

# EFFECTS OF PROGRAMMED PHYSICAL ACTIVITY ON BODY FAT AND BMI IN FEMALE HIGHSCHOOL STUDENTS

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## Abstract

The aim of this research was to determine the effectiveness of different school-based physical activity (PA) interventions on body fat and BMI in female students. This research consisted of (n=106) healthy participants, who regularly attended school physical education (PE) classes. The research sample was divided in two observed groups, using different PA content. In the group A (n=53), PA content consisted of learning volleyball basics, while in the group B (n=53) it consisted of mastering volleyball, basketball games and different techniques, as well as athletics and sport gymnastics, based on regular school curriculum. The results have shown that there was no significant mean difference, based on  $p < 0.05$ , neither in body fat (skinfolds) nor in BMI, after PA interventions in both groups. The conclusion of this research was that the choice of kinesiology operators, methodical work forms and application of PE content in time frame of one school year, were insufficient factors to achieve success in reducing the level of BMI and adiposity. However, those factors played significant part in the prevention of overweight in general, together with other important factors such as total physical activity, health status and eating habits.

Key words: **changes, adiposity, morphological characteristics, adolescents, physical education**

## Introduction

Factors such as defining goals and objectives (limiting factors), the PE curriculum programming by choosing the procedures and kinesiology operators as a part of students' personality development, represents the main characteristics of the PE (Prskalo & Babin, 2006). The gym lesson as the basic form of PE schoolwork organization, is in the service of a comprehensive influence on the students' anthropological status. It is a prerequisite for the increase of total PA in the school population and the way to engage them in other schoolwork forms of physical activities (Prskalo & Babin, 2012). On the other hand, a growing problem that emphasizes the importance of PE is the emergence of sedentary lifestyle (TV, PC, video games, excessive use of mobile phones etc.). Such lifestyle of school population usually leads to physical inactivity increase, postural deformities, and the onset of obesity and overweight and their associated diseases (Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998). Development time (pace of development) of certain morphological dimensions, growth and maturation are different in females (Butte, Garza, & de Onis, 2007). The body height and weight in boys are predominantly increased with the end of puberty. When total body mass is concerned, it is greatly increased in girls. In adolescence period, total body mass in girls is two times bigger than in boys. Hypodermic

adipose tissue ratio in total body mass is high in girls, and higher than in boys of the same age (Malina, Bouchard, & Bar-Or, 2004). It should be noted that the inherent coefficient determines the level of influence of kinesiology operators to any change could be seen. The greatest influence on changes is possible with voluminousity and total weight and the least with longitudinal dimensionality (Malacko & Rado, 2004). Biological legality of growth and development clearly require special attention and action within the framework of programmed PE. Aerobic exercise (walking, jogging, swimming, cycling) longer duration (> 30 min) with lower and moderate intensity contributes to the reduction of body fat and maintaining body weight (Ostojic, 2006). The content of PA that encourages the development of aerobic capacity, endurance, strength, flexibility and general coordination, find their place in the application (Organization, 2008). The curriculum and program content of PE for high school students is consisted of complex and acyclic movements and sports through the program structure of the basic and additional sports (timed differently represented in the ratio of 70:30). The conditions in which technique and sports games are carried out in PE classes, are ranging from medium to a sub-maximal intensity (Janković, Marelić, Hofman, Volčanšek, & Zdražnik, 2003). During middle school age (11-15) and

older (aged 15-18), the successful accomplishment of sports elements and techniques is present, both in PE as well as through active engagement in some of the sports activity (Bompa, 2000). The recommendation of 60 minutes of daily PA in the gymclass and outside, with active breaks during classes as well as further education classes on nutrition, has a preventive effect and impact on the reduction of physical inactivity and increase of daily PA (Organization, 2000; Strong et al., 2005). The aim of this research is to determine, the existence of quantitative changes in adiposity (skinfolds) and body mass index (BMI) in adolescents, as an effect of different kinesiology content.

