SOMATOTYPE PROFILES AND CHANGES DEPENDING ON TREADMILL EXERCISE IN CHILDREN WITH CEREBRAL PALSY

Nazmi SARITAŞ[1]

Hanife ABAKAY[2]

Mustafa KARAKUŞ[1]

Betül COŞKUN[3]

ABSTRACT

Objective. The postponement of the brain development as a result of brain lesion causes some functional inabilities affecting the whole body of the children with cerebral palsy compared to their peers. In this study, it was aimed to investigate the effects of the treadmill exercise on somatotype profiles and some variables in disabled children diagnosed with cerebral palsy.

Methods. The subjects of the study were 37 children with cerebral palsy whose ages range from 7 to 15 and they were taking regular physical therapy in a private education and rehabilitation center. The experimental group and the control group consists of 20 children (8 girls and 12 boys) and 17 children (10 girls and 7 boys), respectively.

The subjects of the experimental group were performed treadmill exercise under the supervision of a physical therapist twice a week for three months (totally 24 walking exercises) while their treatments in the center were continuing. The initial and final speeds, duration of the exercise, the distance covered and the calories burnt were recorded and the somatotypical characteristics of the subjects were evaluated before and after the study.

Results. It was encountered that the initial and final pace of the exercise, the duration of the use of the treadmill, the distance covered and the calories burnt increased significantly. No remarkable changes in the pulse rates were determined before and after the exercise. During the comparison of the experimental and control groups before and after the exercise, some noteworthy variations in ectomorphy and ponderal index were confirmed after the exercise even though no considerable differences in mesomorphy, endomorphy and body fat percentage were determined.

Conclusion. We are of the opinion that the treadmill exercise will positively affect the pace of the exercise, the distance covered, the calories burnt by the children with cerebral palsy, moving more freely, controlled walking and body type.

Key words: cerebral palsy, exercise, somatotype

TREADMİL EGZERSİZİ YAPTIRILAN SEREBRAL PALSİLİ ÇOCUKLARDA SOMATOTİP PROFİLLER VE EGZERSİZE BAĞLI DEĞİŞİKLİKLER

ÖZET

Amaç. Serebral palsili çocuklarda oluşan beyin lezyonu sonucu beyin gelişiminin geri kalması yaşıtlarına oranla tüm vücudu etkileyen fonksiyonel bir yetersizliğe neden olmaktadır. Bu çalışmada serebralpalsi tanısı konmuş engelli çocuklarda treadmil egzersizinin somatotip profiller ve bazı değişkenler üzerine etkisini araştırmak amaçlandı.

Metod. Çalışmaya özel eğitim ve rehabilitasyon merkezinde düzenli fizik tedavi görmekte olan yaşları 7–15 arasında değişen toplam 37 serebral palsili çocuk yer aldı. Deney grubu 20 (8 kız 12 erkek), kontrol grubunda 17 (10 kız, 7 erkek) çocuk yer almıştır. Rehabilitasyon merkezinde fizik tedavileri devam ederken, deney grubundaki çocuklara fizik tedavi uzmanı eşliğinde ekstra tredmilde, haftada 2, üç ay süreyle toplamda 24 kez yürüyüş egzersizi yaptırıldı. Egzersiz başlangıç ve son hızları, egzersiz süresi, mesafe ve tüketilen kalori değerleri ölçüldü. Çalışma öncesi ve sonrası çocukların somatotip özellikleri değerlendirildi.

Bulgular. Egzersize başlangıç ve sonu hızları, tredmildeki egzersiz süresi, mesafe ve tüketilen kalori miktarlarında istatistiksel olarak anlamlı artışlar meydana geldi. Egzersiz başlangıcı ve sonu nabız değerlerinde ise anlamlı farklılıklar bulunmamıştır. Deney ve kontrol gruplarının egzersiz öncesi ve sonrası gruplar arası karşılaştırmada mezomorfi, endomorfi ve vücut yağ yüzdelerinde anlamlı farklılık bulunmazken, egzersiz sonrası ektomorfi ve Ponderal index değerlerinde anlamlı farklılık tespit edildi.

