DIFFERENCES IN BODY COMPOSITION BETWEEN 12 YEARS OLD ATHLETS AND NON-ATHLETS BOTH GENDERS

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(abstract)

Key words: 12 years old pupils, athletes, non-athletes, body composition

This research as part of other extensive research, was implemented on a population of 62 male and 77 female pupils, 11 years old, sixth grade in two elementary schools from Skopje: "11 Oktomvri"(downtown) and "Aco Shopov"(in Radishani, as a suburb). Pupils were asked if they attend any sport regularly. The purpose was to determine the differences in body composition, if any, between athletes and non-athletes. 24 of the male and 35 of the female pupils approach to regular training 3 times a week, and 38 male and 42 female pupils aren't attending any organized physical activity. 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 (PBM), height (PBH) and body mass index (PBMI), percent of fat tissue (%FT), percent of muscle tissue (%MT), abdominal (abdsf), dorsal (dorssf) and upper arm (uparmsf) skin folds and basal metabolism (basmet). From the obtained results it can be concluded that although the male athletes group has better results in smaller body mass, smaller percent of skin folds and higher basal metabolism, statistical significant changes existed only in one variable (percent of muscle tissue - %MT). The results in female group, are almost the same, except there aren't any statistically significant differences in any of the variables. The explanation for such a situation may be, that athletes group have training three times a week, which might be enough for better results in some variables, but not enough (since they have training only three times a week) for statistically significant differences in all variables, which might appear if the first group attend any sport at least five times a week. Besides, we don't have information how long before the research pupils were training, nor if there were continuity.

РАЗЛИКИ ВО СОСТАВ НА ТЕЛОТО МЕЃУ 12 ГОДИШНИ СПОРТИСТИ И НЕСПОРТИСТИ ОД ОБАТА ПОЛА

(апстракт)

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Истражувањето е дел од друго пообемно истражување, а е спроведено на популација од 62 ученици и 77 ученички на возраст од 11 години (шесто одделение), од две скопски училишта – „11 Октомври“ (во Центар) и „Ацо Шопов“ во Радишани, како приградска населба. Ѕите ученици беа прашани дали тренираат редовно некој спорт. Целта беше да се одреди дали постојат разлики во составот на телото, меѓу категоријата кои спортуваат редовно и оние кои не спортуваат. Кај учениците 24 редовно тренираат, а 38 не тренираат, а кај ученичките - 35 редовно тренираат, а 42 не тренираат. Кај сите ученици беа мерени 12 варијабли со чија помош може да се одреди составот на телото, како телесната маса (ТМ), телесната висина (ТВ), индексот на масата на телото (БМИ-body mass index), перцентилната дистрибуција на телесната маса, висината и индексот на масата на телото, процентот на масното и мускулното ткиво, кожни дипли на стомак, грб и надлактица и базалниот метаболизам. Според добиените резултати може да се заклучи дека иако групата на спортисти покажува подобри резултати во однос на помала телесна маса, помал процент на масно и поголем процент на мускулно ткиво, помали вредности на кожните дипли, како и повисок базален метаболизам, сепак не постојат статистички значајни разлики меѓу двете групи. Исклучок е варијаблата процент на мускулно ткиво, каде разликите се статистички значајни. Кај ученичките не постојат статистички значајни разлики меѓу двете групи во ниту една варијабла. Причината може да се должи на тоа што со тие категории, се тренира најчесто три пати неделно, што можеби дава подобри резултати во некои варијабли во однос на оние кои не спортуваат, ама сепак недоволно за тие разлики да бидат и статистички значајни. Освен тоа, немаме информација колку време пред истражувањето децата тренирале и дали постоел континуитет.

1. INTRODUCTION

Today, in modern world, the science has shown that the training and physical activity have very important role in improvement of health of the participants, no matter the age, and no matter the physical condition in the moment. It is important to underline that people have accepted that and started to attend different forms of physical activity. If one want to know evaluate the impact of physical activity on the body, one of the methods is to estimate the body composition prior the exercising, and then after a period of 1, 2 or three months, especially if the subject wants to lose weight. Shukova Stojmanovska D., Kontarev S.&Dimeski F. (2014) have shown that the first changes start to manifest after the first month of regular physical activity, but for the changes to become statistically significant, two months were necessary. This can be a good stimulus for the participants, when the results can be seen very soon, and also they can be followed up in longer period of time. The variables that are followed the most, beside body weight, are percent of fat, percent of muscle tissue, and different skin fold thicknesses. One of the measures tracked very often is body mass index, BMI, although WHO doesn’t recommend it for younger children and older than 50 years. But is is used very much because it is easy to calculate it and it has very high correlation with percent of fat obtained with dual energy x-ray absorptiometry (DXA).

