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The Relationship between Daily Lifestyle and Anthropometric Parameters in Secondary School Student

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Abstract

The aim of this study was to investigate the relationship between daily lifestyle and anthropometric parameters in secondary school boys, aged 10-12 years. The study included 128 male students in secondary school, healthy and voluntarily. Anthropometric and metabolic parameters of the participants were measured before the study. The daily step counts (STEP) were measured by SenseWear® Armband for 6-day without physical education classes. To determine whether the students had active or inactive daily lifestyle habits, STEP values were assigned to three different levels according to the classification of Craig *et al.* (2013): passive group (PG), normal group (NG), and active group (AG). One-way ANOVA, multiple comparison, and Pearson correlation coefficient tests were used. $P<0.05$ was considered significant in all tests. In multiple comparison tests, some anthropometric parameters and STEP averages were significant in favor of AG ($p<0.05$). There were moderate ($r=-0.60$) or high ($r=0.81$) linear relationships between STEP averages and mean values of the anthropometric features ($p<0.01$). It was concluded that the anthropometric parameters and daily step count of male secondary school students have a significant effect on daily lifestyle habits.

Keywords: Lifestyle, Anthropometry, Metabolic parameter, STEP, Secondary school boy.

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Contents

1. Introduction

Physical activity habits and physical fitness levels are defined as children's lifestyle (Arnaoutis *et al.*, 2018). Whether it is a child or an adolescent, the evidence indicates that physical activity has a significant impact on a healthy lifestyle and disease prevention, thus promoting the development of effective interventions that promote a physically active lifestyle in children and adolescents (Hills *et al.*, 2007). Therefore, it has been emphasized that there are important responsibilities of public health and school management to improve physical fitness levels of children and increase their daily physical activities (Janz *et al.*, 2000). Although obesity is considered a complex multifactorial condition, physical inactivity is defined as an important factor in the development of obesity (Morrison *et al.*, 2018). Because today's children's physical activity levels are far below the levels in previous generation children, and the sedentary lifestyle automatically causes obesity (Hills *et al.*, 2007). Obesity and its metabolic results represent one of the five global risks that lead to hyperglycemia, high blood pressure, cardiovascular morbidity, and mortality, as well as tobacco use and physical inactivity (Hofsø *et al.*, 2010). In the last decade, it is estimated that this generation will be the first generation to live shorter than their parents in human history because of the upward trend in obesity is more than expected (Freira *et al.*, 2018). In addition, obesity is considered a public health problem that can cause many emotional and social effects, such as difficulties in relationship, depression and low self-esteem, as well as difficulties in health problems (Barbosa *et al.*, 2018). Today's environment offers an inactive lifestyle that can contribute to obesity in childhood (Hills *et al.*, 2007). Because of the rapid progress of technological activities such as computer and internet habits to reach addiction level especially among children and adolescents, their stay at home increases as well (Barbosa *et al.*, 2018). For this reason, children and adolescents are forced to physically lead to inactive behavior and to a sedentary lifestyle (Bulut, 2013). As a result, the number of overweight children is increasing rapidly in many countries (Seghers and Martien, 2009; Riso *et al.*, 2016) and according to the World Health Organization (WHO), in 2010, 81% of the students aged 11 to 17 were sedentary (World Health Organization (WHO), 2010a). Turkey Physical Activity Guide data states that sedentary lifestyle leads to decreased functional capacity, increased mortality and morbidity associated with chronic diseases[1]. Obesity is associated with adverse health outcomes in both children and adults, and approximately 80% of overweight children become overweight adults (Burdette *et al.*, 2004). However, it has been widely demonstrated that adequate physical activity during childhood has beneficial effects on both short- and long-term health outcomes, and decreases risk factors for several chronic diseases (Riso *et al.*, 2016). For this reason, experts have recommended that for long-term health, prevention of obesity and an active lifestyle should begin in preschool or school-aged children (Pate *et al.*, 2004). Because, participation in regular physical activity has many health benefits for adolescents (Beets *et al.*, 2015) and young people are advised to exercise moderate to vigorous physical exercise every day for one hour (WHO, 2010b). Anthropometric properties are closely related to health development (Pavlovic *et al.*, 2018) and the relationship between physical activity and body fat levels in adolescents is insufficient (Sevarsson *et al.*, 2018). Some researchers have reported a relationship between increased levels of physical activity and low body fat levels (Must and Tybor, 2005) and however, some others have defended the opposite (Basterfield *et al.*, 2012). In addition to the importance of a high level of physical fitness in childhood, the lack of studies evaluating the relationship between anthropometric traits and lifestyle in adolescence is also emphasized (Arnaoutis *et al.*, 2018). Considering all these explanations; in this study, in order to determine whether the 10- to 12-year-old secondary school boys had active or inactive lifestyles, daily step counts (STEP) were measured by SenseWear® Armband during 24 hours for 6 day without physical education classes. To determine the volunteers' daily lifestyle levels, STEP values were assigned to three different levels according to the classification of Craigb *et al.* (2013). Accordingly, the purpose of this study was (1) differences between lifestyles of three groups, (2) anthropometric characteristics of the groups according to their lifestyles, and (3) to examine the relationships between the lifestyle and anthropometric parameters of the groups.

