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The effect of a physical activity program on some anthropometric characteristics in children with emotional and behavioral problems

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Abstract

The aim of this study was to investigate the effects of physical activity on some anthropometric characteristics of children with emotional and behavioral disturbances. Sample consisted of 19 children (between 6,00-12,99 ages) from the child and adolescent psychiatry Unit of the Ege University Medical School. They participate in a twelve-week educative program including controlled PA (2 days a week, 60 min a day, aerobic exercises). Anthropometric data were collected before and after enrolling in the educative program by an accredited ISAK Level II anthropometrist following the ISAK manual (Marfell-Jones et al., 2006). Relaxed Arm (RAG), Contracted Arm (CAG), Waist (WG), Gluteal (GG) and Calf (CG) Girths, Triceps (Tsk), Subscapular (Sbsk), Biceps (Bsk), Iliac (Isk), Supraspinale (Ssk), Abdominal (Ask), Thigh (Thsk) and Calf (Csk) skinfolds, Humeral (HB) and Femoral (FB) breadths, body weight (W), stature (St), sitting height (Sh) and arm span (AS) (Restricted Profile) were measured and used to determine the sum of 8 skinfolds (S8), BMI and percentage of body fat (%BF)(2). Children were divided into two mixed groups according to the age and gender. Student T-test was run for comparing pre- and post- results and Wilcoxon Signed-Rank Tests were used for identify differences by gender and age groups setting always statistical significances at α=0.05. When general pre- and post- test data were compared, significant differences in W, St, Sh, AS, GG and CG were observed ($p<0.05$). Considering only the boys' data, differences ($p<0.05$) were found for W, St, Sh, AS, Tsk and GG results, but in girls only for St, Sbsk, and CG. Finally, children under-10 significantly changed their W, St, Sh, AS, and CG measurements and children over-10 changed their St, Sh, AS, and GG. PA programs can lead to significant changes in some anthropometric characteristics of children with emotional and behavioral problems. Educative programs with PA contents can support their physical fitness levels and physical properties.

Keywords: Children, physical activity, body composition, emotional and behavioral problems

INTRODUCTION

Physical activity (PA), any bodily movement produced by skeletal muscles that requires energy expenditure (ACSM, 2016). Contemporary educational organizations propose that children' experiences in sport and physical edication contribute to the mental acuity, skills and strategies that are important for navigating challenges faced across the life span (America SoHaPe, 2016).

Developmental disabilities, emotional disorders, and disruptive behaviour disorders are the leading mental health related cause of the global burden of disease in children aged below ten years (Patel et al., 2013). Like adults, children and adolescents can have mental health disorders such as depression, anxiety, mood status or self-esteem (Ortega et al., 2008). The term "serious emotional disturbance" refers to a diagnosed mental health problem that substantially disrupts a child's ability to function socially, academically, and emotionally (Brauner and Stepens, 2006). Regular exercise reduces the symptoms of mental disorders (Deslandes et al., 2009) and exercise can be an adjuvant treatment for several mental diseases (Portugal et al., 2013) and promotes a healthy body weight and body composition (Physical Activity Guidelines for Americans, 2008).

The ongoing distortions in the physical condition level of the children have been observed (Runhaar et al., 2010; Trembley et al., 2010) Thus, it is thought that the children with emotional and behavioral disabilities may reveal the similar result. Since some of these children demand medicine then it can be said that their daily physical activities and physical abilities can be affected.

Body composition is a key component of an individual's health and physical fitness profile (Heyvard, 2006; ACSM, 2010). Regular PA is often viewed as essential to normal growth and maturation (Malina, 2002). PA, especially weight bearing activity, is important for growth and maintenance of the muscle and bone compartments (Zemel, 2002). And also several studies have examined between PA and cognitive performance (ACSM, 2016; Etnier et al., 1997), executive function (Diamond, 2013; Chen et al., 2014) in children. But relatively very few data are available examining of PA to physical properties' changes in children with emotional and behavioral disturbances. Therefore the aim of present study was to investigate some anthropometric characteristics' changes of children with emotional and behavioral disturbances in a controlled PA program.

