Vol. XXVI, Issue 2/ 2025

G Y M N A S I U M

Scientific Journal of Education, Sports, and Health

3Original Article

Relations of the Body Composition Parameters and Cardiovascular Risk Factors in Female University Students: A Cross-sectional Study on-site of Outdoor Activity Camp

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DOI: 10.29081/gsjesh.2025.26.2.12

Keywords: *Body Composition, Health risk parameters, PE female students, Outdoor Activities Course*

Abstract

This cross-sectional study investigated the relationship between body composition and cardiovascular risk among physically active female students from the FSPE aged 19–20. Baseline metrics included age, height, weight, BMI, resting metabolic rate (RMR), and resting heart rate; cardiovascular indicators encompassed relative body fat, visceral fat level, relative skeletal muscle mass, and blood pressure (systolic/diastolic). Data from summer outdoor activities at Gazivode Lake (June 2022) were analyzed with descriptive statistics, the KS test, and Pearson/Spearman correlations (SPSS 21.0). Most parameters matched WHO age-related norms. Key associations: body mass correlated positively with BMI (r≈0.87), RMR (r≈0.99), body fat (r≈0.79), visceral fat (r≈0.90), and negatively with diastolic BP (r≈−0.81). BMI correlated with RMR (r≈0.80) and visceral fat (r≈0.91), and inversely with resting heart rate (r≈−0.86) and diastolic BP (r≈−0.78). Conclusions: Higher fat metrics are associated with a higher cardiovascular risk; therefore, interventions should focus on weight reduction and regular moderate physical activity.

1. Introduction

Quality of life appeared in medical literature over fifty years ago. It refers to the physical, physiological, and social domains of health, seen as distinct areas influenced by a person's experiences, beliefs, expectations, and perceptions. It is a significant issue in healthcare practice and scientific research today. The new era in medicine has sparked interest in the medical outcomes of illnesses and in

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information about functioning, well-being, and other important health outcomes.

In most population-based studies that have provided information on the relationship between physical activity and health status, body composition has been estimated by measuring body height and body mass and calculating body mass index (weight/height^2). Historically, body mass index (BMI), calculated from height and weight, has been the primary method in population-based studies for estimating body composition, as highlighted in the works of Zaccagni, Barbieri, & Gualdi-Russo (2014).

The preferred method for determining the amount of body fat and lean body mass in exercise training studies has been hydrostatic or underwater weighing (NICE, 2006; Wilmore, 1989); however, this method lacks accuracy in some subpopulations, including older persons and children, as noted in the OMRON Healthcare Manual (2017). In addition, anthropometric measurements (i.e., girths, diameters, and skinfolds) used to calculate body fat percentage have varying degrees of accuracy and reliability (Wilmore & Behnke, 1970, as cited in Popović, Aleksić-Veljković, Purenović-Ivanović, & Popović, 2019).

Data now suggest that the distribution of body fat, especially accumulation in the abdominal area, and total body fat are significant risk factors for cardiovascular diseases (CVD) and diabetes (Blumberg & Alexander, 1992). Researchers have determined the magnitude of this abdominal or central Obesity by calculating the waist-to-hip circumference ratio or using new electronic methods to image regional fat tissue. New technologies that measure body composition include total body electrical conductivity (Segal et al., 1985), bioelectrical impedance (Lukaski, Bolonchuk, Hall, & Siders, 1986), magnetic resonance imaging, and dual-energy x-ray absorptiometry (DEXA) (Popović, Aleksić-Veljković, Purenović-Ivanović, & Popović, 2020).

Many studies testify that physical appearance or constitutional type is the starting point (recommendation) when interpreting people's state of health, level of physical fitness, sports success, and personality traits. Many detailed aspects need to be examined and studied within the general framework of constitutional types for different interpretations. In addition, the absolute need to select individuals who are eager to engage in sports and physical education must be considered, including any existing methods of selection and adaptation for tasks that require above-average physical and sports performance, such as studying at the Faculty of Sports and Physical Education (FSPE). The size and body composition, primarily predetermined by genetic inheritance, can change with proper diet (dietary regime) and exercise, particularly in terms of body composition. Body size refers to physical size, encompassing volume, body mass, longitudinal parameters, and diameters.

