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Differences in Body Composition between 12 Years Old Pupils Both Genders from Center and Suburb

Daniela Shukova Stojmanovska[1], Georgi Georgiev[2], Serjoza Gontarev[3]

[1, 2, 3]University "Ss. Cyril and Methodius", Faculty of Physical Education, Sport and Health, Skopje, R. Macedonia

Abstract: ***This research was implemented on a population of 12 years old, sixth grade pupils - N=84 (34 male and 50 female) from an elementary school in center, and 110 pupils from an elementary school in suburb (59 male and 51 female). 12 variables through which body composition can be determined, were measured: body mass (BM), height (BH), body mass index (BMI), percentile distribution of body mass index (BMIperc), percentage of fat tissue (%FT), percentage of muscle tissue (%MT), abdominal (abdsf), dorsal (dorssf) and upper arm skin folds (uparmsf) and basal metabolism (basmet). After that two more variables were estimated: the sum of three skin folds as a variable (sumsf) and the sum of body mass index (BMI) and the sum of three skin folds as a new variable - bmisum3, for estimating obesity. The sample was divided into four subsamples: male from center (N=34), female from center (N=50), male from suburb (N=59) and female from suburb (N=51). The purpose of the research was to estimate the differences between the groups, if any, in all variables, so ANOVA (univariant analysis of variance) and MANOVA (multivariant analysis of variance) were calculated, and afterwards LSD tests between all groups and in all variables, to define where the differences between groups come from. Obtained results show that statistically significant differences between four groups existed only in two variables: percentage of muscle tissue (musc%) and basal metabolism (basmet), on a level of .001 and .000, respectively. From the significance of the LSD tests it can be concluded that the differences between groups in those two variables appear due to differences between male pupils from center and female pupils from both schools, and also from differences between male pupils from suburb and female pupils from both schools.***

Keywords: 12 years old pupils, body composition, male, female, percentage of muscle tissue, basal metabolism, center, suburb.

1. Introduction

Children not long ago were found to play outside with their peers all day long and it was their priority during the day, beside obligations. These last 10 years the situation is substantially different. According to Department of Health (2014) children in UK have low activity level, because they are preoccupied with mobile phones. Riddoch C.J., Andersen L.B., Wedderkopp N., Harro M., Klasson-Heggebø L., Sardinha L.B., Cooper A.R., and Ekelund U. (2004), in their research included 9-15 years old pupils from Denmark, Portugal, Estonia and Norwey, and found that when younger (until 9 years) 97% of the children are active and meet the recommendations for health-related physical activity. Unfortunately, at age of 15, they are much less active, and only 82% of the boys and 62% of the girls meet the recommendations for health-related physical activity, potentiating that boys are more active than girls on every age.

Matthews C.E., et all (2008) blames lower physical activity during the day and more hours of sitting lead with "rejuvenation" of some illnesses like hypertension, diabetes, or premature mortality. According to Colberg S.R., et all. (2016) American Diabetes Association recommends individuals break up ST every 30 minwith light-intensity activity which is impossible to achieve with the children today. So maybe sport and physical education classes on a daily basis should be accepted as one of the ways to achieve more physical activity during the day as a counterbalance to sedentary life style so early in life, like in elementary school.

2. Material and Methods

Participants

This research was implemented on a population of 12 years old, sixth grade pupils - N=84 (34 male and 50 female) from an elementary school in center, and 110 pupils from an elementary school in suburb (59 male and 51 female). 12 variables through which body composition can be determined, were measured: body mass (BM), height (BH), body mass index (BMI), percentile distribution of body mass index (BMIperc), percentage of fat tissue (%FT), percentage of muscle tissue (%MT), abdominal (abdsf), dorsal (dorssf) and upper arm skin folds (uparmsf) and basal metabolism (basmet). After that two more variables were estimated: the sum of three skin folds as a variable (sumsf) and the sum of body mass index (BMI) and the sum of three skin folds as a new variable - bmisum3, for estimating obesity. The sample was divided into four subsamples: male from center (N=34), female from center (N=50), male from suburb (N=59) and female from suburb (N=51).