Sonuç. Serebral palsili çocuklarda treadmil egzersizinin; egzersiz hızlarında, yürüme mesafesinin uzamasında, egzersize bağlı kalori harcamasında, daha rahat hareket ve kontrollü yürümeye vücut tiplerinin olumlu yönde düzeleceğine yardımcı olacağı düşüncesindeyiz.

Anahtar kelimeler: Serebral palsi, egzersiz, somatotip

[1] Erciyes University, Physical Education and Sports College, Kayseri-Turkey
[2] Private Melikgazi Special Education and Rehabilitation Center, Kayseri-Turkey
[3] Department of Physical Education and Sport, Middle East Technical University, Ankara-Turkey

INTRODUCTION

Cerebral Palsy, which is the most common reason of the physical impairment in pediatric age group, is a movement and posture defect that cause the non-progressive injury of the undeveloped brain. (Stempien and Gaebler-Spira, 1996; Pellegrino and Dormanns 1998; Kuban and Leviton, 1994; Deluca, 1996; Molnar 1991), yet clinical picture can change eventually, for example, spasticity or involuntary movement takes place later of the location of hypotony in the beginning (Stempien and Gaebler-Spira, 1996). Not only movement and posture defect can create the basic clinical picture to children with cerebral palsy, but also mental retardation, seizures, asterognosia proprioception and hearing disorders take part in the clinical picture (Pellegrino and Dormanns, 1998). In that case, rehabilitation period and also gaining physical independence may be more difficult. In the body, influencing the different systems in the same time requires the multi-disciplinary supervision of children with the cerebral palsy. Because of lesion in the brain, unsuppressing the primitive reflexes in children with cerebral palsy, and that's why delaying of the front of postural and protecting reflexes's development prevents child's expected motor development for his/her age. Muscle weakness, disorders of body and balanced reaction prevent to control the movement, and cause balance disorders (Yalçın et al., 2000). That the child with CP could not realize the normal development steps compared to a normal child's steps respectively, for example; that sitting, turning and crawling activities could not be done in the early stage, presence of hypotonus or hypertonus, and walking late, failing to walk and give the accurate weight of body to the hands and feet, affect the child's skeleton development, and decelerate negatively (Robert et al., 1994; Gilbert et al., 2004; Samson-Fang and Stevenson, 1998; King et al., 2003; Bishop, 2005).

Aerobic exercises play a crucial role for child's growing, maturement, cognitive enhancement and socializing. Lots of work states advantages of exercise in children and adolescents. Aerobic exercises are frequently suggested to support bone development and healthy growth in adolescents. (Brooke-Wavell and Stensel, 2008). It is stated that especially endurance exercises have no effect to the age of 10. It is stated that exercises performed in puberty and adolescent periods, in which growing up is fast, are more efficient for children (Rowland et al., 1997).

Somatotype is a description for body's morphological structure. It is a determination of the relationship between muscularity, fatness and weakness with scientific methods (Özer, 1993). Somatotype evaluations determined based on the physical features are revealed by the help of anthropometric measurements (Tamer, 2000).

During the contraction of heart muscle, the period of pumping blood outside from the heart is called "systole". This period is the highest level of blood pressure time. This pressure is called "systolic blood pressure" (Sevim, 2002). When the heart is full of blood, the pressure is the lowest and this period is called "diastole", and this is called "diastolic blood pressure". The difference between systolic and diastolic blood pressure is called "pulse pressure". The changes in pulse pressure state the pressure of the exercises and position of body changes on the cardiovascular system (Tamer, 2000).

