



ANALYSIS OF ANTHROPOMETRIC INDICATORS ASSOCIATED WITH THE RISK OF DEVELOPING METABOLIC COMPLICATIONS AMONG SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI" STUDENTS

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ABSTRACT

The increasing number of people who are overweight and obese worldwide leads to an increase in the cardiovascular and metabolic diseases. Although the risk of complications is associated with a high Body Mass Index, the distribution of adipose tissue is a more significant factor for development of morbidity and mortality. Numerous studies have shown that in the android (central) type of obesity, the risk of developing metabolic syndrome is increased. The aim of this study was to determine the risk of metabolic complications in connection with the distribution of adipose tissue, among students of Sofia University "St. Kliment Ohridski". **Methods:** Data was collected by measuring the anthropometric indicators "Waist circumference", "Hip circumference" and calculating "Waist/hip ratio", and was statistically processed and analyzed. **Results:** The analysis of the study's results shows a high percentage of the students with an increased risk of morbidity. **Conclusions:** The results obtained show a high percentage of young people with an increased risk of metabolic complications. In this regard, the author recommends an obesity prevention program involving a healthy diet model and regular, targeted physical activity and sports.

Key words: obesity, waist circumference, waist/hip ratio, metabolic syndrome, university students, prevention

INTRODUCTION

Despite numerous attempts and recommendations to reduce the prevalence of obesity and concomitant diseases, obesity remains a global medical and social problem. Overweight and obese people have a number of adverse health consequences, decreased quality of life and life expectancy, in many of the cases. They are at higher risk of certain complications and socio-significant diseases such as arterial hypertension, ischemic heart disease, stroke, type 2 diabetes mellitus, certain types of cancer, joint diseases, cholelithiasis and/or cholecystitis, non-alcoholic steatohepatitis, asthma, sleep apnea, reproductive complications, psychological disorders.

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Although the risk of complications is associated with increased BMI, the distribution of adipose tissue is a more significant factor in the development of morbidity and mortality. Waist circumference and waist/hip ratio are indicators of abdominal obesity and the distribution of visceral fat. They are used to determine the health risk in people who are normal weight, overweight and obese. To some authors' opinion, waist circumference is a better indicator of metabolic risk than BMI (1).

According to WHO, in women an increased cardio metabolic risk is considered when circumference of the waist ≥ 80 cm, and in men ≥ 94 cm. If the waist circumference in men is ≥ 102 cm and ≥ 88 cm in women, there is a significantly increased cardio metabolic risk (2). Android (visceral) obesity carries greater health risk than gynoid obesity (3). In android obesity, the risk of developing metabolic syndrome is increased (4).

The risk factors for occurrence of metabolic syndrome are many, but in first place, we need to put unhealthy nutrition as well as reduced physical activity. Metabolic syndrome predicts an increased risk of heart attacks and strokes, which links it to earlier mortality.

In the android (central) obesity, an increased accumulation of adipose tissue in visceral depots (internal organs) is characteristic. Visceral fat, unlike peripheral, is more closely related to insulin resistance and associated metabolic disorders. In this type of obesity, glucose tolerance (prediabetes), type 2 diabetes mellitus, dyslipidemia (high levels of triglycerides and low levels of "good" - HDL-cholesterol), hyperuricemia (high levels of uric acid), arterial hypertension and ischemic heart disease, are often present (5).

Abdominal (central) obesity, regardless of BMI, is a risk factor for developing type 2 diabetes mellitus and it may be assumed that waist/hip ratio is a better indicator for predicting this disease (6).

Numerous studies have shown that with an increase in BMI, blood pressure rises progressively in both men and women. Arterial hypertension increases the risk of cardiovascular disease, myocardial infarction and stroke (7, 8).

According to D. Wormser; Kaptoge, E; Di Angelantonio (2011) in persons with visceral type of obesity, the risk of ischemic heart disease and myocardial infarction is greater than in individuals with peripheral type of obesity (9).