2. Methods

2.1. Intervention Group

The study included 128 healthy and voluntary secondary school male students aged 10-12 years. To determine the participants' daily lifestyle levels, STEP values were assigned to three different levels according to the classification of Craig et al. (2013). According to this, respectively; first lifestyle level: STEP>12.000 steps/day was assigned to passive level group (PG; n: 9; age: 11.11±0.78 years; height: 149.78±8.71 cm; weight: 56.10±14.01 kg). Second lifestyle level: STEP=12.000-15.000 steps/day were assigned to the normal level group (NG; n: 14; age: 11.43±0.76 years; height: 150.64±10.14 cm; weight: 47.49±9.69 kg). Third lifestyle level: STEP<15,000 steps/day were assigned to the active level group (AG; n: 15; age: 11.13±0.92 years; length: 149.07±5.55 cm; weight: 39.57±4.54 kg). In the selection of the students in the intervention group, apart from the physical education classes, the criteria of not participating in any sports branch or physical activity, no chronic disease and no regular use of medication were taken into consideration. The informed voluntary parental consent and acceptance forms prepared according to the Helsinki Declaration were read and signed by each parents. Thus, necessary permissions were obtained by their families before starting this study.

2.2. Anthropometric and Metabolic Measurements

The anthropometric measurements of the students were taken as shorts, t-shirts and bare feet. A height gauge (Harpenden Stadiometer, Holtain Ltd., UK) with a precision of ±1 mm was used for height measurements. Body weight, body mass index (BMI), basal metabolism rate (BMR), body fat percentage (BF%), lean body mass percentage (LBM%) and body muscle mass percentage (BMM%) values were measured by body analysis device (Tanita BC- 418 MA Professional, Japan). For metabolic measurements, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured with a sphygmomanometer (Erka Switch Stethoscope, Germany). Pulse pressure (PP) was obtained with SBP and DBP difference (Gunay *et al.*, 2018).

[1] T. C. Ministry of Health, Public Health Agency of Turkey (TCMH), 2014. Turkey Physical Activity Guide. 2nd Ed., Ankara: Anıl.

2.3. Measuring the Daily Lifestyle

To determine whether the students had active or inactive lifestyle, STEP was measured by SenseWear® Armband (SWA, Body Media, Inc., Pittsburg, USA) monitor during 24 hours for 6 days without physical education classes. SWA has been reported to provide more accurate predictions than other monitors during mild to moderate activities (Calabró *et al.*, 2014) and is frequently used in children of all ages (Calabro *et al.*, 2009). The SWA was worn on the triceps muscle of the dominant arm (in the middle of the distance between the acromion and the olecranon). Before SWA was worn on the arm, some demographic information such as gender, age, height, body weight, cigarette use and the dominant hand were uploaded from the computer to the device with the help of the SWA software (Innerview 5.1. Body Media, Inc., Pittsburg, PA), and the data in the SWA, which was removed after 6 days, was transferred back to the computer. The intervention group was asked to continue their normal activities as they were on other days, and to remove this device only when they were in aquatic activities, not to remove it from their arms at all other times. Otherwise, it was stated that this study could be adversely affected.