In children, it is also used but mostly through percentile distribution’s curves that are age specific (2-20 years) and gender specific (female and male), obtained by measuring huge population of children, and providing the specifics and periods of children’s growth. That way, every subject’s BMI, or height or weight, can be compared to peer’s BMI, or height or weight, and it can be concluded if that person is taller or heavier than the peers.

According to Petrović (1994) physical activity is increasing the energy expendure, the basal methabolism, and the sympathetic activity, which is reduced in obese persons. That is reason why, regular physical activity leads to decrease of fat percent, increase of muscle tissue, but also increase of basal metabolism, which means, according to Milošević P. (1986), that the energy expendure will be higher during the hall day.

2. METHOD OF WORK

2.1. Subjects

This research as part of other extensive research, was implemented on a population of 62 male and 77 female pupils, 11 years old, sixth grade in two elementary schools from

Skopje: “11 Oktomvri”(centrum) and “Aco Shopov”(in Radishani, as a suburb) in May 2014. Pupils were asked if they attend any sport regularly. 24 of the male and 35 of the female pupils approach to regular training 3 times a week, and 38 male and 42 female pupils aren’t attending any organized physical activity. 11 variables through which body composition can be determined, were measured: body mass (BM), height (BH), body mass index (BMI), percentile distribution of body mass (BMperc), of height (BHperc) and of body mass index (BMIperc), percent of fat tissue (%FT), percent of muscle tissue (%MT), abdominal (abdsf), dorsal (dorssf) and upper arm skin folds (uparmsf) and basal metabolism (basmet).

For the three variables: body height (BH), body weight (BW) and body mass index (BMI), percentiles for each subject individually, were calculated, too, according to their age in years and months. The purpose for that was to see if differences will appear in this variables, between the two subsamples (athletes and non-athletes) and to estimate which subsample has better results.

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

2.2. Statistical analysis

In order to estimate the differences between groups of pupils that are training regularly and the ones that are not training, descriptive statistics was applied and T – test of small independent samples. The results are shown in six tables.

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

- percentile distribution of height for male and female
  http://reference.medscape.com/calculator/height-age-percentile-boys,
  http://reference.medscape.com/calculator/height-age-percentile-girls
- percentile distribution of weight for male and female
  http://reference.medscape.com/calculator/weight-age-percentile-boys
  http://reference.medscape.com/calculator/weight-age-percentile-girls
- 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

2.3. Purpose of the research

The purpose of the research was to see if any differences in the body composition existed between the two groups, athletes vs. non-athletes, both genders, and also to estimate in which variables the changes are the biggest.

3. RESULTS AND DISCUSSION

The results in the research are showen in six tables. In table 1 are shown results of statistical analysis of male athletes (N=24), with these varibales: mean, standard deviation, minimum, maximum, range, skewness and kurtosis. According to the results of the skewness it can be concluded that in 10 out of 12 variables the ditribution is simetric, since their values are less than 1. Only in two variables (dorsal skin fold-dorssf and body weight in percentile-BWperc) the distribution is assimetyric. It can also be seen that in three varibales (BMIperc, BHperc and BWperc) the values are negative which means that male athletes 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 subject have different values of the variables. There are exceptions in only 2 variables: dorsal skin fold (dorssf), and body weight in percentile (BWperc).

Table 1. Statistical analysis of male athletes (N=24)

ser. num.	variables	Mean	Std. Deviation	Minimum	Maximum	Range	Skewness	Kurtosis
1	BH	154,000	8,4068	138,0	167,0	29,0	,180	-,965
2	BW	49,696	9,9321	34,5	70,2	35,7	,305	-,436
3	BMI	21,075	3,3598	16,1	26,0	9,9	,069	-1,528
4	fat%	24,108	7,6143	9,7	35,3	25,6	-,368	-1,129
5	mm%	35,538	2,7356	31,9	41,0	9,1	,702	-,756
6	basmet	1473,46	131,786	1247	1753	506	,134	-,040
7	uparmsf	20,42	7,506	10	33	23	,166	-1,536
8	dorssf	11,25	6,496	5	33	28	2,057	5,016
9	abdsf	22,19	11,274	6	40	34	,173	-1,332
10	BMIperc	72,25	25,893	24	97	73	-,708	-,963
11	BHperc	72,13	26,640	11	100	89	-,892	-,098
12	BWperc	76,63	25,587	25	98	73	-1,273	,020

