



Evaluation of BMI of secondary school students in terms of some variables¹

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Abstract

The aim of this study is to investigate Body Mass Index (BMI) in Turkish adolescents who regularly participate in physical activity and sedentary adolescents. A total of 941 female and male students aged between 12-14 years were included in the study. 444 female and 497 male students studying at public primary schools of different socio-economic levels voluntarily participated in the study. 290 participants were chosen among those who regularly participating in physical activities at least four days a week. On the other hand, 651 participants were composed of sedentary individuals who did not regularly participate in physical activity and only took physical education class one hour a week. BMI classification was categorized as normal weight (<25), overweight (25-30), and obese (>30), and formulized as $BMI = \text{Bodyweight (kg)} / \text{square Height (m}^2\text{)}$. Data was collected by Personal Information Form. Statistical analysis of data was performed with Two-Way Variance Analysis, t-test for independent samples and Bonferroni Analysis for age variable in SPSS 15.0 packet software.

The results obtained in the study showed that BMI increases in male and female students with age, and there is a significant difference between BMIs in terms of age and gender ($p < 0.05$). In addition, a significant difference was also detected in BMI values of adolescents who regularly participate in physical activity and sedentary adolescents ($p < 0.05$).

Keywords: Adolescence; primary school; sport; body mass index

Introduction

Obesity is a metabolic disease caused by excess fat storage in body. The reason of obesity is the longtime energy instability (Wang et al., 2005). Overeating habit, metabolic and hormonal deficiencies, genetic factors, psychological disorders, and sedentary lifestyle can also be cited among the reasons of obesity (De Lorenzo et al., 2001). Obesity forms due to the complex interaction

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between cultural, social, genetic, physiological, behavioral and psychological factors (Atalay & Hasçelik., 2000).

It is a serious health problem for advanced ages due to its result; however, recent studies have revealed its increasing threat for children and adults (Hiteman et al., 2003).

Obesity is an important problem for children especially on account of its biopsychosocial results (Must & Strauss.,1999; Wabitsch, 2000). Furthermore, children entering puberty overweight or obese will also be overweight or obese in the adulthood (Togashi et al., 2002). The future prevalence of diseases related to overweight or obesity like type II diabetes, hypertension, cardiovascular disorder or metabolic syndrome is depended on the current prevalence of obesity and overweight in today's children (Must et al., 1992; Frontini et al., 2001); therefore, anthropometric follow-up of children is quiet important for their future life.

Researchers have detected fatty streaks and fibrous plaques in the arteries of overweight and obese adolescents, indicating early atherosclerosis, a major risk factor for heart attack or stroke (Haque et al., 2008). Overweight adolescents are also more likely to experience anxiety, depression, attempt suicide, or have low self-esteem and body dissatisfaction and are more likely to attempt suicide (Brown,Teufel, Birch, & Kancherla, 2006; Thompson et al., 2007; Wardle & Cooke 2005).Furthermore, overweight adolescents are more likely to repeat a grade in school, drop out of school, have few friends, and be subjected to weightrelated teasing from friends or family (Falkner et al., 2001; Crosnoe & Mueller., 2004; Keery, Boutelle, van den Berg, & Thompson, 2005).

Researchers associate regular physical activity with a lower risk of overweight, obesity, hypercholesteremia, hypertension, diabetes mellitus type 2, and cardiovascular disease (Elgar et al., 2005; Forshee, Anderson, & Storey, 2004; Taylor et al., 2002). Adolescents who engage in 30 minutes of moderate physical activity (such as brisk walking, bike riding, or swimming) or 20 minutes of vigorous physical activity (such as jogging, rowing, or stair-climbing) at least 3 times a week can significantly lower their risk of cerebrovascular and cardiovascular disease in adulthood (Twisk, Kemper, & van Mechelen, 2002). Research has shown that Promoting Physical Activity 5 regular physical activity can effectively decrease insulin resistance in at-risk adolescents (Kirk et al., 2005). Additionally, physical activity has mental health benefit: physically active adolescents have a lower prevalenceof anxiety and depression (Strohle et al., 2007).