Treadmill is a device used frequently on the mechanics for training and test-purpose, in addition, used in the rehabilitation practices (Alton et al., 1998). This device enables to see extensive severe movement, and to do kinematical

analysis (Alton et al., 1998). Treadmill can be used with the aim of rehabilitation for the patients who have low levels of physical fitness (Mark et al., 1987; Barbeau et al., 1999; Hesse et al., 1999). Especially, for the people having gait disorder, treadmill is useful device to straighten these gait disorder (Colombo et al., 2000; Kosak and Reding, 2000; Barbeau et al., 2006).

This work was done to examine the effects of exercise on some parameters related to exercise and somatotype in children with cerebral palsy who was doing treadmill exercise.

MATERIAL AND METHOD

Eight boys, 12 girls approximately 20 children between the ages of 7 and 15 who receive a treatment in a private education and rehabilitation center regularly and diagnosed cerebral palsy at the level of 1-4 according to the GMFCS were selected as experiment group for this study. In the control group, there are 17 children (10 girls and 7 boys). While the children in each group are doing stretching on especially contracted muscles with physiatrist in the rehabilitation center twice a week 45 minutes also rehabilitation program included strengthening exercises to their weak muscle groups, walking education in plain and different floor, and balance exercises were conducted. In addition, children in the test group performed the treadmill exercises twice a week for 3 months, approximately 24 treadmill exercises, with the physiatrist. In the treadmill, no elevation was made, zero point slopes was used. In the treadmill, beginning speed is 1.2 km/h, and it was increased 0.2 km /h for each 3 minutes. In the treadmill beginning-final speed, burning calorie amount, distance, and the period of the treadmill was saved. In the workout, a treadmill branded Team Work was used. Children in control group performed no exercises

Before we began to work, we had had a report in ethics committee approval with the decision dated 02.12.2008 and numbered 2008/620 was received by Erciyes University Dean's Office of Medical Faculty. Informed consent form was taken from all volunteers and their parents by giving information.

Weight, Height and Pulse Measurement

Weight measurement of the children clothed only short was determined with digital scale to nearest 0.01 kg. and recorded as kg. Height was measured in closed standing position. Pulse measurement was done with the device named Nellcor Puritan Bennett NPB-40.

Skinfold Measurement

In fat measurement of subsurface skin, holtain skinfold caliper, of which pressure in every space is 10 gr/mm^2 and sensivity is 0.2 mm, was used. Measurements were taken in standing position from the right body side by holding the skin and sub-surface skin by means of reading of the indicator in 2-3 seconds.

Body Fat Percentage

The formula was used to calculate the body density (Durning and Womersly, 1974).

For Men: D= 1.1553-0.0643. LogX (Biceps+Triceps+Subscapula+Subrailiac)

For Women: D= 1.1369-0.0598. LogX (Biceps+Triceps+Subscapula+Subrailiac)

The formula of Siri was used to calculate body density for women.

Body fax index: ([4.95/D]-4.5)x100 (Siri 1961)

Heath-carter formula in determination of somatotype

In the research, Heath-Carter method was used to determine the Somatotype (Carter, 2002)

Endomorphic Component

This calculation is used by calculating the person’s skin thickness of triceps,

subscapula and suprailiac region as mm and applying this formula.

X = (Triceps) + (Suprailiac) + (Subscapula)

Endomorph = $0.1451x - 0.00068x^2 + 0.0000014x^3 - 0.7182$

Mezomorphic Component

This calculation is made with the following processes.

E=Humerus epicondyle diameter (cm)

K=Femur epicondyle diameter (cm)

A=Recovered arm circumference= biceps circumference on flexion (cm) Triceps÷10

C = Recovered calf circumference= calf circumference (cm) – Medial calf ÷ 10

H = Height (cm)

Mesomorph= 0.858(E) + 0.601 (K) + 0.188 (A) + 0.161 (C) – 0,131 (H) + 4.5

Ectomorphic Component: This calculation is made by calculating ponderal index derived from the relationship between height and weight.