Table 2. Statistical analysis of male non-athletes (N=38)

ser. num.	variables	Mean	Std. Deviation	Minimum	Maximum	Range	Skewness	Kurtosis
1	BH	151,605	8,3068	135,0	167,0	32,0	,045	-,814
2	BW	49,955	13,7289	26,4	75,6	49,2	,255	-1,083
3	BMI	21,392	4,5647	14,5	27,9	13,4	-,162	-1,507
4	fat%	25,221	10,0342	6,4	40,0	33,6	-,334	-1,226
5	mm%	33,842	3,1403	28,6	41,9	13,3	,550	-,192
6	basmet	1450,00	190,303	1106	1805	699	,294	-,844
7	uparmsf	19,68	9,074	6	35	29	-,068	-1,262
8	dorssf	12,50	7,664	4	32	28	,885	-,106
9	abdsf	23,13	13,006	4	40	36	-,139	-1,611
10	BMIperc	67,76	35,867	3	98	95	-,742	-1,272
11	BHperc	63,92	31,245	3	100	97	-,574	-,984
12	BWperc	68,95	32,195	1	99	98	-,696	-,961

Statistical analysis of male non-athletes is shown in table 2. From the results of the skewness it can be concluded that non-athletes have negative values in the variables connected to obesity, which means non-athletes have above average values in those variables, like: body mass index (BMI), percent of fat (fat%), abdominal (abdsf) and upperarm skin folds (uparmsf), body mas index in percentiles (BMIperc), body weight in percentiles (BWperc) and in body height in percentiles (BHperc). From the results of kurtosis shown in the same table, it can be seen that since all the variables have negative values the distribution has a flattened distribution, which means the results are forming a platycurtic curve, meaning they have different values.

Table 3. T-test between male athletes (N=24) and non-athletes (N=38)

ser. num.	variables	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
1	BH	24	154,000	8,4068	1,7160	1,101	60	,275
		38	151,605	8,3068	1,3475			
2	BW	24	49,696	9,9321	2,0274	-,080	60	,936
		38	49,955	13,7289	2,2271			
3	BMI	24	21,075	3,3598	,6858	-,293	60	,770
		38	21,392	4,5647	,7405			
4	fat%	24	24,108	7,6143	1,5543	-,465	60	,644
		38	25,221	10,0342	1,6278			
5	**mm%**	**24**	**35,538**	**2,7356**	**,5584**	**2,174**	**60**	**,034**
		38	33,842	3,1403	,5094			
6	basmet	24	1473,46	131,786	26,901	,528	60	,599
		38	1450,00	190,303	30,871			
7	uparmsf	24	20,42	7,506	1,532	,330	60	,742
		38	19,68	9,074	1,472			
8	dorssf	24	11,25	6,496	1,326	-,662	60	,510
		38	12,50	7,664	1,243			
9	abdsf	24	22,19	11,274	2,301	-,293	60	,771
		38	23,13	13,006	2,110			
10	BMIperc	24	72,25	25,893	5,285	,531	60	,597
		38	67,76	35,867	5,818			
11	BHperc	24	72,13	26,640	5,438	1,064	60	,291
		38	63,92	31,245	5,069			
12	BWperc	24	76,63	25,587	5,223	,987	60	,328
		38	68,95	32,195	5,223			

T –test of small independent samples, shown in table 3, was applied to see if those changes are statistically significant. So, statistically significant differences existed only in one variable, percent of muscle tissue (mm%), on a level of .034. But from the obtained results and the signs of the variables, it can also be concluded that athletes have higher values in body height (BH), percent of muscle tissue (mm%), basal metabolism (basmet), upperarm skin fold (uparmsf), body mass index in percentiles (BMIperc), body height in percentiles (BHperc) and body weight in percentiles (BWperc). Body weight (BW), percent of fat (fat%) and the body mass index (BMI) have higher values in non-athletes (probably due to more fat in the body), but the percentile distribution of the same variables (BWperc and BMIperc), have higher values in athletes, probably due to higher values in height and in muscle tissue, participating also in weight and in calculating BMI (which can also be seen in table 1 and 2).