This study was performed to investigate Body Mass Index in terms of certain variables among Turkish adolescents who either regularly participate in physical activities or lead a sedentary life.

Material and method

This is a comparative and descriptive study. Study sample was composed of 941 voluntary students (444 female and 497 male) aged between 12-14 years studying at 5 randomly selected public primary schools with different socio-economic levels in Izmir. 290 participants were chosen among individuals who regularly participate in physical activities at least four days a week. On the other hand, 651 participants were chosen among individuals who lead a sedentary life and only take physical education and sport class one hour a week. In addition, official consents of provincial directorate for national education and schools, and students who did not prefer to participate were no included in the study.

Data collection tools

Personal information form

Personal Information Form was used to obtain demographic features. For determining personal information, form included questions about age, gender, educational and professional status of mothers and fathers, income levels and transportation type to school.

Collection of BMI data

BMI is calculated by dividing body weight with square height ($BMI = \text{body weight (kg)} / \text{square height (m}^2\text{)}$) (Weinstein et al., 2008). BMI is the best and easiest index that shows the overweight based on the relation between weight and height (Özer, 2006; Heyward & Wagner, 2004). BMI is an obesity index gradually accepted throughout the world in 1990s (Rowland, 1991; Van Itallie, 1988). BMI is widely used in epidemiological studies requiring the measurement of large population as it is easy to calculate. Obesity diagnosis is established when the index is over 27.8 kg/m² in adult males and 27,3 kg/m² in adult females (Seidell, 2002). The last classification accepted by WHO is given in Table 1.

Height of participants was measured by milimetric height scale, and body weight was measured by electronic bascule. Body weights and heights were recorded in personal information form and then formulated ($BMI = \text{Body weight (kg)} / \text{square height (m}^2\text{)}$). BMI was calculated for each participant by dividing body weight with square height. BMI values were separated into three

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categories according to classification criteria, which were normal weight (<25), overweight (25-30), and obese (>30).

Table 1. BMI classification in adolescents by WHO

Classification	BMI kg/m ²	Risk for disease
Underweight	< 18.5	Low
Normal	18.5 – 24.9	-
Overweight	25 >	Medium
Pre-obese	25 - 29.9	High
1 st degree obese	30 - 34.9	Moderately high
2 nd degree obese	35 – 39.9	Extremely high
3 rd degree obese	40 >	Very extremely high

Data collection

Anthropometric measurements of all students (bodyweight and height) were carried out in gym centers and open areas determined by school administration with the help of physical education teachers. Measurements were performed by the same researcher to decrease error rate. Height was measured shoeless and weight was measured with only school uniform after taking off jacket and other similar clothes by using standard bascule and height scale. Evaluations were made based on BMI percentiles peculiar to age and gender (Cole, 2000; Sava et al., 2000).

Data analysis

Statistical analysis of data was carried out with SPSS 15.0 packet software. Data was given as mean \pm standard deviation (SD). All P values were compared to 0.05 of significance level. In the evaluation of study data, descriptive statistic techniques were used to compare personal information of participants. In addition, X² test, two-way variance analysis and Bonferroni analysis for age were also used in the study.

Findings

Table 2. Obesity status concerning gender

	Female		Male		Total	
	N	%	N	%	N	%
Normal weight (<25)	392	88.2	447	89.9	839	89.2
Overweight (25-30)	43	9.7	44	8.9	87	9.2
Obese (>30)	9	2.1	6	1.2	15	1.6