METHOD

Participants

Sample consisted of 19 volunteer children (between 6,00-12,99 ages, n=6 girls and n=13 boys) from the child and adolescent psychiatry Unit of the Ege University Faculty of Medicine. They participate in a twelve-week educative program including controlled PA (2 days a week, 60 min a day, moderate-to-vigorous physical activities and children's plays) in 2011. The aim of the study and the kind of measurements to be used was explained to the participants and their parents, who gave their written informed consent.

Anthropometric Measurements

Anthropometric data were collected before and after enrolling in the educative program by an accredited ISAK (International Society for the Advancement of Kinanthropometry) Level II anthropometrist following the ISAK manual (Marfell-Jones et al., 2006). Relaxed Arm (RAG), Contracted Arm (CAG), Waist (WG), Gluteal (GG) and Calf (CG) Girths, Triceps (Tsk), Subscapular (Sbsk), Biceps (Bsk), Iliac (Isk), Supraspinale (Ssk), Abdominal (Ask), Thigh (Thsk) and Calf (Csk)

skinfolds, Humeral (HB) and Femoral (FB) breadths, body weight (W), stature (St), sitting height (Sh) and arm span (AS) (Restricted Profile) were measured and used to determine the sum of 8 skinfolds (S8), BMI and percentage of body fat (%BF).

Body weight (BW) was measured through an electronic scale with a sensitivity of 0.1 kg. Stature, sitting height and arm span were measured with anthropometric tape (Cescorf-brand, 0.1 cm distinction) on the wall. BMI was calculated as body weight (kg) divided by stature (m) squared. RAG, CAG, WG, GG and CG girths were measured with anthropometric tape (Cescorf-brand, 0.1 cm distinction). The breadths of Humerus and Femur were measured with calipers (Cescorf). Skinfold thickness were measured with a Holtain skinfold calipers. Measurements were performed twice (the average was used as criterion score) and at the right side of the body (Tsk, Sbsk, Bsk, Isk, Ssk, Ask, Thsk, Csk). Sum of 8 skinfolds was also determined. BF% was calculated with formulas developed by Slaughter for girls [0,610 x (triceps+medial calf) + 5.1] and for boys [0,735 x (triceps+medial calf) + 1] (Slaughter et al., 1988). BMI was calculated by dividing weight by height squared (kg/m^2).

Statistical Analyses

Children were divided into two mixed groups according to the age and gender. Student T-test was run for comparing pre- and post- results and Wilcoxon Signed-Rank Tests were used for identify differences by gender and age groups setting always statistical significances at α=0.05.

RESULTS

When general pre- and post- test data were compared, significant differences in W, St, Sh, AS, GG and CG were observed ($p<0.05$) (Table 2). Considering only the boys' data, differences ($p<0.05$) were found for W, St, Sh, AS, Tsk and GG results (Table 4), but in girls only for St, Sbsk, and CG Table 3). Finally, children under-10 significantly changed their W, St, Sh, AS (Table 5), and CG measurements and children over-10 changed their St, Sh, AS, and GG (Table 6).

Table 1. Frequence distribution according to ages and genders

	Ages (Decimal age)						
	6.00-6.99	7.00-7.99	8.00-8.99	9.00 - 9.99	10.00-10.99	11.00-11.99	12.00-12.99
Girls n=6	-	1	3	2	-	-	-
Boys n=13	1	1	2	4	2	1	2

Table 2. Change of physical properties in children (general)