The variables for estimating the body composition and basal metabolism were measured with Tanita TBF-400, and skin folds were measured with a calliper.

Statistical analysis

The purpose of the research was to estimate the differences between the groups, if any, in all variables, so ANOVA (univariant analysis of variance) and MANOVA (multivariant analysis of variance) were calculated, and after words LSD tests between all groups and in all variables, to define where the differences between groups come from.

Percentile distribution was calculated with software application of the CDC Center for disease control and prevention, and it was estimated individually according to the precise age in years and months:

- percentile distribution of BMI for male and female, modificated by Frisancho A.R., (1990), whereby instead in 4, subjects were devided into 5 categories (instead one degree of underweight, there are two- extreme underweight (under 5th percetile), and underweight (5th to 15th percetile).

http://reference.medscape.com/calculator/body-mass-index-percentile-boys
http://reference.medscape.com/calculator/body-mass-index-percentile-girls

The division of the groups (by percentile distribution) with this method is shown below:

- Under 5th percentile - extreme under average values
- From 5th to 15th percentile - under average values
- From 15th to 85th percentile - average values
- From 85th to 95th percentile - above average values
- Over 95th percentile - extreme above average values

Purpose of the research

The purpose of the research was to see if any statistically significant differences in the body composition and the measured variables existed between the four groups, male and female from center and male and female from suburb, and also to estimate the cause of the differences, or to see which differences between which groups are statistically significant.

3. Results and Discussion

The results in the research are showen in seven tables. In table 1 are shown results of statistical analysis of male pupils from center (N=24), with these varibales: mean, standard deviation, minimum, maximum, skewness and kurtosis. According to the results of the skewness it can be concluded that in 11 out of 12 variables the ditribution is simetric, since their values are less than 1. The only exception is the variable (dorsal skin fold-dorssf) where the distribution is assimetyric. It can also be seen that in five variables (BH, BMI, fat%, uparmsf and bmiperc) the values are negative which means that male pupils from center have above average values in those variables. From the kurtosis values in the same table it can be concluded that it has flattened ditribution, platykurtic curve, which means that the subjects have different values of the variables. The exception is variable - dorssf with positive sign, which means that the subjects have simmilar values.

The results of Statistical analysis of female pupils from elementary school in center, presented in table 2, are very similar with their male peers. All variables (except one - dorssf) have symetric ditribution (skewness less than 1) and in five variables female pupils have above average values (BH, fat%, musc%, basmet and bmiperc), because the signs of the variables are negative. From the kurtosis values in the same table it can be concluded that it is leptocurtic in half of variables - BW, BMI, uparmsf, dorssf, sumsf and bmisum3 (the subjects have simmilar values), and in the other half of the variables is platocurtic, which means the results are dispersed.

Table 1: Statistical analysis of male pupils from elementary school in center (N=34)

variables	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
BH (height)	153.69	8.829	135	167	-.061	-1.007
BW (weight)	49.84	11.724	26	73	.211	-.660
BMI	21.01	4.089	15	28	-.078	-1.328
fat%	23.46	9.315	6	40	-.209	-1.014
musc%	35.11	3.314	29	42	.356	-.658
uparmsf	19.97	8.237	6	33	-.043	-1.238
dorssf	11.44	6.916	4	32	1.570	2.052
abdsf	22.37	11.693	4	40	.093	-1.366
basmet	1468.65	164.328	1106	1793	.110	-.141
bmiperc	68.32	32.885	3	98	-.765	-1.008
sumsf	53.78	25.058	14	104	.246	-.958
bmisum3	74.88	28.864	29	128	.178	-1.098

Table 2: Statistical analysis of female pupils from elementary school in center (N=50)

variables	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
BH (height)	153.98	6.830	140	168	-.139	-.526
BW (weight)	49.18	10.761	29	82	.592	.648
BMI	20.70	3.729	14	33	.703	1.292
fat%	24.67	8.125	8	39	-.246	-.880
musc%	32.88	2.702	25	39	-.232	-.116
uparmsf	18.39	6.859	8	40	.551	.418
dorssf	12.60	6.331	5	32	1.331	1.453
abdsf	20.34	9.235	5	40	.497	-.269
basmet	1327.36	91.549	1111	1516	-.137	-.228
bmiperc	68.34	28.163	2	99	-.991	-.275
sumsf	51.33	20.296	19	104	.554	.134
bmisum3	72.06	23.700	33	137	.538	.232