## Methods

### Subjects

The sample consisted of 106 healthy, first and second grade, female high school students, aged from 14 to 16, capable of active participation in PE classes during one school year. There were 53 female students in the group A and 53 in the group B. The students were enrolled in studies based on their age and health status. The research was conducted in accordance with the school principals' authorisation and the parents' consent.

### The sample of variables

After the skinfold sites were marked, subcutaneous fat (skinfolds) were assessed by appliance of three variables:

1. Subcutaneous fat – skinfold thickness subscapular (ANALED),  
Measurement was conducted on the left side of the body under the lower angle of the scapula, with the skinfold caliper and precision of 1mm.
2. Subcutaneous fat – skinfold thickness abdominal (ANATRB)  
Measurement was conducted on the left side of the body, relating to the umbilicus, 5 cm distance with the skinfold caliper and precision of 1mm.
3. Subcutaneous fat – skinfold thickness triceps (ANANAD).  
Measurement was taken from the back of the left arm, above the triceps muscle with the skinfold caliper and precision of 1mm.

In purpose of calculating BMI, the measurement was carried out as followed:

1. Longitudinal dimensionality –body height (AVISTJ)  
Body height was measured with a stadiometer and precision of 1mm.
2. Voluminousity –body weight (AMASTJ)  
Body weight was assessed with a calibrated digital scale and precision of 100 gr.

After the estimation of anthropometric characteristics were done, the BMI was calculated as body weight divided by height squared (kilogram per meter squared).

### Collecting data methods

The baseline assessment was made in the beginning of the school year, in both groups, by appliance of variables for estimating skinfold thickness and BMI. In the same way, final measurement was made, at the end of the school year in both groups. All assessments were made at the same daytime (in the morning) and at the beginning of the lesson. Assessments of each variable were made three times and then the average was included in the data analysis. Measurements were conducted in the accordance with IBP program. Assessments of body fat and anthropometric characteristics were obtained with a calibrated digital scale and stadiometer (SECA, OMEGA, GERMANY) as well as with skinfold caliper (BASELINE, USA). Every students' BMI is calculated as body weight divided by height (kilogram per meter squared). The measurement was conducted by a professional educated person.

### Study design

The group A students attended volleyball curriculum contents lessons. The lessons consisted of teaching, practising and repeating volleyball basics as well as applying rules through the gameplay. Natural forms of movement and warm up exercises defined introductory part of PE lesson. The main part of the lesson in the A group was consisted of teaching, practising and repeating volleyball basics (the A part of the lesson) as well as applying rules through the game (the B part of the lesson). Relaxation and stretching exercises were final part of lesson (individual and frontal form as well as pair work form of PE lesson organization were present). In both groups, lessons are conducted throughout organization parts with appliance of same methodical and organization forms of work (individual, frontal, group and parallel form of methodical organization work). The second group B students practised volleyball and basketball techniques (teaching, practising of basic sports techniques) as well as gymnastics and athletics elements. Both groups' contents were carried out regularly twice a week (45 min per lesson) during a school year in totalled of 70 classes within a school year based on secondary schools curriculum contents of Federation of Bosnia and Herzegovina. The way of conducting PA content and kinesiology operators throughout PE lessons was same in both groups. The PA content in group B is programmed so that the basic sport (volleyball) is consisted in 70% of total yearly curriculum content and the rest of 30% is referred on additional sport (basketball, gymnastics and athletics) according to PE curriculum for technical highschools in Federation of Bosnia and Herzegovina. The PE content was conducted during one school year, twice a week, in total duration of 70 lessons. The part of 66 lessons was

consisted of PA interevntion content and the rest of 4 lessons were related to initial and final measurements of body fat(skinfolds) and BMI. According to schedule of PE, all lessons were conducted daily from 13:00 p.m. to 19:00 p.m.(CET)

## Statistical analysis

Before proceeding to any multivariate data processing, Kolmogorov-Smirnov (KS) test of normality was carried out with results obtained in both timeline measurements and groups. Data distribution did not differ from normal so the next step in analysis was application of T-test for two dependent groups. With help of this statistic method we determined the difference between arithmetic means of results from applied variables, at the baseline and after PA interventions, in both groups. We also used T test for two independent groups to determine differences between arithmetic means of results obtained at the baseline in both groups as well as after PA interventions in both groups too. We determined individual quantitative changes resulted as the effects of different kinesiology content at  $p < 0.05$ . Data processing was conducted with application of spss 20 statistic program.