N=19	Pre-Test	Post-Test	Student t Test		Wilcoxon Rank Test	
	$\bar{X}$ SD	$\bar{X}$ SD	t	p	z	p
Body Weight (kg)	32.5±13.8	33.4±13.4	-2.30	0.03*	-2.92	0.00*
Stature (cm)	134.4±10.4	135.6±10.6	-6.38	0.00*	-3.73	0.00*
BMI (kg/m^2)	17.4±4.5	17.6±4.3	-1.16	0.26	-2.01	0.04*
Sitting Height (cm)	69.2±4.6	70.4±5	-4.55	0.00*	-3.49	0.00*
Arm Span (cm)	133.1±10.6	134.4±10.5	-4.44	0.00*	-3.33	0.00*
Triceps (mm)	10.5±6.7	10.9±6.8	-1.45	0.16	-1.29	0.20
Subscapular (mm)	8.3±6.7	8.5±6.8	-0.64	0.53	-0.57	0.57
Biceps (mm)	6.1±4.4	6.1±4	-0.07	0.95	-0.50	0.62
Iliac-crest (mm)	12.7±12	12.1±11.3	1.42	0.17	-1.64	0.10
Suprasipinale (mm)	8.0±6.7	8.0±6.9	-0.06	0.95	-0.35	0.73
Abdominal (mm)	11.8±10.9	11.5±9.8	0.78	0.45	-0.39	0.70
Front Thigh (mm)	15.8±9.4	15.3±8.4	1.03	0.32	-0.75	0.45
Calf (mm)	10.4±8.3	10.2±7.4	0.62	0.55	-0.44	0.66
Sum of 8 Skf. (mm)	84.0±63.3	83.0±60.3	0.81	0.43	-0.28	0.78
BF (%)	16.9±10.7	17.1±10.1	-0.71	0.49	-0.98	0.33
Arm (Relaxed) (cm)	19.3±4.1	19.5±4.4	-1.49	0.15	-1.02	0.31
Arm (Flexed and Tensed)	20.6±4.4	20.8±4.4	-1.22	0.24	-1.20	0.23
Waist (cm)	58.8±10.5	59.2±10.3	-0.64	0.53	-0.40	0.69
Gluteal (Hip) (cm)	72.9±12	73.6±12.1	-2.65	0.02*	-2.52	0.01*
Calf (cm)	27.1±4.7	27.6±5	-2.89	0.01*	-2.47	0.01*
Humerus (Biepicondylar) (cm)	5.4±0.5	5.5±0.5	-1.86	0.08	-1.71	0.09
Femur (Biepicondylar) (cm)	7.9±0.7	7.9±0.7	-0.24	0.81	-0.19	0.85

*p<0.05

Table 3. Change of physical properties in girls

N=6	Pre-Test	Post-Test	Wilcoxon Rank Test	
	$\bar{X}$ SD	$\bar{X}$ SD	z	P
Body Weight (kg)	26.7±6	27.6±5.8	-1.89	0.06
Stature (cm)	128.1±4.8	129.3±5.3	-2.21	0.03*
BMI (kg/m^2)	16.2±3.2	16.4±3	-0.94	0.35
Sitting Height (cm)	66.9±1.4	67.9±1.6	-1.75	0.08
Arm Span (cm)	127.3±4.9	128.5±5.4	-1.69	0.09
Triceps (mm)	10.5±5.2	10.1±5.1	-1.57	0.12
Subscapular (mm)	7.3±4.3	8.5±6.1	-2.02	0.04*
Biceps (mm)	5.7±2.6	5.9±2.1	-0.81	0.42
Iliac-crest (mm)	11.8±10.6	11.3±8.7	0.00	1.00
Suprasipinale (mm)	7.3±5	8.0±6.4	-1.08	0.28
Abdominal (mm)	11.0±7.1	11.7±7.2	-1.58	0.12
Front Thigh (mm)	16.2±10.8	15.4±7.9	-0.32	0.75
Calf (mm)	8.5±4.2	8.8±4.7	-1.84	0.07
Sum of 8 Skf. (mm)	78.4±49	79.9±47.6	-1.05	0.29
BF (%)	16.5±5.8	16.6±6	-1.21	0.23
Arm (Relaxed) (cm)	18.0±2	18.0±1.9	-0.41	0.68
Arm (Flexed and Tensed)	18.9±2.3	19.1±2.2	-0.31	0.75
Waist (cm)	55.3±7.7	55.7±6.6	-0.73	0.46
Gluteal (Hip) (cm)	68.7±7.4	69.3±6	-0.73	0.46
Calf (cm)	24.8±2	25.4±1.9	-2.00	0.05*
Humerus (Biepicondylar)(cm)	5.1±0.4	5.2±0.38	-1.63	0.1
Femur (Biepicondylar) (cm)	7.4±0.4	7.4±0.3	-0.41	0.68