Table 3. Height, weight and BMI distributions by age and gender

	Gender	Age	n	X±Sd	min	max
Height (cm)	Female	12	125	151,98±8,27	131,00	173,00
		13	165	157,07 ±7,07	132,00	175,00
		14	154	159,96± 7,06	140,00	180,00
	Male	12	111	151,72± 8,24	136,00	174,00
		13	181	158,32 ±8,23	139,00	180,00
		14	205	165,09±10,86	140,00	192,00
	Total	12	236	151,86±8,24	131,00	174,00
		13	346	157,72±7,71	132,00	180,00
		14	359	162,89±9,75	140,00	192,00
Body Weight (kg)	Female	12	125	45,50±9,90	26,60	73,10
		13	165	51,68±11,75	32,90	84,00
		14	154	53,66±10,74	27,80	94,70
	Male	12	111	45,38±12,96	24,90	112,70
		13	181	51,24±12,39	30,30	112,70
		14	205	56,37±12,75	29,70	91,30
	Total	12	236	45,44±11,42	24,90	112,70
		13	346	51,45±12,07	30,30	112,70
		14	359	55,21±11,99	27,80	94,70
Body Mass Index	Female	12	125	19,47±3,28	14,00	30,00
		13	165	20,92±4,18	13,00	35,00
		14	154	20,88±3,65	14,00	36,00
	Male	12	111	19,33±4,01	13,00	40,00
		13	181	20,25±3,81	13,00	40,00
		14	205	20,51±3,49	13,00	32,00
	Total	12	236	19,40±3,63	13,00	40,00
		13	346	20,57±4,00	13,00	40,00
		14	359	20,67±3,56	13,00	36,00

As can be seen in Table 2, 89.2% of female students were normal weight, 9.7% were overweight, and 2.1% were obese, while 89.9% of male students were normal weight, 8.9% were overweight, and 1.2% of them were obese.

Table 3 demonstrates that weight, height and BMI increased in female and male students with age. Height, weight and BMI values of female students were higher than those of male students in 12-13 years of age curves, but this turned in male students' favor in 14 years of age curve.

Table 4. Height, weight and BMI (Analysis of variances)

		df	Mean square	F	P
Height	Age	2	8066.53	110.79	.000*
	Sex	1	935.59	12.85	.000*
	Age*sex	2	595.13	8.17	.000*
Weight	Age	2	6469.86	45.89	.000*
	Sex	1	115.77	.821	.365
	Age*sex	2	251.87	1.78	.168
BMI	Age	2	137.042	9.743	.000*
	Sex	1	35.386	2.516	.113
	Age*sex	2	5.166	.367	.693

*P<0.05

A significant difference was detected between adolescent ages in terms of weight (F=45.893, P=.000), height (F=110.792, P=.000) and BMI (F=9.743, P=.000). In addition, no significant relation was detected between different genders in terms of age and BMI as well as between age and gender, while there was a significant difference between genders concerning height (F=12.850, P=.000) as well as age and gender (F=8.174, P=.000).

Table 5. Height, weight and BMI distributions by age and gender of individuals concerning physical activity status

	Gender	Age	Participating in physical activity		Sedentary	
			n	X±Sd	N	X±Sd
Height (cm)	Female	12	36	154,86±8,72	89	150,82±7,84
		13	44	158,11±6,90	121	156,70±7,11
		14	40	162,15±7,76	114	159,19±6,66
	Male	12	28	154,21±7,79	83	150,87±8,26
		13	50	161,66±9,03	131	157,04±7,55
		14	92	170,54± 7,06	113	160,66±9,16
Body weight (kg)	Female	12	36	44,62±8,08	89	45,86±10,57
		13	44	51,76±10,64	121	51,66±12,17
		14	40	52,57± 7,06	114	54,04±11,33
	Male	12	28	46,02±13,45	83	45,17±12,87
		13	50	50,11±9,55	131	51,67±13,32
		14	92	59,58± 11,82	113	53,76±12,93
Body Mass Index	Female	12	36	18,33±2,30	89	19,93±3,51
		13	44	20,65±3,59	121	21,02±4,39
		14	40	19,85±2,23	114	21,25± 3,97
	Male	12	28	19,00±4,09	83	19,44±4,00
		13	50	19,06±2,30	131	20,70±4,17
		14	92	20,28± 2,79	113	20,69±3,98

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Table 5 indicates that height, weight and BMI values were in favor of adolescents regularly participating in physical activities compared to sedentary adolescents. In addition, the results of variance analysis demonstrated a significant relation between BMI values of adolescents regularly participating in physical activities and sedentary adolescents ($F=34.995$, $P=.000$).