RPI = H (height – cm) ÷3 *w* (weight kg)

RPI > 40.75 Ectomorphy = 0.732 RPI – 28.58

4.75 ≥ RPI > 38.25 Ectomorphy= 0.463 RPI – 17.63

If RPI is ≤ 38.25; Add 0,1 on outcome

Body-Mass Index and Ponderal Index

BKI is calculated with the formula of weight / height (m^2). Generally, if the conclusion is more than 30kg/W; it is accepted as criteria for obesity. Ponderal index is calculated according to the formula:

Ponderal index= ([weight (kg)] / height^3[m]) (Carter, 2002)

Statistical analysis

SPSS 13.0 was used to analyses the data. Descriptive statistics were presented with arithmetic mean and standard deviation. Independent sample t test was used to compare the anthropometrical measurements between the groups; paired sample t test was used to compare the anthropometrical measurements of the children with SP in the same group. Margin of error was accepted 0.05.

RESULTS

Table 1. Characteristic features of experimental and control groups

Variables		Control Group (n=17)	Experimental Group (n=20)
		X±SD	**X±SD**
Age (years)	Pre	10.6±2.79	11.15±2.18
	Post	--	--
Weight (kg)	Pre	28.55±11.97	31.05±8.59
	Post	**29.89±11.94*** **	31.57±7.58
Height (cm)	Pre	127.32±16.63	135.13±9.79
	Post	**128.33±16.64***	**137.39±10.82****
Body mass index (kg/m^2)	Pre	16.83±3.04	16.76±2.90
	Post	**17.45±2.85****	16.55±2.44
Body Fat (%)	Pre	13.72±4.86	14.13±6.49
	Post	17.07±7.32	12.88±6.26
Resting heart rate (bpm)	Pre	108.12±17.55	99.00±16.66
	Post	105.53±21.07	97.70±17.92
Systolic blood pressure (mmHg)	Pre	100.18±18.93	101.80±17.06
	Post	**125.47±33.05***	**103.45±18.21$^{\Delta}$**
Diastolic blood pressure (mmHg)	Pre	68.29±16.64	67.10±18.83
	Post	82.59±27.38	**62.10±14.83 $^{\Delta}$**

*p<0.05 **p<0.01***p<0.001 Intragroup Δ: Intergroup

A statistically significant increase was found in body weight (p<0.001), height (p<0.05), BMI (p<0.05) and systolic blood pressure of the post-exercise parameters of control group (p<0.01). There was a

significant increase in post-exercise body height of experimental group (p<0.01). A significant difference was detected in post-exercise systolic and diastolic blood pressure of control (p<0.01) and experimental groups (p<0.05).

Table 2. Comparison of some variables based on exercise in children with cerebral palsy who performed treadmill exercise

Variables	Pre- exercise program	Post- exercise program
	X±SD	**X±SD**
Resting heart rate (beats /min)	92.85±9.41	89.31±5.97
pulse after workout (beats /min)	127.28±11.01	125.95±11.93
Initial speed of exercise (m/s)	1.43±0.51	2.47±0.91***
Final speed of exercise (m/s)	2.51±1.12	3.47±1.26***
Exercise time (min)	15.17±1.11	22.34±1.83***
Distance (m)	458.33±150.37	1127.85±442.70***
Consumed calories (kcal)	27.85±9.24	69.67±27.51***

***p<0.001

There was no significant change in weight, and pre- and post-exercise pulse of the children with cerebral palsy who performed treadmill exercise (p>0.05). A significant increase occurred in initial speed, final speed, exercise time, distance and consumed calorie (p<0.001).

Table 3. Comparison of somatotype features of control and experimental groups

Variables		Control Group (n=17)	Experimental Group (n=20)
		X±SD	**X±SD**
Endomorphy	Pre	3.61±1.08	3.52±1.62
	Post	4.40±2.20	3.36±1.52
Mesomorphy	Pre	3.27±1.30	2.91±1.87
	Post	4.38±1.34	3.90±1.88
Ectomorphy	Pre	2.53±1.23	3.28±1.55
	Post	2.25±1.19	**3.53±1.52****
Ponderal Index	Pre	42.42±1.81	43.46±2.25
	Post	42.02±1.77	**43.83±2.16****

*p<0.05 **p<0.01***p<0.001

No significant difference was found in endomorphy and mesomorphy of pre- and post-exercise somatotype features of control and experimental groups (p>0.05). A significant increase was found in post-exercise ectomorphy and ponderal index values between the groups (p<0.01).