*p<0.05

Table 4. Change of physical properties in boys

N=13	Pre-Test	Post-Test	Wilcoxon Rank Test	
	$\bar{X}$ SD	$\bar{X}$ SD	z	P
Body Weight (kg)	35.2±15.7	36.1±15.2	-2.20	0.03*
Stature (cm)	137.3±11.2	138.5±11.3	-3.06	0.00*
BMI (kg/m^2)	17.9±5.1	18.2±4.8	-1.78	0.08
Sitting Height (cm)	70.2±5.2	71.6±5.6	-2.99	0.00*
Arm Span (cm)	135.7±11.5	137.0±11.4	-3.01	0.00*
Triceps (mm)	10.6±7.4	11.2±7.6	-2.14	0.03*
Subscapular (mm)	8.7±7.6	8.5±7.3	-0.62	0.53
Biceps (mm)	6.3±5.1	6.3±4.7	-0.24	0.81
Iliac-crest (mm)	13.2±13	12.5±12.6	-1.82	0.07
Suprasipinale (mm)	8.3±7.5	8.0±7.4	-1.19	0.24
Abdominal (mm)	12.2±12.5	11.4±11	-0.67	0.50
Front Thigh (mm)	15.6±9.1	15.3±8.9	-1.02	0.31
Calf (mm)	11.3±9.7	10.9±8.5	-0.32	0.75
Sum of 8 Skf. (mm)	86.6±70.6	84.4±67.1	-0.94	0.35
BF (%)	17.1±12.5	17.3±11.8	-0.53	0.59
Arm (Relaxed) (cm)	19.9±4.7	20.2±5.1	-1.30	0.20
Arm (Flexed and Tensed)	21.4±4.9	21.6±5	-1.38	0.17
Waist (cm)	60.5±11.5	60.9±11.4	-0.11	0.92
Gluteal (Hip) (cm)	74.8±13.4	75.6±13.8	-2.59	0.01*
Calf (cm)	28.2±5.3	28.6±5.7	-1.69	0.09
Humerus (Biepicondylar)(cm)	5.6±0.5	5.7±0.6	-0.99	0.32
Femur (Biepicondylar) (cm)	8.2±0.7	8.2±0.6	-0.12	0.91

*p<0.05

Table 5. Change of physical properties in children under ten years old.

N=14	Pre-Test	Post-Test	Wilcoxon Rank Test	
	$\bar{X}$ SD	$\bar{X}$ SD	z	P
Body Weight (kg)	27.6 ±7	28.6 ±7.3	-3.08	0.00*
Stature (cm)	129.7±6.2	130.9±6.4	-3.18	0.00*
BMI (kg/m^2)	16.2±3	16.5±3.1	-1.82	0.07
Sitting Height (cm)	67.1±2.6	68.3±2.7	-2.83	0.00*
Arm Span (cm)	128.7±6.9	130.1±6.5	-2.80	0.01*
Triceps (mm)	9.4±5.3	9.5±5.5	-0.47	0.64
Subscapular (mm)	6.9±4.6	7.4±5.8	-1.20	0.23
Biceps (mm)	5.3±2.9	5.4±2.9	-0.71	0.48
Iliac-crest (mm)	10.7±10.5	10.0±9.8	-1.73	0.08
Suprasipinale (mm)	6.5±4.4	6.8±5.6	-0.31	0.76
Abdominal (mm)	9.7±8.2	9.8±8.3	-0.88	0.38
Front Thigh (mm)	14.1±9.2	13.6±7.5	-0.51	0.61
Calf (mm)	8.4±5.9	8.5±5.3	-1.17	0.24
Sum of 8 Skf. (mm)	71.3±49.8	71.2±49.8	-0.25	0.81
BF (%)	14.8±7.9	15.0±7.6	-1.01	0.31
Arm (Relaxed) (cm)	17.9±2.6	18.0±2.6	-0.53	0.60
Arm (Flexed and Tensed)	19.1±2.6	19.3±2.8	-0.82	0.41
Waist (cm)	55.6±6.9	56.4±7.7	-1.01	0.31
Gluteal (Hip) (cm)	69.0±7.9	69.7±8	-1.63	0.10
Calf (cm)	25.3±2.8	25.7±2.9	-2.21	0.03*
Humerus (Biepicondylar)(cm)	5.3±0.4	5.3±0.4	-0.52	0.60
Femur (Biepicondylar) (cm)	7.6±0.6	7.7±0.5	-0.18	0.86

*p<0.05

Table 6. Change of physical properties in children over ten years old.