Table 6. Height, weight and BMI of multiple comparison

			Mean Difference (I-J)	P
Height	12 Age	13 Age	-5.8682*	.000*
		14 Age	-11.0340*	.000*
weight	12 Age	13 Age	-6.0068*	.000*
		14 Age	-9.7644*	.000*
BMI	12 Age	13 Age	-1.1684*	.001*
		14 Age	-1.2673*	.000*

* $P<0.05$

As can be seen in Table 6 In terms of age, the results of Multiple Comparison analysis demonstrated a significant relation between 12 age values with 13 age values and 14 age values according to Height, weight and BMI ($p<0.05$).

Table 7. BMI values of adolescents concerning physical activity status

	Normal weight (<25)		Overweight (25-30)		Obese (>30)		Total	
	N	%	N	%	N	%	N	%
Regularly exercising	277	95.6	12	4.1	1	0.3	290	100
Sedentary	562	86.3	75	11.5	14	2.2	651	100

$X^2: 22.536$ $p: 0.00$

Table 7 presents the BMI values of adolescents concerning physical activity levels of students. As a result of the statistical analysis, a significant relation was observed between BMI values and physical activity levels.

Discussion and result

This study investigated BMI values of Turkish adolescents regularly participating in physical activities or leading a sedentary lifestyle.

As a result of the study, no significant difference was observed in body weights of children aged 12-14 years in terms of gender, while female students aged 12 and 13 years were determined to have higher body weight compared to their male contemporaries; however, this turned in favor of

males in 14 years of age. Similar studies reported that height and body weight of girls were higher than those of boys at the same age (Çolak, 2006; Temel & Aksoy, 2001; Ziyagil et al., 1999).

Malina (1991) reported that because girls enter puberty earlier, they temporarily have higher height and body weight than boys at the beginning of this period. Therefore, in the early stage of adolescent growth, girls are temporarily taller and heavier than boys. Previous studies stated that girls have the highest increase in height at 12 years of age, while boys have the highest increase at 14 years of age; on the other hand, girls have the highest increase in weight at 12.5 years of age that is 6 months later than the highest increase in height, while boys have the highest increase in weight at 14 years of age which is the same age when the highest increase in height occurs (Rogol et al., 2002).

In this study, it is concluded that Turkish girls reach in rapid growth period earlier than boys, and therefore, they have higher body weight than boys. On the other hand, boys have higher body weight than girls at 14 years of age, which indicates that they enter puberty later than girls. From this regard, the present study is compatible with the literature. In addition, no significant difference was found considering height in favor of girls, as indicated in literature, and this could be caused by the fact that boys have the highest increase in height at 14 years of age, and surpass their female contemporaries in height.

As children in adolescence period maintain physical growth, height and body weight are expected to increase in parallel with age. In this study, girls were found to have significantly higher BMI than boys. It was reported that girls were fatter than boys at all ages, and there was no big difference before puberty (Temel & Aksoy, 2001). In the previous studies performed on children aged 12-14 years, it was determined that subcutaneous fat thickness, body fat rate, body fat mass and body mass index were higher in girls than boys (Çolak, 2006). In the present study, overweight and obesity prevalence of girls and boys were found lower than those in some other countries (Goodman S et al. 2002; Kasmini, 1997; Kromeyer et al. 1999; Ogden et al. 2002; Rahmani-Nia et al. 2008). Inadequate nutrition, socio economic and socio cultural factors are cited among the reasons; however, overweight and underweight should be of particular interest to future studies.

A significant difference was detected between BMI values of adolescents regularly participating in physical activities and sedentary adolescents. Adolescents regularly participating in physical activities were found to have normal BMI (<25) and weight. This result demonstrates positive effects of physical activities. Boyce et al. (2008) reported that obesity increases due to lack

of physical activity and exercise, and losing weight is closely related to exercising. This result is compatible with the findings of the present study, as well.