2.4. Statistical Analysis

Mean and standard deviations (X±SD) of the results and percentage distribution of the intervention group (%) were presented in the text. Shapiro-Wilk test was used for normality of all variables, and Levene statistics was used for the homogeneity of variances. Since all the data showed normal distribution ($p>0.05$), parametric tests were performed. The data obtained from the study were compared with the One-way ANOVA test, and the Tukey multiple comparison (post-hoc) tests were used for the differences between the groups. The linear relations between daily lifestyle and anthropometric variables were determined by Pearson correlation coefficient (r). The statistical calculations of the study were done with IBM SPSS 25.0 package program, and $p<0.05$ level was accepted as significant in all tests.

3. Results

The anthropometric, metabolic and STEP values obtained from the intervention group were given between Tables 1 and 2 as below.

Table-1. Descriptive, ANOVA and multiple comparison values of the intervention group

Variable	Group	N	%	X±SD	%95 CI LB	%95 CI UB	F	*p*	Post-hoc test
Age (yrs.)	PG	39	23.7	11.11±0.78	10.51	11.71	0.60	0.56	PG≤AG≤NG
	NG	44	36.8	11.43±0.76	10.99	11.87			
	AG	45	39.5	11.13±0.92	10.63	11.64			
	Total	128	100.0	11.24±0.82	10.97	11.51			
Height (cm)	PG	39	23.7	149.78±8.71	143.08	156.48	0.13	0.88	AG≤PG≤NG
	NG	44	36.8	150.64±10.14	144.79	156.5			
	AG	45	39.5	149.07±5.55	145.99	152.14			
	Total	128	100.0	149.82±8.04	147.17	152.46			
Wight (kg)	PG	39	23.7	56.10±14.01	45.33	66.87	8.88	0.00*	AG≤NG<PG
	NG	44	36.8	47.49±9.69	41.9	53.09			
	AG	45	39.5	39.57±4.54	37.06	42.09			
	Total	128	100.0	46.41±11.20	42.72	50.09			
BMI (kg/m²)	PG	39	23.7	24.69±3.96	21.65	27.73	25.46	0.00*	AG<NG<PG
	NG	44	36.8	20.73±1.81	19.68	21.77			
	AG	45	39.5	17.77±1.14	17.13	18.4			
	Total	128	100.0	20.50±3.51	19.34	21.65			
BMR (kcal)	PG	39	23.7	1611.4±218.4	1443.6	1779.3	6.96	0.00*	NG≤PG<AG
	NG	44	36.8	1472.2±182.5	1366.9	1577.6			
	AG	45	39.5	1356.1±91.7	1305.3	1406.9			
	Total	128	100.0	1459.3±187.6	1397.7	1521.0			
FM (%)	PG	39	23.7	30.20±5.90	25.67	34.73	18.61	0.00*	AG<NG<PG
	NG	44	36.8	23.69±5.99	20.24	27.15			
	AG	45	39.5	17.17±3.54	15.21	19.13			
	Total	128	100.0	22.66±7.16	20.31	25.01			
LBM (%)	PG	39	23.7	69.80±5.90	65.27	74.33	18.60	0.00*	PG<NG<AG
	NG	44	36.8	76.31±5.99	72.86	79.77			
	AG	45	39.5	82.83±3.54	80.87	84.79			
	Total	128	100.0	77.34±7.16	74.99	79.7			
BMM (%)	PG	39	23.7	52.94±5.83	48.46	57.43	33.73	0.00*	PG<NG<AG
	NG	44	36.8	60.57±5.70	57.28	63.86			
	AG	45	39.5	70.55±4.33	68.16	72.95			
	Total	128	100.0	62.71±8.70	59.84	65.57			
SBP (mmHg)	PG	39	23.7	132.00±9.85	124.43	139.57	3.01	0.06	NG≤ AG≤PG
	NG	44	36.8	123.50±7.59	119.12	127.88			
	AG	45	39.5	126.40±7.50	122.25	130.55			
	Total	128	100.0	126.66±8.56	123.84	129.47			
DBP (mmHg)	PG	39	23.7	78.56±8.40	72.1	85.01	0.12	0.89	NG≤PG≤AG
	NG	44	36.8	77.64±4.09	75.28	80			
	AG	45	39.5	78.60±5.41	75.6	81.6			
	Total	128	100.0	78.24±5.69	76.37	80.11			
PP (mmHg)	PG	39	23.7	48.22±4.58	44.7	51.74	0.78	0.47	NG≤AG≤PG
	NG	44	36.8	45.93±6.23	42.33	49.53			
	AG	45	39.5	48.13±4.82	45.46	50.8			
	Total	128	100.0	47.34±5.31	45.6	49.09			
STEP (step/day)	PG	39	23.7	11066±761	10481	11650	117.25	0.00*	PG<NG<AG
	NG	44	36.8	13337±830	12858	13816			
	AG	45	39.5	16701±1040	16125	17277			
	Total	128	100.0	14127±2445	13323	14930			