N=5	Pre-Test	Post-Test	Wilcoxon Rank Test	
	$\overline{X}$ SD	$\overline{X}$ SD	z	p
Body Weight (kg)	46.3±19.6	46.9±18.1	-0.67	0.50
Stature (cm)	147.5±8.7	148.5±9.5	-2.02	0.04*
BMI (kg/m^2)	20.6±6.7	20.7±6	-0.67	0.50
Sitting Height (cm)	74.9±4.1	76.6±4.9	-2.02	0.04*
Arm Span (cm)	145.3±9.9	146.4±10.9	-2.12	0.03*
Triceps (mm)	13.7±9.6	14.6±9.4	-1.48	0.14
Subscapular (mm)	12.3±10.3	11.6±9.1	-0.67	0.50
Biceps (mm)	8.5±7.1	8.3±6.2	0.00	1.00
Iliac-crest (mm)	18.4±15.6	18.0±14	-0.54	0.59
Suprasipinale (mm)	12.2±10.5	11.4±9.7	-1.07	0.29
Abdominal (mm)	17.8±16	16.2±13	-0.67	0.50
Front Thigh (mm)	20.5±9.3	20.2±9.6	-0.37	0.72
Calf (mm)	16.0±12	15.2±10.7	-0.68	0.50
Sum of 8 Skf. (mm)	119.6±88.5	115.8±80.5	-0.68	0.50
BF (%)	22.8±15.8	22.9±14.7	0.00	1.00
Arm (Relaxed) (cm)	22.9±5.5	23.7±6.1	-1.10	0.27
Arm (Flexed and Tensed)	24.9±5.8	25.3±5.5	-1.10	0.27
Waist (cm)	68.0±14.4	67.2±13.3	-0.67	0.50
Gluteal (Hip) (cm)	83.6±15.8	84.7±15.6	-2.02	0.04*
Calf (cm)	32.2±5.6	32.8±6.2	-1.10	0.27
Humerus (Biepicondylar)(cm)	5.9±0.6	6.1±0.4	-1.83	0.07
Femur (Biepicondylar) (cm)	8.8±0.5	8.7±0.4	-0.58	0.56

*p<0.05

DISCUSSION

Anthropometric measurements give a good description of the body as a whole. The measurements are those which are routinely taken for a variety of purposes such as monitoring athletes, tracking growth, development, aging and motor performance, and linking physical activity and nutrition interventions to changes in body size, shape and composition (Marfell-Jones et al., 2006).

The aim of present study was to investigate some anthropometric characteristics' changes of children with emotional and behavioral disturbances in a twelve-week educative program including controlled PA (2 days a week, 60 min a day, aerobic exercises). The mid childhood growth spurt, which occurs in many children around 6-8 years old, is small increase in the rate of gain in weight, height, and body breadth (Zemel, 2002). In this study we determined this properties, when general pre- and post- test data were compared, significant differences in W, St, Sh, AS, GG and CG were observed ($p<0.05$) (Table 2). In addition we examined anthropometric characteristics' changes at two groups (under and over 10 years old). Children under-10 significantly changed their W, St, Sh, AS (Table 5), and CG measurements and children over-10 changed their St, Sh, AS, and GG (Table 6). In this observation, we found almost same physical properties of differences according to general data.

In children with emotional and behavioral disturbances, comparing changes in body composition associated with a program of regular PA studies is limited. In this study, considering only the boys' data, differences ($p<0.05$) were found for W, St, Sh, AS, Tsk and GG results (Table 4), but in girls only for St, Sbsk, and CG (Table 3). But in other anthropometric measurement' values were not observed differences both in boys and in girls.