Cardiovascular diseases cause mortality in the majority of developed countries, as well as in many countries in development. In countries like Serbia, where a high percentage represents the olderpopulation, this problem is significant. Cardiovascular diseases occur as a result of the action of numerous risk factors (obesity, high blood pressure, insufficient physical activity, hyperlipoproteinemia, inadequate nutrition, and unhealthy lifestyle).

Regarding cardiovascular risk factors, young people in the risk group most often remain in that group throughout their lives; the table indicates the necessity of early recognition and preventive action. In the sense of lowering and mitigating cardiovascular risk factors, preventive action has proven successful in many cases in different population groups, especially among young people (Panunzio et al., 2007; Qian et al., 2007 as cited in Bubanj, et al., 2013).

Health is not only the absence of disease and infirmity, but it is also complex and multifactorial—it is a state of complete physical, mental, and social well-being. Physical activity is vital in maintaining and improving our daily health, based on guidelines that regulate the content, intensity, and frequency of the required physical effort. So, conscious and intentional physical activity has become essential to a healthy lifestyle (Stănescu & Vasile, 2014 as cited in Purenović-Ivanović, Stojanović, Veličković, Živković, & Đošić, 2022).

The type of constitution of FSPE students is the basic procedure. This approach is necessary because almost every kind of physical fitness test must be unconditionally defined or interpreted in terms of the constitutional type. Furthermore, physical status or body composition indicates the relative amount of bodily substances, such as internal organs, subcutaneous fat tissue, skeletal muscle, bone, blood, water, and other content, as listed by WHO (2002) as cited in Purenović-Ivanović, Popović, Đorđević, & Živković (2013).

Assessment of body composition provides an excellent opportunity to pre-distribute a person's body size into two major structural components: body fat (BF) and lean (non-fat) body mass (LBM), meaning relative body fat and muscles are of extreme importance in practice, as indicated by Cvetković, Obradović, and Kalajdžić (2008).

Although large amounts of BF are undesirable from a health perspective, it is impossible to determine precisely the optimal BF levels or body mass in a particular individual. Therefore, assessing body composition in individuals, populations, or specific samples is vital for clinical trials, medical practices, and other purposes, such as evaluating applicants for FSPE studies. Individuals engaged in active sports activities differ significantly in many somatic traits from those who practice a more sedentary lifestyle. In addition, all previous studies have found a significant relationship between FSPE students' physical status and their motor activity achievement, indicating the need to establish their physical status (Bale, 1980).

The *primary purpose* of this study was to determine the status of the primary sample characteristics, body composition, and health status parameters, which are considered essential factors for study success, in a specifically selected sample of female FSPE students. The *aim* of this research, shaped as a cross-sectional study design, is to determine the relationships of the selected Body composition parameters with cardiovascular risk factors (relative body fat, level of visceral fat, systolic and diastolic blood pressure) of physically active female students.

The *additional purpose* of this study is an among-groups comparative analysis (with the results of the previously realized research presented concisely in tables) to examine the possible differences between those of similar age and give insight into the status of the specific groups regarding the estimated results. This fact could also indicate possible omissions in the "primary evaluation process" on the entrance exam for FSPE studies.

In this sense, the study question was: Are there statistically significant correlations between Body composition parameters and the selected cardiovascular risk factorsin physically active university students?

Based on the problem, aim, and tasks of the research, the following general hypothesis can be set:

H—An inspection will be conducted to determine statistically significant relations between body composition parameters and selected cardiovascular risk factors in physically active female students who participated in summer outdoor activities.

1.1 The obesity parameters

Obesity (lat. *obesit*y) represents a chronic disease, manifesting as excessive body fat accumulation and increased body weight. Any weight gain of 10% or more above the ideal indicates a significant issue, such as Obesity (Ross & Janssen, 2007). That is the oldest and most common metabolic disorder. The code man arises when caloric input exceeds the energy required over an extended period without adequate energy expenditure. Then, the excess calories are stored in the organism in e nergy reserves (glycogen, fats) and consumed in case of increased body needs or starvation.