*p<0.05; %: distribution of the intervention group; CI: confidence interval for mean; LB: lower bound; UB: upper bound <: significant difference in favor; ≤: insignificant difference in favor; PG: passive level group; NG: normal level group; AG: active level group; BMI: body mass index; BMR: basal metabolism rate; FM: fat mass; LBM: lean body mass; BMM: body muscle mass; SBP: systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure; STEP: daily step count

The STEP values of the study group were assigned into three different levels, and the daily lifestyle levels of the groups were determined. There was a significant difference between the groups in terms of weight, BMI, BMR, BF% , LBM%, BMM% and STEP averages ($p<0.05$).

In the post-hoc tests of the groups; the weight ($F=8.88$; AG<NG<PG), BMI ($F=25.46$; AG<NG<PG) and BF% ($F=18.61$; AG<NG<PG) averages were difference in favor of PG. On the other hand BMR ($F=6.96$; NG≤PG<AG), LBM% ($F=18.60$; PG<NG<AG), BMM% ($F=33.73$; PG<NG<AG) and STEP ($F=117.25$; PG<NG<AG) averages were significant in favor of AG ($p<0.05$; Table 1).

Table-2. The relationships between anthropometric and metabolic parameters with STEP

	Age	Height	Wight	BMI	BMR	FM%	LBM%	BMM%	SBP	DBP	PP
Height	0.66**	1									
Wight	0.44**	0.71**	1								
BMI	0.19	0.32*	0.90**	1							
BMR	0.46**	0.73**	0.95**	0.82**	1						
FM%	0.03	0.14	0.73**	0.89**	0.64**	1					
LBM%	-0.03	-0.14	-0.73**	-0.89**	-0.64**	-1.0**	1				
BMM%	-0.21	-0.33*	-0.84**	-0.93**	-0.77**	-0.91**	0.91**	1			
SBP	0.06	-0.20	0.05	0.22	0.07	0.11	-0.11	-0.18	1		
DBP	-0.08	-0.12	-0.15	-0.11	-0.05	-0.10	0.10	0.03	0.53**	1	
PP	0.07	-0.22	-0.12	-0.02	-0.17	-0.06	0.06	0.04	0.66**	-0.08	1
STEP	-0.03	-0.05	-0.60**	-0.79**	-0.53**	-0.76**	0.76**	0.81**	-0.12	0.05	0.10

*p<0.05; **p<0.01; BMI: body mass index; BMR: basal metabolism rate; FM: fat mass; LBM: lean body mass; BMM: body muscle mass; SBP: systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure; STEP: daily step count

Generally, when the relationships between the averages of STEP and anthropometric parameters were examined, there were between moderate ($r=-0.60$) or high ($r=0.81$) level of linear relationships were observed ($p<0.01$; Table 2).