Body weight and length or stature, the most basic information used to assess growth and nutritional status (Zemel, 2002). Body weight can be potentially influenced by regular activity, resulting in changes in body composition (Malina, 2002). In this study, it was considered that pre-and post-test differences might be effected both growth and PA. And also girls compared to their counterparts, it was observed that W, St, BMI values are similar with Turkish children (% 50 persentile) (Neyzi et al., 2008). And also it was observed that according to the classification designed by Lohman et al. for 6-17 ages of %BF values (Heyvard, 2006) were seen medium levels in girls and boys.

In this study, changes in some anthropometric measurements have been observed. All the same, the results of girls under 10 (n=6, 7-9 ages) and boys over 10 (n=5, 10-12 ages) were compared with the studies done with healthy children. The study done with the girls (on triceps skinfold and arm circumference values) have revealed similar results with Öztürk et al. (2009) and the waist circumference results were similar with the average results of Hatipoğlu et al. (2007). In the boys, the W, St, BMI values were above average of the standards for 11-12 ages obtained from Akgün et al. (1990) and Neyzi et al. (2008) (% 50 percentile values). It has also been observed in some studies that the children are now heavier and taller than they were in the past (Trembley et al., 2010). The arm circumference and triceps skinfold results were bigger than average observed from Akgün et al. (1990) and also Öztürk et al. (2009). The waist circumference measurements were also above than the ones measured (average values) by Hatipoğlu et al. (2007). This made us think that the positive environmental factors were not adequate for these children to support an active living.

Each child, in order to maintain his/her normal physical growth and development, needs to attend the activities on a regular basis (Leblanc et al., 2011). Children and adolescents should do 60 minutes or more of physical activity daily (aerobic, muscle-strengthening, and bone-strengthening). It is important to encourage them to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety (Physical Activity Guidelines for Americans, 2008). Children with emotional and behavioral problems and their parents may keep themselves away from social surroundings in order not to be labelled. It is suggested that furter studies can be performed with more participation.

Consequently, in this study we observed potential influences of regular PA on children' some anthropometric properties during growth. Certain limitations may affect the interpretation of our study findings. We would like to point out that these were because there hasn't been enough number of participants in this study and there were also differences between ages and gender. Nevertheless, it is thought that this study may be aware of these issues. This feature is not increased in children who are the future of health care costs and to participate in such activities in terms of reduction of efficiency is recommended.

In conclusion, PA programs can lead to significant changes in some anthropometric characteristics of children with emotional and behavioral problems. Educative programs with PA contents can support their physical fitness levels and physical properties.

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References

ACSM's Health-Related Physical Fitness Assessment Manual, (2010). 3rd ed./editor, Leonard A. Kaminsky: American College of Sports medicine, p.3.

ACSM, (2016). Physical Activity, Fitness, Cognitive Function and Academic Achievement in Children: A Systematic Review. Med. Sci. Sports&Exercise, DOI: 10.1249/MSS.0000000000000901.

America SoHaPE. National Standards & Grade-Level Outcomes for K-12 Physical Education (2014). Champaign (IL): Human Kinetics;. In American College of Sports Medicine, Physical Activity, Fitness, Cognitive Function, and Academic Achievement in Children: A Systematic Review. Med. Sci. Sports&Exercise, 2016, DOI: 10.1249/MSS.0000000000000901.

Akgün,. N., Ergen, E., Ertat, A., İşlegen, Ç., Çolakoğlu, H., Emlek, Y. (1990). Eurofit test results in the western part of Turkey, Council of Europe, VIth European Research Seminar. The Eurofit Tests of Physical Fitness, 26-30 June, Izmir, Turkey, p. 69-115.

Brauner, C.B., Stephens, C.B., (2006). Estimating the prevalence of early childhood serious emotional/behavioral disorders: Challenges and Recommendations. Public health reports, 121, 303-310.

Chen, A.G., Yan, J., Yin, H.C., Pan, C.Y., Chang, Y.K. (2014). Effects of acute aerobic exercise on multiple aspects of executive function in preadolescent children. *Psychol Sport Exerc*., 15(6), 627-36.