DISCUSSION

The most important findings of this study occurred during treadmill exercise applied by experimental groups. The study was evaluated as pre- and post-exercise. Significant differences were found in pre- and post-exercise speed, exercise time, distance and consumed calorie. Mattern-Baxter et al., (2009) found a significant increase in speed and distance values of 6 children with cerebral palsy, who have different functional levels and at the age of 2.5 and 3.9, in 4-week treadmill exercise. Provost et al., (2007) detected some increases in walking speed and energy expenditure of the children with cerebral palsy in weight-supported treadmill training. This results show parallelism with the present study. 30 volunteer families, having children with down syndrome, applied treadmill exercises 5 times a week and 8 minutes a day at home in order to

search the effects of treadmill exercises on walking of the children with down

syndrome. With this study, it was demonstrated that the children with down syndrome start walking earlier by using treadmill exercises (Ulrich et al., 2001). In a study named 'Using weight-supported treadmill in palsy rehabilitation' it was emphasized that treadmill is efficient for acquisition of symmetric walking pattern and enhancement of walking speed and endurance (Hakgüder, 2007).

Experts assessments about growth and development of child while rehabilitation is important. It is important to assess the child's growth and developments with anthropometrical measurements and to begin rehabilitation program before causing permanent damage. At the end of the study made on the children with hemi lateral cerebral Palsy (HSP), it was found that lower extremity muscles and bone development remain weak as a result of lateness of walking and functions due to the spasticity in the children with HSP (Uygur, 2007).

When comparing the pre- and post-exercise endomorphy values, no significant difference was found. On the other hand, in a study made on male distance athletes by dividing into three equal groups according to their personal best time for the 10km run, elite and good runners were found less endomorphic compared to the average runners (Bale et al., 1986).

A significant increase was found in pre- and post-exercise mesomorphy value of control and experimental groups in intragroup comparison. It was thought that this increase occurred due to the stretching and strength exercises performed by both groups. Regular exercise affects the somatotype features of people. This effect is higher in mesomorphy values. Other studies, of which results are similar to our findings, support this significant change (Jürimae et al., 2005; Linhares et al., 2009). However, differentness from literature may be due to the variation of research groups. A significant difference was found in post-exercise ectomorphy values of experimental and control groups. In intragroup comparisons, there was no significant difference. It was detected that post-exercise ponderal index values were found higher in experimental group. While ponderal index is increasing in experimental group, it decreased in control group.

Linhares et al., (2009) investigated the effects of basic physical activity on body composition of adolescents and found significant differences in BMI. In the study, ponderal index showed significant differences based on the regular exercise but every regular exercise can not have significant effects on ponderal index (Stewart et al., 2002; Lawlor et al., 2005; Çolakoğlu and Karacan, 2006). Alteration of body mass index and ponderal index levels is most probably due to the quality and duration of exercise, and the features of the group. Nevertheless, similar studies supporting these findings are highly available (Bale et al., 1986; Jürimae et al., 2005; linhares et al., 2009). Biçer et al., (2004) detected a significant decrease in body fat percentage in a study named 'The effects of power and strength exercises on the movement skill and ability of mentally retarded children'.

In conclusion, it was thought that anthropometric assessments are important criteria and regular implementation of these assessments makes important contributions on interpretation of treatment efficiency at the beginning and end of the study, and also it sets light to change the treatment plan when needed. It can be concluded that treadmill exercise increases the walking

performance of children with cerebral palsy and improves the exercise tolerance.

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