BMI classification was categorized as normal weight (<25), overweight (25-30), and obese (>30) (Seidell, 2002). Accordingly, the number of individuals with normal BMI (<25) was found higher among those who regularly participate in physical activities than sedentary adolescents. Many previous studies reported that BMI could be maintained at normal levels through exercising (Alves et al. 2008; Byrd-Williams et al. 2007). The present study shows similarity with other studies in this regard. It can be suggested that adolescents regularly exercising and participating in physical activities can better manage BMI.

The number of overweight sedentary adolescents (25-30 BMI) was found higher than overweight adolescents (25-30 BMI) regularly participating in physical activities (Table 5). The results of some other studies support the findings of the present study (Alves et al. 2008, Sevimli, 2008).

It was determined in this study that Turkish adolescents, regularly participating in physical activities, had better results in all parameters compared to sedentary adolescents. In addition, significant differences were detected between participation in physical activity and BMI. This result is also compatible with the literature.

Malnutrition and sedentary lifestyle are among the most important factors causing obesity and overweight at present. Technology facilitates daily living conditions, but brings many disadvantages, as well. Studies especially indicate that obese and overweight children will also have weight problems in their future life. In the present study, BMI values of individuals regularly participating in physical activities were lower than those of sedentary individuals, and regular physical activity has positive effects on BMI. Regular exercises and physical activities help adolescents to maintain the ideal body weight and also contribute to maintain BMI at normal levels. From this regard, it is important to inform sedentary adolescents on BMI. In order to raise a healthy society, sport and physical activity habits should be promoted at early ages and developed as an indispensable part of living style for family and society.

References

- Atalay, A., Hasçelik, H.Z. (2000). Obezite. *Hacettepe Tıp Dergisi*. 31 (4) :320-329
- Alves, J.G., Gale, C.R., Mutrie, N., Correia, J.B., Batty, G.D. (2008). 6-Month Exercise Intervention Among Inactive and Overweight Favela-Residing Women in Brazil: The Caranguejo Exercise Trial. *Am J Public Health*. 12.p.120-5.
- Boyce, R.W., Boone, E.L., Cioci, B.W., Lee, A.H. (2008). Physical activity, weight gain and occupational health among call centre employees. *Occup Med*. 58(4):p.238-44.
- Byrd-Williams, C., Kelly, L.A., Davis, J.N., Spruijt-Metz, D., Goran, M.I. (2007). Influence of gender, BMI and Hispanic ethnicity on physical activity in children. *Int J Pediatr Obes*. 2(3):p.159-66.
- Brown, S.L., Teufel, J.A., Birch, D.A., Kancherla, V. (2006). Gender, age and behavior differences in early adolescent worry. *Journal of School Health*, 76, 430–437.
- Cole, T.J., Bellizzi, M.C., Dietz, W.H. (2000). Establishing a Standard definition for child overweight and obesity worldwide: *international survey*. *BMJ* 320:1240-1243.
- Crosnoe, R., Mueller, C. (2004). Body Mass Index, academic achievement and school context: Examining the educational experiences of adolescents at risk of obesity. *Journal of Health and Social Behavior*, 45, 393–407.
- Çolak, M. (2006). Erzincan İlinde Yaşayan 12-14 yaş Kız ve Erkek Çocuklarda Sağlıkla ilişkili Fiziksel Uygunluk Düzeylerinin Değerlendirilmesi, *Gazi Üniversitesi Yayınlanmamış Doktora Tezi*, Ankara
- De Lorenzo, A., MAiolo, C., Mohamed, E.I., Andreoli, A., Luca, P.P., Rossi, P. (2001). Body composition analysis and changes in airways function in obese adults after hypocaloric diet. *Chest*.119(5):p.1409-1414.
- Elgar, F.J., Roberts, C., Moore, L., & Tudor-Smith, C. (2005). Sedentary behaviour, physical activity and weight problems in adolescents in Wales. *Public Health*, 1999, 518–524.
- Falkner, N.H., Neumark-Sztainer, D., Story, M., Jeffrey, R. W., Beuhring, T., & Resnick, M. (2001). Social, educational, and psychological correlates of weight status in adolescents. *Obesity Research*, 9, 32–42.
- Forshee, R.A., Anderson, P.A., & Storey, M. L. (2004). The role of beverage consumption, physical activity, sedentary behavior and demographics on body mass index of adolescents. *International Journal of Food Sciences and Nutrition*, 55, 463–478.
- Frontini, M.G., Bao, W., Elkasabany, A., Srinivasan, S.R., Berenson G. (2001). Comparison of weight-for-height indices as a measure of adiposity and cardiovascular risk from childhood to young adulthood: the Bogalusa heart study. *J Clin Epidemiol*. 54:817–2
- Goodman, S., et al. (2002). Childhood obesity of growing urgency. *The Med Journal of Australia*. 176: 400-401.
- Hiteman, M.K., Starapoli, C.A., Benedict, C., Borgeest, C., Flaws, J.A. (2003). Risk faktörs for hot flashes in midlife women. *Journal of Women's Health*. 12:p.459-472.
- Haque, A. K., GAdre, S., Taylor, J., Haque, S. A., Freeman, D., & Duarte, A. (2008). Pulmonary and cardiovascular complications of obesity: An autopsy study of 76 obese subjects. *Archives of Pathology and Laboratory Medicine*, 132, 1397–1404.
- Heyward, V.H., Wagner, D.R. (2004). Applied bodycomposition assessment. *Human Kinetics Books*. p.3-105.