4. Discussion and Conclusion

In this study, in order to determine whether the 10- to 12-year-old secondary school boys had active or inactive lifestyles, they were measured by SWA during 24 hours for 6 day without physical education classes. Also, in order to determine the physical activity levels of adolescents living in our country, the daily step counts should be identified by appropriate calculations (Güllü, 2018). Therefore, the STEP values of the students were assigned at three different levels, and then the daily lifestyle levels of the groups (PG, NG and AG) were determined.

Body weight is known to be effective on daily lifestyle behaviors (Koning *et al.*, 2018). In addition, these differences in weight status are frequently observed in adolescence (Morrison *et al.*, 2018). Therefore, rapid developments in the body limbs (arms and legs) called "growth spurts" are observed during adolescence (Akçan *et al.*, 1999) and in addition, the fact that the height increase and growth rates are at the highest level (Lopes *et al.*, 2018) suggested that the weights between the groups may be different. The extra body weight in childhood and adolescence is associated with life-long negative health outcomes (Pavlovic *et al.*, 2018) and adolescents with high weight and body fat, regardless of gender, are also known to have lower motor performance (Barbosa *et al.*, 2018). That was why, it could be said that the student with excessive body weight were disadvantaged in activities requiring body mass transport (Arnaoutis *et al.*, 2018) and therefore, it could be said that the student with high body weight in this study were not active enough to be at the AG level, so they were at the PG level. These cases may explain the weight average of the group devoted into three different lifestyles was significantly in favor of PG (AG≤NG<PG; $p<0.05$; Table 1).

The BMI is an indicator of the state of weight ranging from extreme weakness to obesity, and also it is a concept that is easily understood by the public (Lopes *et al.*, 2018). At the same time, it is assumed that boys with high BMI will have lower performance in physical fitness tests than children with weak and normal BMI (Lopes *et al.*, 2018). Because nowadays, children are experiencing a sedentary lifestyle and risk of obesity more than ever because of increased television viewing time, lack of sports facilities, and many other reasons such as the widespread use of computer or video games (Arnaoutis *et al.*, 2018). Moreover, it has also been proposed that BMI can be used as an appropriate cutoff level for the definition of international finesse in children and adolescents (Cole *et al.*, 2007). As a result of these observations, when the mean BMI values of our intervention group are examined, it is seen that PG is overweight, NG is in normal weight and AG is in weak category. For this reason, it can be said that the weight variable was in favor of PG, and it also allowed direct BMI values to be in favor of PG (AG<NG<PG; $p<0.05$; Table 1). Thus, it can be thought that PG, which is overweight according to BMI classification, has a significant effect on taking place at the first lifestyle level (<12.000 steps), and also, the findings of the physical features obtained in this study were consistent with the literature findings (Neyzi *et al.*, 2008).

In physical activities, the need for energy increases because of the usage of motion sensors (Koning *et al.*, 2018). Children's and adolescents' regular participation in more physical activity allows them to develop a lifestyle (Seghers and Martien, 2009) and as a result they need higher calories (Riso *et al.*, 2016; Sevarsson *et al.*, 2018). In addition, this lifestyle is known to reduce adiposity, as it benefits children's physical and mental health, and is associated with improved physical fitness, bone health and beneficial cardio-metabolic biomarkers (Sevarsson *et al.*, 2018). On the other hand, it is reported that inactivity-related conditions, such as obesity, may cause health problems and contribute to energy imbalance (Hormazábal-Peralta *et al.*, 2018). Over the last decade, it has been observed that it has a more pronounced effect on metabolic complications because of the increasing tendency in obesity (Freira *et al.*, 2018). These explanations may lead to be in favor of AG, depending on increased energy usage for daily physical activity (NG≤PG<AG; $p<0.05$; Table 1). For this reason, it can be considered that the AG had a significant effect in taking place at the third lifestyle level (>15.000 steps).