## Results

As a first step in statistic analysis, Kolmogorov-Smirnov test of normality (tabel 1.) was conducted, with the results from initial and final measurements in both groups. The level of statistical significance was at  $p < 0.05$ .

With use of T test for two independent groups, result analysis of initial measurement in both groups was conducted. There were no significant differences between arithmetic means at  $p < 0.05$ . Such conclusion pointed that the samples of analyzed groups were from the same population in relation to variables (Table 2.).

After determining that there was no deviation from normal results distribution (tabel 1.), arithmetic mean differences of final measurement results was analysed (tabel 2.). Such results indicated that there was no statistical significant difference between arithmetic means of results obtained from the final measurement of skinfolds and BMI.

With the application of T paired test for dependent groups, partial analysis of arithmetic means in both groups were made, separately. It was made from the results obtained after PA intervention (Tabel 3). There was no significant difference of arithmetic means obtained at  $p < 0.05$ .

**Table 1.** KS normality of distribution ,initial and final measurement within groups

Variable	Group	Kolmogorov-Smirnov test of normality			
		Initial		Final	
		Statistic	Sig.	Statistic	Sig.
AVISTJ	A	.09	.20	.10	.20
	B	.07	.20	.08	.20
AMASTJ	A	.09	.20	.09	.20
	B	.08	.20	.07	.20
BMI	A	.07	.20	.11	.20
	B	.07	.20	.07	.20
ANALED	A	.12	.07	.10	.20
	B	.11	.09	.12	.07
ANANAD	A	.07	.20	.07	.20
	B	.09	.20	.12	.08
ANATRB	A	.08	.20	.08	.20
	B	.06	.20	.09	.20

**Table 2.** T-test for independent groups

Variable	Initial measurement						Final measurement						
	A group	B group	Mean	Std. Dev.	t	Sig.	A grupa	B grupa	Mean	Std. Dev.	t	df	Sig.
AVISTJ	164.78	165.36	-.58	8.74	-.48	.63	165.43	165.39	.04	7.64	.04	52	.97
AMASTJ	53.30	54.71	-1.41	8.02	-1.28	.21	53.78	53.93	-.15	8.10	-.14	52	.89
BMI	19.60	19.97	-.38	1.93	-1.41	.16	19.60	19.68	-.08	2.14	-.27	52	.79
ANALED	12.78	12.82	-.04	4.82	-.06	.96	12.86	12.42	.43	5.36	.59	52	.56
ANANAD	13.72	14.48	-.76	4.66	-1.18	.24	14.38	13.79	.59	4.13	1.03	52	.31
ANATRB	20.05	20.06	-.02	.92	-.13	.89	19.72	19.79	-.07	5.69	-.09	52	.93

**Table 3.** T paired test for dependent groups

Variable	Group A						Group B						
	I	F	Mean	Std. Dev.	t	Sig.	I	F	Mean	Std. Dev.	t	Df	Sig.
AVISTJ	164.78	165.43	-.65	5.53	52	.60	165.36	165.39	-.03	5.30	-.04	52	.97
AMASTJ	53.30	53.78	-.48	3.36	52	.72	54.71	53.93	.77	7.16	.79	52	.44
BMI	19.60	19.60	-.01	0.02	52	.98	19.97	19.68	.29	2.16	.97	52	.34
ANALED	12.78	12.86	-.08	1.11	52	.91	12.82	12.42	.39	5.13	.55	52	.58
ANANAD	13.72	14.38	-.66	1.16	52	.25	14.48	13.79	.69	5.44	.92	52	.36
ANATRB	20.05	19.72	.32	0.39	52	.70	20.06	19.79	.27	6.43	.31	52	.76

## Discussion

The aim of this research was to determine quantitative changes in body fat (skinfolds) and BMI in female high-school students, obtained as the effects of different PA content. Increased food intake with high energy-dense and low fiber diet, combined with sugar, sweetened beverages, sedentary way of life and physical inactivity are the main factors of obesity and overweight in adolescents and children (Doak, Visscher, Renders, & Seidell, 2006).