- Ozsaker, M. (2012). Evaluation of BMI of secondary school students in terms of some variables. *International Journal of Human Sciences* [Online]. (9)2, 276-287.
- Kirk, S., Zeller, M., Claytor, R., Santangelo, M., Khoury, P. R., and Daniels, S. R. (2005). The relationship of health outcomes to improvement in BMI in children and adolescents. *Obesity Research*, 13, 876–882.
- Kasmini, K. (1997). Prevalence of overweight and obese school children age between 7 to 16 years amongst the major pacific groups in Kuala Lumpur, Malaysia. *Asia Pacific J Clin Nutr*, 6: 172-174.
- Kromeyer, H.K., Zellner, K. and Jaeger, U. (1999). Prevalence of overweight and obesity among school children in Jena (Germany). *Int J Obes*. 23: 1143-1150.
- Keery, H., Boutelle, K., van den Berg, P., & Thompson, J. K. (2005). The impact of appearance-related teasing by family members. *Journal of Adolescent Health*, 37, 120–127.
- Malina, R.M., Bouchard, C. (1991). Growth, Maturation and Physical Activity. *Human Kinetics Book*, USA Charrtpaign, Illinois, 52-424,
- Must, A., Strauss, R.S. (1999). Risks and consequences of childhood and adolescent obesity. *Int J Obes Relat Metab Disord*. 23:2–11
- Must, A., Jacques, P.F., Dallal, G.E., Bajema, C.J., Dietz, W.H. (1992). Long-term morbidity and mortality of overweight adolescents. A follow-up of the Harvard Growth Study of 1922 to 1935. *N Engl J Med*. 327:1350-5
- Ogden, C.L., et al. (2002). Prevalence and trends in overweight among US children and adolescents 1999-2000. *Jama*. 288: 1728-1732.
- Özer, M.K. (2006). Fiziksel Uygunluk. Ankara. Nobel Yayınevi. p.173-230.
- Rowland, T.W. (1991). Effects of obesity on aerobic fitness in adolescent females. *Am J Dis Child*. 145(7):p.764-8.
- Rogol, A.D., Roemmich, J.N., Clark, P.A. (2002). Growth at Puberty. *Journal of Adolescent Health*. 31:192-200.
- Rahmani-Nia, F., Rahnama, N., Bambaiechi, E. (2008). Prevalence of Overweight and Underweight among Iranian High-school Students. *International Journal of Sports Science and Engineering*. Vol. 02, No. 02, pp. 101-106
- Seidell, J.C. (2002). Obezitenin epidemiyolojisi. *International Textbook of Obesity*. Eds.: Björntorp P. Çev. Kahramanoğlu M. Göteborg: Wiley. p.23-29.
- Savva, S.C., Tornaritis, M., Savva, M.E., et al. (2000). Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *International Journal of Obesity and Related Metabolic Disorders*. 24:1453-1458.
- Sevimli, D.(2008). Erişkinlerde Fiziksel Aktivite - Beden Kitle İndeksi İlişkisinin Araştırılması *TAF Prev Med Bull*. 7(6):523-528
- Strohle, A., Hofler, M., Pfister, H., Muller, A-G., Hoyer, J., Wittchen, H-U. et al. (2007). Physical activity and prevalence and incidence of mental disorders in adolescents and young adults. *Psychological Medicine*, 37, 1657–1666.
- Togashi, K., Masuda, H., Rankinen, T., Tanaka, S., Bouchard, C., Kamiya, H. (2002). A 12-year follow-up study of treated obese children in Japan. *Int J Obes Relat Metab Disord*. 26:770–7
- Temel, Z.F., Aksoy, B.A.(2001). Ergen ve Gelişimi. Ankara: Nobel Yayıncılık. 22-24.