A number of studies have shown that the most effective treatment for overweight and obesity are programs including diet treatment, increased physical activity, behavioral therapy and a multidisciplinary team (10, 11).

The **aim** of this study was to determine the risk of developing metabolic complications, in connection with the distribution of adipose tissue, among Sofia University "St. Kliment Ohridski" students, and to assess the effect of applied kinesitherapy methodology with different weekly frequency in terms of waist circumference indicator.

METHODS

In the experiment took part 269 Sofia University "St. Kliment Ohridski" students, of

which 128 men (47.58 %) and 141 women (52.42 %), most aged between 19 and 25 years.

Two experimental groups were formed:

- Experimental Group 1 (EG1) – of 10 students, who underwent 60 minutes of moderate-intensity physical exertion once a week, and recommended hypocalory balanced diet (1200-1400 kcal/day). 15 classes were held over a period of 15 weeks during the winter semester. The students were trained to perform the kinesitherapy complex at home.
- Experimental Group 2 (EG2) – also of 10 students, who underwent 60-minute physical exertion of moderate intensity three times a week, and recommended hypocalory balanced diet (1200-1400 kcal/day). 45 classes were held over a period of 15 weeks during the winter semester. The students were trained to perform the kinesitherapy complex at home.

For achieving the aim of the study, the following research and statistical methods were used:

- Anthropometry – a method of examining physical development, by measuring the human body. In the presented study, before the first and after the last procedure, waist circumference (cm), hip circumference (cm) was measured and the waist/hip ratio was determined;
- Alternative analysis for determining the relative shares of the relevant responses (as a percentage);
- Variance analysis;
- Comparative analysis with Student t-test for dependent and independent samples.

Methodology of the kinesitherapy applied:

The purpose of kinesitherapy applied in this study was to reduce waist circumference and reach optimal and healthy values for the individual.

Means of kinesitherapy applied:

- Generally development exercises;
- Active exercises;
- Exercises with and on equipment;
- Resistance exercises;
- Isometric and isotonic exercises;
- Balance and coordination exercises;
- Stretching and relaxing exercises;
- Breathing exercises.

RESULTS

Table 1 shows the distribution of the 269 students studied, by gender and waist circumference due to the fact that the pre-existing deposition of fat in the abdomen and visceral depots leads to an increase in the risk of diabetes, arterial hypertension and

cardiovascular disease. As seen, at increased risk are 8.7% of men and 17.4% of women, while 1.6% of men and 7.6% of women have a significantly increased risk. According to the waist/hip ratio, 10.9% of men and 12% of women have a significantly increased risk of metabolic complications (**Table 1**).

Table 1. Distribution of waist circumference and waist/hip ratio by gender

Indicator	Limitations				Risk of metabolic complications
	men		women		
Waist circumference	up to 94 cm	13,1 %	up to 80 cm	51,6 %	low
Waist circumference	> 94 cm	8,7 %	> 80 cm	17,4%	Significantly increased
Waist circumference	> 102 cm	1,6 %	> 88 cm	7,6 %	Significantly increased
Waist/hip ratio	≥ 0,90 cm	10,9 %	≥ 0,85 cm	12 %	Significantly increased

The variance analysis of the indicator waist circumference's results, defines EG1 as satisfactory homogeneous ($10 \leq V \leq 30 \%$), both at the beginning and at the end of the experiment. EG2 is satisfactorily homogeneous ($10 \leq V \leq 30 \%$) at the beginning and homogeneous ($V \leq 10\%$) at the end of the experiment. The asymmetry and excess values are lower than the theoretical critical (at $N = 10$ and $\alpha = 0,05$, critical values of $As_{0,05} = 1,374$ and $Ex_{0,05} = 2,668$).