Table 4. Statistical analysis of female athletes (N=35)

ser. num.	variables	Mean	Std. Deviation	Minimum	Maximum	Range	Skewness	Kurtosis
1	BH	153,200	7,1406	140,0	167,5	27,5	-,061	-,559
2	BW	48,854	11,8768	30,7	73,1	42,4	,483	-,455
3	BMI	20,766	4,1834	14,0	29,7	15,7	,658	-,171
4	fat%	24,594	8,9769	8,7	40,6	31,9	,188	-,839
5	mm%	32,980	2,6929	28,2	37,3	9,1	-,348	-1,007
6	basmet	1321,69	102,932	1114	1504	390	-,042	-,568
7	uparmsf	18,89	7,729	8	39	31	,669	-,147
8	dorssf	12,97	9,080	5	40	35	1,975	3,322
9	abdsf	19,83	10,629	5	40	35	,726	-,472
10	BMIperc	67,94	28,345	1	98	97	-,939	-,285
11	BHperc	67,03	30,026	10	100	90	-,747	-,924
12	BWperc	69,06	29,517	5	99	94	-,987	-,301

According to the results for the female athletes, shown in table 4, it can be concluded that there is a symmetric distribution in all variables, except one, dorsal skin fold (dorssf). From the sign of the variables in skweness we can say that female athletes are taller (BH), lighter (BW), have less fat (fat%), smaller values of all skin fold thicknesses (uparmsf, dorssf and abdsf) more muscle tissue (mm%) and bigger values of basal metabolism (basalmet). All variables, except one, dorsal skin fold (dorssf), have negative sign in kurtosis, which means that the results are forming platycurtic curve, meaning they have different values.

Table 5. Statistical analysis of female non-athletes (N=42)

ser. num.	variables	Mean	Std. Deviation	Minimum	Maximum	Range	Skewness	Kurtosis
1	BH	152,869	7,6653	132,0	166,0	34,0	-,302	,022
2	BW	50,162	11,5854	29,1	81,5	52,4	,374	-,061
3	BMI	21,395	4,4806	14,3	33,6	19,3	,761	,927
4	fat%	26,655	9,2500	8,3	45,6	37,3	-,360	-,459
5	mm%	32,095	2,9666	25,3	38,7	13,4	-,097	-,101
6	basmet	1331,64	96,542	1111	1516	405	-,246	-,618
7	uparmsf	19,20	7,963	7	40	33	,712	,584
8	dorssf	12,83	6,829	5	37	32	1,538	2,961
9	abdsf	20,31	9,291	5	40	35	,201	-,502
10	BMIperc	68,52	31,020	2	99	97	-,938	-,593
11	BHperc	64,98	28,989	4	100	96	-,626	-,900
12	BWperc	72,36	27,319	3	100	97	-1,175	,457

In table 5 are shown results of statistical analysis of female non-athletes. It can be seen that all variables are symmetric, except two: dorsal skin fold (dorssf) and body weight in percentiles (BWperc). The values and signs of kurtosis are showing that some of the variables have platycurtic curve, meaning they have different values, like: BW, fat%, mm%, basmet, abdsf, BMIperc and BHperc, while in others they are forming a leptocurtic curve, meaning that they are very close and grouped on similar level (BH, BMI, uparmsf, dorssf, BWperc).

The results of the T-test for independed samples are displayed in table 6. The situation is very similar to the male group, in terms of non existing statistical differences between both subsamples in all variables. Besides the differences are not statistically significant, it can be seen that female athletes are higher (BH), with higher values in body height percentile (BHperc) and have more muscle tissue (mm%). Non-athletes are heavier (BW), bigger value of BMI, bigger value in body mass index in percentiles (BMIperc) and body weight in percentiles (BWperc).

Table 6. T-test between female athletes (N=35) and non-athletes (N=42)

ser. num.	variables	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
1	BH	35	153,200	7,1406	1,2070	,195	75	,846
		42	152,869	7,6653	1,1828			
2	BW	35	48,854	11,8768	2,0075	-,488	75	,627
		42	50,162	11,5854	1,7877			
3	BMI	35	20,766	4,1834	,7071	-,633	75	,529
		42	21,395	4,4806	,6914			
4	fat%	35	24,594	8,9769	1,5174	-,986	75	,327
		42	26,655	9,2500	1,4273			
5	mm%	35	32,980	2,6929	,4552	1,358	75	,178
		42	32,095	2,9666	,4578			
6	basmet	35	1321,69	102,932	17,399	-,437	75	,663
		42	1331,64	96,542	14,897			
7	uparmsf	35	18,89	7,729	1,306	-,176	75	,861
		42	19,20	7,963	1,229			
8	dorssf	35	12,97	9,080	1,535	,076	75	,940
		42	12,83	6,829	1,054			
9	abdsf	35	19,83	10,629	1,797	-,212	75	,833
		42	20,31	9,291	1,434			
10	BMIperc	35	67,94	28,345	4,791	-,085	75	,932
		42	68,52	31,020	4,787			
11	BHperc	35	67,03	30,026	5,075	,304	75	,762
		42	64,98	28,989	4,473			
12	BWperc	35	69,06	29,517	4,989	-,509	75	,612
		42	72,36	27,319	4,215			

If regular physical activity, is applied at children or older individuals, according to Shukova Stojmanovska D., Kontarev S.&Dimeski F. (2014), at least 2 months are necessary for the changes to be seen. As a respond, the subjects get more muscle tissue, which burns more calories, and at the same time they also burn fat. At the end there is weight decrease and decreasing of body mass index (BMI) and the percent of fat. That is the reason why athletes, both genders, are lighter, have less fat (percent of fat and skin fold thicknesses) and more muscle tissue, than non-athletes.