Table 3: Statistical analysis of male pupils from elementary school in suburb (N=59)

variables	Mean	Std.Dev.	Minimum	Maximum	Skewness	Kurtosis
BH (height)	151.53	7.734	135	167	.028	-.572
BW (weight)	48.68	12.093	29	76	.429	-.737
BMI	21.04	4.195	15	30	.297	-1.164
fat%	24.54	9.154	6	41	-.130	-1.163
musc%	34.45	3.031	29	42	.465	-.147
uparmsf	18.44	8.565	6	40	.398	-.771
dorssf	11.08	6.657	4	33	1.202	.979
abdsf	20.71	12.069	6	40	.286	-1.476
basmet	1439.56	161.768	1146	1805	.260	-.693
bmiperc	68.39	30.945	2	98	-.778	-.850
sumsf	50.24	25.871	17	97	.325	-1.410
bmisum3	71.32	29.848	32	125	.295	-1.441

Statistical analysis of male pupils from elementary school in suburb, presented in table 3, shows that skewness is less than 1 in all variables, except one (dorssf), which means the distribution is symmetric. Only in two variables the signs are negative, which means these pupils have above average values - fat% and bmiperc, which actually means worse results. From the kurtosis values in the same table it can be concluded that it has flattened ditribution, platykurtic curve,

which means that the subjects have different values of all the variables, except one (dorssf).

Table 4: Statistical analysis of female pupils from elementary school in suburb (N=51)

variables	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
BH (height)	151.90	7.326	132	166	-.298	-.116
BW (weight)	49.88	12.977	27	75	.291	-.977
BMI	21.42	5.174	14	34	.463	-.838
fat%	26.52	10.612	7	46	-.065	-1.164
musc%	32.62	4.322	26	54	2.245	10.435
uparmsf	19.00	8.798	7	40	.619	-.514
dorssf	12.98	9.184	5	40	1.916	3.208
abdsf	19.53	10.635	5	40	.485	-.783
basmet	1322.86	109.213	1070	1515	-.101	-.680
bmiperc	63.78	32.851	1	99	-.566	-1.145
sumsf	51.51	26.968	18	117	.873	-.021
bmisum3	72.96	31.317	33	151	.844	-.086

Statistical analysis of female pupils from elementary school in suburb, presented in table 4, shows that skewness is less than 1 in all variables, except two (musc% and dorssf), which means the distribution is symmetric. In four variables this pupils have above average values - BH, fat%, basmet and bmiperc. From the kurtosis values in the same table it can be concluded that it has flattened ditribution, platykurtic curve, because of the negative signs of the most of the variables, which means that the subjects have different values of the variables. Only in two variables - musc% and dorssf, the results are simmilar (positive sign).

Table 5: ANOVA (univariant analysis of variance) and MANOVA (multivariant analysis of variance) between the four subsamples (male and female from elementary school in center and male and female from elementary school in suburb)

variables		N	Mean	Std. Dev.	Mean Square	F	Sig.
musc%	1	34	35.11	3.314	64.846	5.634	0.001
	2	50	32.88	2.702			
	3	59	34.45	3.031			
	4	51	32.62	4.322			
	Total	194	33.68	3.513			
basmet	1	34	1468.65	164.328	258849.8	14.398	.000
	2	50	1327.36	91.549			
	3	59	1439.56	161.768			
	4	51	1322.86	109.213			
	Total	194	1385.06	147.387			

Wilks' Lambda	F	Hypothesis df	Error df	Sig.
0.159	12.687	36	529.603	.000

Univariant analysis of variance (ANOVA) and multivariant analysis of variance (MANOVA) in all 12 variables, between the four groups of pupils (male and female from elementary school in center and male and female from elementary school in suburb) are presented in table 5. As it can be seen, only statistically significant variables are presented in the table. It can be seen that the differences between groups are statistically significant on a level of .000. But from the ANOVA it can be seen that statistically significant differences appear only in two variables: percentage of muscle tissue (musc%) and basal metabolism (basmet), on a level of .001 and .000, respectively. To be sure, differences between which groups are making the differences statistically significant, LSD tests were applied, and they are presented in table 6. As it can be seen, only the variables that have statistically significant differences are shown, percentage of muscle tissue (musc%) and basal metabolism (basmet), on a level of .001 and .000, respectively.