In EG1, at the beginning of the therapy course, the average value of the waist circumference was 88 cm, and at the end, it decreased to 84.4 cm. According to WHO, in women with waist circumference ≥ 88 cm there is a significantly increased cardio metabolic risk, and with waist circumference ≥ 80 cm we consider increased cardio metabolic risk, which means that even at the end of the experiment, the risk of metabolic complications remains. In our opinion, this is due to the insufficient number of therapy classes per week. As seen in **Table 2**, the estimated growth is $d = -3.60$ cm (-4.09 %). The empirical value obtained by the Student t-test for dependent samples ($t_{emp} = 9,16$) is greater than the critical value, which means that the difference (-3,60 cm) is statistically significant and is supported by a guarantee probability $P(t) = 100\%$.

In EG2, in the beginning of the therapy, the average waist circumference was 83.8 cm, and at the end of the experimental period decreased to 76.7 cm, which means that at first there is an

increased risk of metabolic complications, but at the end of the experimental period the risk is low. The growth in results in EG2 is large, $d = -7.10$ (-8.47 %) at Cohen's $d = 2,01$, and Student t-test for dependent samples showed that it is statistically significant ($t_{emp} = 6,35$, $P(t) = 99,99 \%$).

This means that for the study period, waist circumference decreased in both group, but in EG2, where the kinesitherapy methodology was applied 3 times a week, the reduction of the indicator was greater. The comparison of the mean values of the two groups at the beginning of the experiment, showed that the difference between them is 4,20 cm, which not statistically reliable ($t_{emp} = 0,99$, $P(t) = 66,68 \%$), which means that at the beginning of the experiment, the two groups were relatively uniform and comparable to this indicator. At the end of the experiment, EG2 has a credible ($t_{emp} = 2,15$, $P(t) = 95,42 \%$) higher reduction in waist circumference ($d = 7.70$). During the course of the experiment, EG2 achieved significantly greater growth ($d = -7,10$ cm), than that shown by EG1 ($d = -3,60$). The difference between the two growths is large – $d = 3.50$ cm, at Cohen's $d = 1.11$, and is statistically significant ($t_{emp} = 2.95$, $P(t) = 99.15 \%$) (**Table 2**). Therefore, the methodology of kinesitherapy applied three times a week leads to greater statistically significant changes in the waist circumference indicator, than applying the methodology once a week.

Table 2. Comparative analysis of the indicator waist circumference results

Indicator waist circumference	n	I test		II test		Growth			Statistical significance	
		\bar{X}_1	S ₁	\bar{X}_2	S ₂	d	d%	Cohen's d	t _{emp}	P (t)
EG 1	10	88	9.81	84.4	9.40	-3.60	-4.09	2.90	9.16	100.00
EG 2	10	83.8	9.07	76.7	6.36	-7.10	-8.47	2.01	6.35	99.99
Difference	d	4.200		7.70		3.50				
	Cohen's d	0.445		0.880		1.114				
Statistical significance	t	0.99		2.15		2.95				
	P(t)	66.68		95.42		99.15				

CONCLUSIONS

Our survey show high percentage of Sofia University “St. Kliment Ohridski” students, with an increased risk of metabolic complications observed, in both women (17.4 %), and men (8.7 %). With a significantly increased risk are 7.6% of female and 1.6% of male students.

The kinesitherapy methodology applied three times a week in EG2, leads to greater statistically significant changes in the waist circumference indicator, than applying the methodology once a week (EG1), in which at the end of the experimental period, the risk of metabolic complications remains increased.

The above-mentioned facts indicate the significance of the problem. Regular, targeted physical activity, combined with a healthy diet model, are the basis of the treatment of the android type of obesity and for the prevention of metabolic complications.

In recent years, there has been a continuous decline in the level of physical activity of adolescents and the resulting consequences. We are witnessing an ever-increasing number of overweight and obese students, and students with hypertension, diabetes mellitus, and spinal distortions. Today, sedentary lifestyle is defined as one of the leading risk factors for mortality in people around the world.

Therefore, preserving and strengthening students' health and creating knowledge, skills and habits for a healthy lifestyle, is one of the main tasks of sports pedagogues in higher education institutions. This will lead to the necessary degree of physical activity in each individual, to maintain good health, prevent a

number of chronic diseases and keep a high level of working capacity for life.

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