Obesity is considered a multicausal disease; it arises from various factors (hereditary, metabolic, physiological, psychological, sociological, and cultural). This disease in contemporary man usually arises due to interactions between genotype and factors in the external environment, which are usually caused by excessive intake of energetic nutrients, lack of physical activity, and genetic susceptibility. The American Medical Association (2013) classified Obesity as a disease.

Table 1. *Health risks connected with Obesity (Katzmarzyk & Janssen, 2004 as cited in Benić, 2022)*

Health Status	The percentage of higher risk among obese persons
Pre-mortality	25 to 50%
Coronary artery disease	circa 200%
Head stroke	25 to 50%
Hypertension	over 400%
Diabetes 2 type	circa 350%
Colon cancer	25 to 50%
Postmenopausal breast cancer	25 to 50%
Gallbladder disease	circa 350%
Osteoarthritis	circa 200%

Apart from being one of the main risk factors for the occurrence of a wide range of cardiovascular diseases, it also works indirectly, causing other diseases. In that way, except for the aesthetic appearance, obesity may create serious health problems affecting quality of life (Table 1).

2. Materials and Methods

2.1 Sample of Examinees

The sample comprises a total of first-year undergraduate female students of the Faculty of Sports and Physical Education (FSPE), aged 19-20, who participated in this cross-sectional study after receiving basic information about the research, its scientific importance, and personal benefits for them, and in general.

The sample respondents were assessed from June 16 to 18, 2022, along with the Practical Lessons – "on-site" of Outdoor Activity Camp at Gazivode Lake in Kosovo (as practical study curriculum requirements).

This generation was the first to present students after two years of COVID lockdown restrictions. Table 2 shows the baseline characteristics of the examinees (N=7) estimated within the FSPE female students (in Leposavić) of the University in Pristine/Kosovska Mitrovica.

2.2. Sample of Measuring Instruments and Procedures

The testing protocol adheres to the principles outlined in the Helsinki Declaration (WMA, 2013) and was conducted by the same well-guided examiners (authors) in well-lit rooms with optimal microclimatic conditions.

Participants wore their underwear, and data were collected and entered into measure lists prepared explicitly for this research.

Anthropometric measurements are according to the International Biological Program (Weiner & Lourie, 1969) – Martin's anthropometry- and Body height (BH) is measured to 0.1 cm.

Body composition parameters: Body mass (BM), in 0.1 kg, as well as their Body Mass Index (BMI), in 0.1 kg/m^2, relative Body Fat (BF), in 0.1%, Visceral Fat (ViscF), in levels), relative Skeletal muscles (SM), in 0.1%, Resting Metabolic Rate (RMR), in kcal, of the participants, were measured using a bio impedance device Omron BF511 (Kyoto, Japan), after entering data on age, gender, and body height of respondents. Health status assessment was conducted using the digital tensiometer *PRIZMA*.

2.3. Statistical Data Evaluation

All data were analyzed using the Statistical Package for the Social Sciences (IBM SPSS 21.0, SPSS Inc., Chicago, USA). Descriptive statistics and normality of data distribution: average value (Mean), standard deviation (SD), minimum (Min), maximum (Max), and *Kolmogorov-Smirnov* test (K-S).

Determination of the relationship between Body Composition and Cardiovascular Risk Factors variables: *Pearson*'s or *Spearman*'s correlations. A criterion of statistical significance has an estimate on the probability level of 95%, that is, $p<0.05$, and 99%, $p<0.001$.

3. Results and Discussions

3.1. Age and Basic Anthropometry

Female FSPE students in their first year of study (N=7) form a homogeneous group in terms of age, as they all belong to the corresponding generation when enrolling in the Physical Education study. However, the average age of the respondents (19.3) is calculated, with a small interval of 1 year. When we compare this data with different samples of female FSPE (University of Niš) students, this sample is the youngest, considering the first year of study, indicating their greater homogeneity regarding generational affiliation. (Popović et al., 2023).