LSD test of a variable percentage of muscle tissue (musc%), shows that differences in that variable are due to differences between male pupils from center and female pupils from both elementary schools (center and suburb), on a level of .000 and .000, and also between male pupils from suburb and female pupils from both elementary schools (center and suburb), on a level of .000 and .000.

Table 6: Statistically significant LSD tests between the four subsamples of pupils (male - N=34 and female - N= 50 from center and male - N=59 and female - N=51 from suburb) and in variables: percentage of muscle tissue (musc%) and basal metabolism (basmet)

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.
musc%	1	2	2.236*	.754	.003
		3	.664	.731	.364
		4	2.496*	.751	.001
	2	1	-2.236*	.754	.003
		3	-1.571*	.652	.017
		4	.260	.675	.700
	3	1	-.664	.731	.364
		2	1.571*	.652	.017
		4	1.832*	.649	.005
	4	1	-2.496*	.751	.001
		2	-.260	.675	.700
		3	-1.832*	.649	.005
basmet	1	2	141.287*	29.805	.000
		3	29.088	28.871	.315
		4	145.784*	29.687	.000
	2	1	-141.287*	29.805	.000
		3	-112.199*	25.774	.000
		4	4.497	26.685	.866
	3	1	-29.088	28.871	.315
		2	112.199*	25.774	.000
		4	116.697*	25.637	.000
	4	1	-145.784*	29.687	.000
		2	-4.497	26.685	.866
		3	-116.697*	25.637	.000

*The mean difference is significant at the 0.05 level.

LSD test of a variable basal metabolism (basmet), displays almost identical results, meaning that the differences between groups are due to differences between male pupils from center and female pupils from both elementary schools (center and suburb), on a level of .003 and .001, and also between male pupils from suburb and female pupils from both elementary schools (center and suburb), on a level of .017 and .005, respectively.

Although differences between the two groups of male pupils, and the two groups of female pupils are not statistically significant (shown in table 6), it can be seen in table 5 that pupils that go in the elementary school in center have larger percentage of muscle tissue in both genders

(center - 35.11% male, 32.88% female and suburb - 34.45% male, 32.62% female).

This is not the result what we thought we will get, because it is unexpected pupils from center to have more muscle tissue than pupils in suburb. So the only differences might be that the children from school in center are more often taken to some sport activities, maybe due to being richer, and on the other side, pupils from suburb have mixed nationality and mixed financial opportunities. Shukova Stojmanovska D.,& Georgiev G. (2017) presented that approximately one third of the male pupils are attending sport activities (24 out of 62) and half of the female pupils (38 out of 77) in both settlements. According to Frazer A., Voss C., Winters M., Jean Naylor P., Higgins W., and Mc Kay K. (2015) children that live in the center are more active when going to school and usually go by walking or cycling, and also are more active during the day. Their peers from suburb are more often driven to school and are less active during the day. Larouche R., Saunders T.J., Faulkner G.E.J., Colley R., and Tremblay M. (2014) confirmed their results (saying that active pupils are more active during the day), but however think that it only increases the cardiovascular fitness, but has no connection to body composition. Cooper A.R., Page A.S. Foster L.J., and Qahwaji D. (2003) found out that only the male pupils that go to school by walking or cycling are more active during the day. Owen C.G., Nightingale C.M., Rudnicka A.R., van Sluijs E.M.F., Ekelund E., Cook D.G., and Whincup P.H. (2012), in their research found that white pupils in UK usually go to school walking or cycling, the black African pupils usually go to school by public transport and Asian pupils usually go by car, which might be the reason why Asian pupils are the least active during the day, even out of school. They suggest that also the distance from home to school should be taken into consideration and apply that pupils that live at bigger distances, make more steps during the day.