- Ozsaker, M. (2012). Evaluation of BMI of secondary school students in terms of some variables. *International Journal of Human Sciences* [Online]. (9)2, 276-287.
- Taylor, A. J., Watkins, T., Bell, D., Carrow, J., Bindeman, J., Scherr, D. et al. (2002). Physical activity and the presence and extent of calcified coronary atherosclerosis. *Medicine and Science in Sports and Exercise*, 34, 228–233.
- Thompson, J. K., Shroff, H., Herboso, H., Cafri, G., Rodriguez, J., & Rodriguez, M. (2007). Relations among multiple peer influences, body dissatisfaction, eating disturbance and self-esteem: A comparison of average weight, at risk for overweight and overweight adolescent girls. *Journal of Pediatric Psychology* 32, 24–29.
- Twisk, J.W.R., Kemper, H.C.G., & Van Mechelen, W. (2002). The relationship between physical fitness and physical activity during adolescence and cardiovascular disease risk factors at adult age: The Amsterdam Growth and Health Longitudinal Study. *International Journal of Sports Medicine*, 23, S8–S14.
- Van Itallie, T.B. (1988). Topography of Body Fat: Relationship to Risk of cardiovascular and other Diseases. Eds.:Lohman TG, Roche AF, Martorell R. Anthropometric Standardization Reference Manual. *Illions:Human Kinetics Books*. p.1144-50.
- WHO (World Health Organization)Obesity. (2000). Preventing and managing the global epidemic. *WHO Report* 894,Geneva,
- Wardle, J. & Cooke, L. (2005). The impact of obesity of psychological wellbeing. *Best Practice & Research Clinical Endocrinology & Metabolism*, 19, 421–440.
- Wabitsch, M. (2000). Overweight and obesity in European children: Definition and diagnostic procedures, risk factors and consequences for later health outcome.*Eur J Pediatr*. 159:8–13.
- Weinstein, A.R., Sesso, H.D., Lee, I.M., Rexrode, K.M., Cook, N.R., Manson, J.E., et al.(2008). The joint of physical activity and body mass index on coronary heart disease risk in women. *Arch Intern Med*.168(8):p.884-90.
- Wang, Y., Lobstein, T. (2006). Worldwide trends in childhood overweight and obesity. *IntJ Pediatr Obes*. 1:11–25
- Wang, F., McDonald, T., Reffitt, B., Edington, D. (2005). BMI, physical activity, and health care utilization/costs among medicare retirees. *Obes Res*.13(8):p.1450-7.
- Ziyagil, M.A., Zorba, E., Bozatlı, S, İmamoğlu O. (1999). 6-14 yaş grubu çocuklarda yaş, cinsiyet ve spor yapma alışkanlığının sürat ve anaerobik güce etkisi. *C.B.Ü.Beden Eğitimi ve Spor Bilimleri Dergisi* (3):9-18.