Prevention of body fat increase with school-based PA interventions and balanced energy expenditure can be successfully implemented at early school age than is the case in adolescents (Doak et al., 2006). The reason is found in body height increase in this age group. Increase of body height and body mass is noted in final measurement of both groups. The total PA is important factor of weight and total body mass regulation but has no influence on body height increase which is genetically conditioned (Butte et al., 2007). The BMI should be observed as an independent measure and does not indicate if the increase causes an increase in fat mass (Organization, 2000). In this research, the obtained results from the initial measurement was processed by using the KS test of normality which indicated the similarity of entities without statistically significant differences between arithmetic means. Furthermore, the same result was obtained after the analysis of the arithmetic means differences in final measurements, in both groups. The results pointed out that there was no significant difference in the outcome. By the analysis of arithmetic mean differences within groups after the PA content was conducted, the volleyball content in the group A and combined content of different sports games in the group B, highlights unchanged results. There were no changes in body fat (skinfolds) or BMI as well as in reduction of total body weight at all. Statistically significant increase of body height could not be seen. As the results indicate, there were no changes in body fat and BMI reductions and the increase of body height is related to the individual growth and maturation pace. But the conclusion could be made that the PA content of both groups contributed to the level maintenance of the analyzed morphological characteristics. Reduction of BMI and body fat is not possible without time pattern increase for school based interventions (Harris, Kuramoto, Schuler, & Retallack, 2009; Sun et al., 2013). Weekly number of PA lessons is insufficient to achieve positive outcomes and morphological transformations (Prskalo & Babin, 2012). Additional classes, active school breaks as well as after school sports activities, are contributing to decrease of body fat (Klakk, Chinapaw, Heidemann, Andersen, & Wedderkopp, 2013; Kriemler et al., 2010; Prskalo & Babin, 2008; Wardle, Brodersen, & Boniface, 2007). The scope and choice of school based PA can provide BMI reduction but not a reduction in body fat equally (Dollman, Ridley, Magarey, Martin, & Hemphill, 2007; Farias et al., 2009; Martinez Vizcaino et al., 2007; Singh, Paw, Brug, &

van Mechelen, 2009; Sun et al., 2013). The outcomes of several studies indicated that regardless of the scope and choice, there is no significant reduction of BMI and body fat (Flodmark, Marcus, & Britton, 2006). But at the same time, the evidence of stabilization of the BMI can be found as a contribution to obesity/overweight prevention (Farias et al., 2009; Klakk et al., 2013).

## Conclusion

Genetic conditionality is the limiting factor of changes in longitudinality dimension but leaves a free space for kinesiology content whose purpose is to affect and support changes in other morphological dimensionalities during the school year PE lessons. In this research, the outcomes implicate that applied PA interventions in both groups did not have statistically significant effects. With the insight of arithmetic means differences within each group after PA intervention, it can be concluded that there were no changes in statistical significant level. However, generally speaking, none of the contents had sufficient scope and intensity to cause positive changes in terms of values reduction of skinfold and BMI within age group normatives. But even in this case, the PA interventions in both groups contributed to their development support as well as level maintenance and prevention of increase. One of the important factors which could contribute to the decrease of recommended levels of BMI and body fat is the increase of number of planned PE classes within one school year. The attention should be focused on process of programming PE curriculum by choosing PA content, way of lesson organization in accordance with students' needs and motivation and most important of all, their growth and maturation pace, is insufficient. To achieve a significant effects of kinesiology operators it is necessary to combine regular classes with additional one on weekly basis as well as to provide informative and educational classes involving healthy diet and need for after-school sports activities. Recommendation of number and lesson duration increase per week is also unavoidable. These factors are crucial in obesity/overweight prevention and related health disorders caused by it in this particular aged population. The goal is to create regular healthy lifestyle habits in order to preserve and maintain health status in older age to come.

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