Deslandes, A., Moraes, H., Ferreira, C., Veiga, H., Silveira, H., Mouta, R., Pompeu, F.A., Cautinho, E.S., Laks, J. (2009). Exercise and mental health. *Neuropsychobiyology*, 59, 191-198.

Diamond, A. (2013). Executive functions. *Annu Rev Psychol*., 64: 135-68.

Etnier, J.L, Salazar, W., Landers, D.M., Petruzzello, S.J, Han, M., Nowell, P. (1997). The influence of physical fitness and exercise upon cognitive functioning: a meta-analysis. *J Sport Exerc Psychol*., 19, 249–77.

Hatipoglu, N., Özturk, A., Mazıcıoğlu, M.M., Kurtoglu, S., Seyhan, S., Lokoglu, F. (2007). Waist circumference percentiles for 7- to 17-year-old Turkish children and adolescentes. *Eur J Pediatr*., DOI 10.1007/s00431-007-0502-3.

Heyward, V.H. Advanced fitness assessment and exercise prescription, 5th ed., Human Kinetics, USA, 2006, p171, 198.

Leblanc, J., Dickson, L. (2011). Çocuklar ve Spor, Ed. Gazanfer Kemal Gül (Translated Deniz Erben, Tanju Bağırgan) Spor Yayınevi ve Kitabevi, Ankara, p. 72, 85.

Malina, R.M. (2002). Exercise and Growth: Physical activity as a factor in growth and maturation. In: Human Growth and Development, Edited by: Noel Cameron, Elsevier Science (USA), p. 321.

Marfell-Jones, M.J., Olds, T., Stewart, A.D., Carter, L. (2006). International Standards for Anthropometric Assessment. Potchefstroom, South Africa.

Neyzi, O., Günöz, H., Furman, A., Bundak, R., Gökçay, G., Darendeliler, F., Baş, F. (2008). Türk çocuklarında vücut ağırlığı, boy uzunluğu, baş çevresi ve vücut kitle indeksi referans değerleri. *Çocuk Sağlığı ve Hastalıkları Dergisi*, 51, 1-14.

Ortega, F.B., Ruiz, J.R., Castillo, M.J., Sjöström, M. (2008). Physical fitness in childhood and adolescence: a powerful marker of health. *Int J of Obes*, 32, 1-11.

Öztürk, A., Budak, N., Çiçek, B., Mazıcıoğlu, M.M., Bayram, F., Kurtoğlu, S. (2009). Cross-sectional reference values for mid-upper arm circumference, triceps skinfold thickness and arm fat area of Turkish children and adolescentes. *International Journal of Food Sciences and Nutrition*, 60(4), 267-281.

Patel, V., Kieling, C., Maulik, P.K., Divan, G. (2013). Improving access to care for children with mental disorders: A global perspective, Arc Dis Child, 98(5), 323-327.

Portugal, E., Cevada, T., Monteiro-Junior, R.S., Guimaraes, T.T., Rubini, E.C., Lattari, E., Blois, C., Deslandes, A.C. (2013). Neuroscience of Exercise: From neurobiology mechanisms to mental health. *Neuropsychobiyology*, 68, 1-14.

Physical Activity Guidelines for Americans (2008). Washington, DC: US Department of Health and Human Services, p18.

Runhaar, J., Collard, D. C. M., Singh, A. S., Kemper, H. C. G., Van Mechelen, W., & Chinapaw, M. (2010). Motor fitness in Dutch youth: differences over a 26-year period (1980–2006). *Journal of Science and Medicine in Sport*, 13(3), 323-328.

Slaughter, M.H., Lohman, T.G., Boileau, R.A., Horswill, C.A., Stillman, R.J., Van Loan, M.D., Bemben, D.A. (1988). Skinfold equations for estimation of body fatness in children and youth. *Hum Biol.* 60, 709-23.

Tremblay, M.S., Shields, M., Laviolette, M., Craig, C.L., Janssen, I., Connor Gorber, S. (2010). Fitness of Canadian children and youth: results from the 2007-2009 Canadian Health Measures Survey. Health-Reports, 21, 1-14.

Zemel, B. (2002). Body composition during growth and development, In: Human Growth and Development, Edited by: Noel Cameron, Elsevier Science, USA, p. 271-291.