Table 7: Values of three variables - basal metabolism (basmet), body weight (BW) and fat percentage (fat%) in four subsamples of pupils (center and suburb)

variables	center		suburb	
	male	female	male	female
basal metabolism (basmet)	1468kcal I	1327kcal III	1439kcal II	1322kcal IV
body weight (BW)	49.84kg II	49.18kg III	48.68kg IV	49.88kg I
fat percentage (fat%)	23.46% I	24.67% III	24.54% II	26.52% IV

Wanted to establish if there are some connections between basal metabolism and weight and the percentage of fat (fat%). Basal metabolism, depends on body weight, age and gender (Klausen B., Toubro S., and Astrup A. ,1997). So if body weight (BW) is analyzed in table 7, it can be seen that male pupils from center are heavier than their female peers from center (49.84kg male v.s. 49.18kg female), but also than male pupils from suburb (49.84kg male v.s.48.68kg). The female pupils from suburb are the heaviest with a weight of 49.88kg, probably due to larger percentage of fat tissue - fat% at female pupils (26.52%) in comparison to male pupils (24.54%). The obtained results show that male in center spend more calories on basal metabolism (1468kcal) in comparison to male in suburb (1439kcal), probably due to higher values of body weight (49.84kg v.s. 48.68kg) and smaller percentage of fat tissue (23.46% v.s. 24.54%). So, male in both settlements have higher basal metabolism then female. Female from suburb are the heaviest (49.88kg) and the male pupils from suburb are the lightest (48.68kg). The biggest fat percentage have female from center (24.67%) and the smallest have male from center (23.46%). Shukova Stojmanovska D., Georgiev G.,&Konatrev S. (2016) have found that the percentages of overweight pupils in center v.s. suburb are 31% to 19% and the percentages of obese pupils in center v.s. suburb are 14% to 23%, respectively, although the average percentage of both groups together are similar (45% in center and 42% in suburb).

Although Jèquier E. (1984) find in his research that heavier people spend more energy during the day, however according to some authors like, Tremblay A., Sauvè L., Desprès J.P., Nadeau A., Thèriault G., and Bouchard C. (1989) and Ranneries C., Bülow J., Buemann B., Cristiensen N.J., Madsen J.,and Astrup A. (1998), obese people and subjects predisposed to obesity have lower basal metabolism. This statement can be proved with the results shown in table 7, where it can be seen that female from suburb are the heaviest (49.88kg), but yet have the lowest basal metabolism (1322kcal), probably due to the highest fat percentage (26.52%). But Ravussin E., et all. (1988) give another perspective in this subject, by claiming that the chances for gaining weight by 10 kg in the next 4 years (follow up study) are bigger in subjects that have lower basal metabolism by only 200kcal on a daily basis. Astrup A., et all. (1999) have the same opinion, considering lower resting metabolic rate in previously obese subjects, as a mark of increased chances of regain weight.

So maybe in the next research we will try to find out more about basal metabolism in children with different body mass index and try to follow up this children in longer period. Also we think that the usage of mobile phones in “good purpose”, like using applications for choose healthy meal (Clarke P.,&Evans S.H., 2014), or motivating people to exercise (Ranucci C., et all., 2017), and all in order to decrease weight and BMI (Fangchao L., et all., 2015), instead of playing games, should be investigated in the future, too.

4. Conclusion

Obtained results show that statistically significant differences between four groups existed only in two variables: percentage of muscle tissue (musc%) and basal metabolism (basmet), on a level of .001 and .000, respectively. From the significance of the LSD tests it can be concluded that the differences between groups in those two variables appear due to differences between male pupils from center and female pupils from both schools, and also from differences between male pupils from suburb and female pupils from both schools.

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Author Profile

Daniela Shukova Stojmanovska, Faculty of Physical Education, Sport and Health, University “Ss. Cyril and Mathodius” Skopje, R. Macedonia