Table 2. *The baseline sample characteristics and normality of distribution (N=7)*

Variables	Mean±SD	Min – Max	K-S (Sig.)
Age (yrs.)	19.66±0.35	19.3 – 20.18	.688
BH (cm)	172.57±3.56	168.0 – 178.0	.984
BM (kg)	59.61±5.24	52.8 – 68.1	.987

Legend: Mean– average, SD– standard deviation, **Min**– minimum value, **Max**– maximum value, **K-S**– *Kolmogorov-Smirnov* test, **Sig.**– significance, **BH**– body height, **BM**– body mass.

3.2. Body Composition

In the original table, *Omron Healthcare* classified the classification on four levels, but this study shows only detailed data regarding females (aged 18-39 years) by parameters.

Table 3. *Body composition values in female FSPE students (N=7)*

Variables	Mean±SD	Min – Max	K-S (Sig.)
BMI (kg/cm^2)	20. 01±1.51	18.2 – 22.4	.797
BF%	22.79±4.09	15.9 – 26.7	.901
SM%	33.2±1.99	30.5 – 36.1	1.000
ViscF level	2.14±0.69	1 – 3	.571
RMR (kcal)	1357.57±66.54	1282 – 1474	.995

Legend: Mean– average, SD– standard deviation, **Min**– minimum value, **Max**– maximum value, **K-S**– *Kolmogorov-Smirnov* test, **Sig.**– significance, **BF%**– relative body fat, **SM%**– relative skeletal muscle mass, **ViscF**– visceral fat level, **RMR**– Resting Metabolism Rate

They are separate parts of the Omron table, based on research elaborated by British authors (McCarthy et al., 2000, as cited in OMRON HEALTHCARE, 2017, and the American one (Gallagher, Heymsfield, Heo, Jebb, Murgatroyd, & Sakamoto, 2000).

Table 4. *Nutrition classification of adults according to BMI values - WHO (1998); Ross & Janssen, 2007)*

BMI (weight/height^2)	BMI (World Health Organization Determinants)	BMI value
less than 18.5	- (low obesity)	**7.0**-10.7
	- (low obesity)	10.8-14.5
	- (low obesity)	14.6-**18.4**
18.5 or more, and less than 25	0 (normal obesity)	**18.5**-20.5
	0 (normal obesity)	20.6-22.7
	0 (normal obesity)	22.8-**24.9**
25 or more and less than 30	+ (Pre-obesity)	**25.0**-26.5
	+ (Pre-obesity)	26.6-28.2
	+ (Pre-obesity)	28.3-**29.9**
30 or more, less than 40	++ (Obesity)	**30.0**-34.9
	++ (Obesity)	35.0-**39.9**
40+ extremely high Obesity	+++ (Obesity)	40.0-90.0

Body Mass Index (BMI)

In the longitudinal research carried out for nine years on a sample of FSPE students from Belgrade University (Moskovljević, 2013), slightly higher BMI values were recorded (21.17±1.93 kg/m^2), as well as in the study carried out on the female PE students from University of Niš (Popović, et al., 2020), but are recorded lower average values of body height (169.3±5.15 cm) were recorded. Regarding body mass, student-athletes from Belgrade University had a slightly higher average value (60.32±5.86 kg). Research conducted on the students of the general population – non-athlete 120 female students of the Faculty of Medicine, University of Zagreb (Mašina, Zečić, & Pavlović, 2014), in which higher values were determined (BMI=21.59 kg/m^2), as well as in 80 Dubrovnik female students from different departments (Selmanović, Čale-Mratović, & Ban, 2014) (BMI=22.5 kg/m^2).

When it comes to heart rate at rest, on average, RHR has been noticed to be on the upper side of the healthy range (8557±22.39 beats/min), which is a slightly higher average than that recorded in non-athlete female students from America, in whom RHR, in average, was 78.7±12.9 beats/min (Pribis, Burtnack, McKenzie, & Thayer, 2010). With most of our respondents (n=29, or 55.77%), average RHR values have been estimate; in a third of female student-athletes (n=18, or 34.62%), slightly increased values have been recorded RHR; the code four respondents (7.69%) recorded is tachycardia, bradycardia only the code one (1.92%), and that is the only one who practices athletics.