There might be several reasons for such results. First, we don't have information if the athletes both genders have been training ordinarily for longer period of time or maybe they started one month before the research. Second, we don’t have information if the subjects have accessed different types of sports or only one. Third, the subjects that train professionally were not divided from the ones that approach on training three times a week. And the last, and maybe the most important is that in the athlete group were subjects that train professionally and ones that train only three times a week. Maybe, if only the professional subjects were taken into consideration, or maybe only subjects that train at least for a year, the results would’ve been different, meaning that maybe than the differences between groups would’ve been statistically significant, probably in both genders.

Biro, M.F., Khoury, P. &Morisson, J.A. (2006), say that, the leaner the male athletes are (with smaller BMI) they got earlier their puberty. Malina, R.M., Meleski, B.W. and Shoup, R.F. (1982) think that the reason for that is the smaller percent of body fat in young athletes. Since male athletes are entering puberty earlier, it means that they are growing faster and they will reach their final height earlier, which might be the reason that they are taller.

According to Frisch, R.E., 1980 (quotation Milojević, M.&Berić, B., 1983) at some female athletes the puberty appear later and in male sportsmen earlier. According to Malina, R.M. (1983) this happened in all female athletes exclude swimmers. Stager, J.M., Robertshaw, D. and Miescher, E. (1984) think that this is happening even in swimmers, too. Birgitta, L., et al. (2007) think that menarche appear earlier in girls that have less physical activity, which means that the girls that are performing sport got the period later. The intensity of the physical activity has a major connection with menarche. Malina, R.M., Spirduso, W.W., Tate, C. and Baylor, A.M. (1978) research the age of menarche at 110 girls that are not doing any sport, 59 high school girls, 53 students athletes and 18 volleyball players - olympic candidates. So as a conclusion they stated that athletes have the menarche later than other groups, but the olympic athletes got the period the latest - even later than the “common” athletes. This means that female athletes shood access vigorous physical activity for the changes vs. non-athletes to be visible. But, even three times a week physical activity, can bring changes in body composition like decrease in percent of fat, skin fold thicknesses, and weight, and increase in percent of muscle tissue, basal metabolism and even in height. This means that female athletes at age of 12 most likely haven’t got their period, and haven’t entered puberty, so that’s the reason they are taller. On the other hand, female nonathlete’s weight and BMI are higher, which, according to Biro, M.F., Khoury, P. and Morisson, J.A. (2006), might lead to earlier puberty. That might be the reason why female non-athletes have lower height, due to earlier finishing of the growth (table 6).

4. CONCLUSION

In the conclusion we can say that T-test for independent samples was applied to estimate the differences in the 12 variables measured in this research between male athletes and non-athletes, and female athletes and non-athletes. From the obtained results, it can be said that statistical significant differences existed only in male sample and only in one variable - percent of muscle tissue (mm%) on a level of .034. In the female sample there weren’t any statistical significant differences between subsamples (athletes and non-athletes).

However a tendency can be notices that athletes are taller (BH), lighter (BW), with smaller body mass index (BMI), percent of fat (fat%) and skin fold thicknesses (uparmsf, dorssf and abdsf) and higher values of basal metabolism even at that age. Also in percentile distribution of height, weight and BMI, all the pupils are in average values, but athletes show higher values in body height in percentiles (BHperc), due to pronounced height, but reduced values in body weight in percentiles (BWperc) and in body mass index in percentiles (BMIperc), due to lower values of weight.

The explanations for such a situation might be several:

- no information about the length of training period prior the research;
- no information if the subjects have accessed different types of sports or only one;
- no information if the subjects trained professionally or just three times a week;
- probably the differences between groups would've been statistically significant if only professional subjects were taken into consideration. That way, maybe it would've been difficult to provide a good sample.

So, the athletes group, both genders, have training three times a week, which might be enough for better results in some variables, but not enough (since they have training only three times a week) for statistically significant differences in all variables, which might appear if the first group attend any sport at least five times a week.

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