of both children and adolescents. However, there are very few studies which involve hemiparetic individuals whose physical condition is good in literature and this shows the efficiency of our study and its contribution to literature.

CONCLUSION

As a result, CP has an effect on cardiorespiratory state and these problems prevent children from developing physically, mentally and socially and lower their quality of life, Therefore, more studies are needed on this subject and families need to be informed about aerobic training.

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