Although the anthropometric characteristics and lifestyle habits in childhood suggest that it is closely related to physical fitness, it is stated that other parameters may indirectly affect lifestyle habits (Arnaoutis *et al.*, 2018). In order to determine the health status of children and adolescents, the importance of using fat mass and fat percentage which are evaluated by bioelectrical impedance analysis instead of BMI are emphasized (Vantieghem *et al.*, 2018). Therefore, anthropometric parameters (Pavlovic *et al.*, 2018) such as body weight, lean body mass, fat mass and muscle mass are very closely related to health development in adolescence (Lopes *et al.*, 2018). Because body composition parameters related to physical health should be well defined, and being physically active is one of the healthiest behaviors (Vantieghem *et al.*, 2018). Therefore, adolescents are advised to perform moderate to vigorous physical activity for at least 60 minutes per day (WHO, 2010b). Compliance with these recommendations results in appropriate body weight, increased insulin sensitivity and reduced blood pressure (Vantieghem *et al.*, 2018). It has also been reported to be associated with a high level of physical fitness, a favorable body composition, and protection against hypertension (Arnaoutis *et al.*, 2018). The sedentary and inactive lifestyle in children was found to be associated with BF%, LBM% (Riso *et al.*, 2016) and higher levels of fats (Morrison *et al.*, 2018). This explanations suggests that BF% was in favor of PG with a passive lifestyle level, (AG<NG<PG). This may also explain the role of PG in the first lifestyle level (<12.000 steps). On the other hand, it was shown that children with daily physical activity lifestyle had a greater impact on BMM% component and were strongly associated with low fat indexes because they tend to gain less weight over time (Riso *et al.*, 2016). As a result of these explanations, LBM% and BMM% variables could be provided in favor of AG. Therefore, it can be considered that the AG had made a significant contribution to taking place in the third lifestyle level (>15.000 steps) compared to other groups (PG<NG<AG; p<0.05; Table 1).

In order to determine the physical activity levels of adolescents living in our country, the daily step counts should be identified by appropriate calculations (Güllü, 2018). Therefore, the STEP values of the students were assigned at PG, NG and AG levels. A significant difference was observed between the groups in the 95% confidence interval (P<0.05, Table 1).

Students who go to school by walking or cycling have the potential to significantly increase their daily steps as well as their physical activity level (Bassett *et al.*, 2013). In addition, with the increase of family participation and awareness, children reported a two-fold increase in walking and cycling to school (Craigb *et al.*, 2013). In the present study, although the intervention group could not be assessed how went and came to school, the differences between the STEP averages were significant in favor of AG (F=117.25; p<0.05; PG<NG<AG; Table 1). Also, in a similar study performed according to the number of daily steps in 6-12 age group children (Tudor-Locke *et al.*, 2004) it was found that the AG was gold, NG was silver, and PG was bronze category, respectively. Moreover, children with low weight were observed to have higher daily activity (STEP) levels (Morrison *et al.*, 2018) than overweight children. The cause of sedentary life in children and adolescents is often attributed to environmental factors, in particular to inactive lifestyle habits (Arnaoutis *et al.*, 2018). For this reason, a passive lifestyle may adversely affect the psychological perspective of children, their participation in physical activity, and leisure sports in leisure time (Morrison *et al.*, 2018) both in the present and in the future. As a result of these observations, in the 99% confidence interval, the relationship between STEP averages and anthropometric feature averages can explain the linear relationships between the moderate (r=0.60) or high (r=0.81) level, (p<0.01; Table 2).

The potential innovation of this study was the determination of the daily step number intervals of the male secondary school students in the 10-12-age group by appropriate lifestyle levels. In addition, it was concluded that the parameters such as anthropometric, basal metabolism and the number of steps per day of secondary school boys had a significant effect on daily lifestyle habits. On the other hand, it was concluded that today's environment forces students to a sedentary lifestyle that may experience health problems such as obesity. Therefore, in order to prevent the occurrence of future diseases, prudent approaches that encourage students to a physically active lifestyle should be supported by school management, physical education teacher and health policies.

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