Given the fact that bradycardia (RHR<60 beats/min) is a common physiological phenomenon among the sports population, especially in endurance sports (Doyen, Matelot, & Carré, 2019), such as athletes, as the cardiovascular system in intense training (Bahrain, Levy, Busey, Caldwell, & Stratton, 2016), the data obtained are surprising. A possible explanation for the small percentage of respondents with suitable training is that many are former athletes whose physical activity now only brings them to practical classes. Both bradycardia and tachycardia belong to cardiac arrhythmias and are present in the athlete population.

Namely, long enough training leads to the structural and electrical cardiac remodeling, known as “sports heart," characterized by dilation and hypertrophy of all four heart chambers and enhanced vagal tone in resting rate (Miljoen et al., 2019). Unfortunately, the "sports heart" is recognized as a risk factor for developing atrial arrhythmias. However, it is also a very sensitive parameter, which in the resting state shows significant variations (depending on gender, age, training level, environmental temperature, body position, diet, level of hydration, presence of caffeine in the blood, use of drugs, emotional state, and illness).

Relative Body Fat (BF%)

Body Fat Percentage refers to the amount of body fat mass in relation to the total body weight, expressed as a percentage. The device uses the BI method to estimate:

Body fat percentage (%) = {body fat mass (kg) / Bodyweight)} x 100

Depending on the body's fat distribution, the classification is visceral or subcutaneous fat (below the skin). Subcutaneous fat accumulates around the stomach, upper arms, hips, and thighs, distorting the body's proportions. Although not directly linked to an increased disease risk, it may increase pressure on the heart and cause other complications. Therefore, subcutaneous fat is not displayed in this unit but is part of the body fat percentage.

Mechanisms that explain the association between fat tissues and the risk of Obesity are not entirely understood. Several factors affect body fat distribution, which mainly depends on *gender* (women have a higher percentage of fat and adipose tissue around the thighs, buttocks, and stomach), *age* (average value representation of bodily fats se increases from the period of adolescence, and decreases in older years), *race* (whites have more abdominal and visceral fat from African Americans).

However, also on *the level of physical activity* (athletes have a lower percentage of fat than the general population, but also among athletes), it is possible to notice differences. Similar to sports, endurance disciplines and aesthetic-coordination types have a smaller percentage of fat in the athlete's body. (Purenović-Ivanović, 2017). Body fat percentage reference values are in Table 5.

Table 5. *Body fat percentage classification in females (Omron Healthcare, 2017)*

Age (years)	- (low)	0 (normal)	+ (high)	++ (very high)
18 - 39	< 21.0%	21.0 – 32.9%	33.0 – 38.9%	≥ 39.0%

Visceral Fat (Visc F) level

Visceral fat is fat surrounding internal organs. Excessive visceral fat is closely linked to elevated levels of fat in the bloodstream, which can lead to common diseases such as hyperlipidemia and diabetes, impairing the ability of insulin to transfer energy from the bloodstream and use it in cells. To prevent or improve conditions of common diseases, reducing visceral fat levels to an acceptable level is essential. People with high visceral fat levels tend to have large stomachs. However, this is not always the case; high visceral fat levels can lead to metabolic Obesity. Metabolically obese (visceral Obesity with average weight) represents fat levels that are higher than average, even if a person's weight is at or below the standard for their height.

Table 6. *Visceral fat levels classification of results in females (Omron Healthcare, 2017)*

Visceral fat level	Classification level
1 – 9	0 (normal)
10 – 14	+ (high)
15 – 30	++ (very high)

Relative skeletal muscle mass (SM %)

Skeletal Muscles are of two types: muscles in internal organs (such as the heart) and skeletal muscles (attached to bones) used to move the body. Skeletal muscle can increase through exercise and other activities. Increasing the ratio of skeletal muscle enables the body to burn energy more efficiently, reducing the likelihood of converting energy to fat and facilitating a more energetic lifestyle.

Table 7. *Skeletal muscle percentage classification of results in females (Omron Healthcare, 2017)*

Age (years)	- (low)	0 (normal)	+ (high)	++ (very high)
18 - 39	< 24.3%	24.3 – 30.3%	30.4 – 35.3%	≥ 35.4%

Resting metabolism rate (RMR)

Regardless of the person's activity level, a minimum caloric intake is required to sustain the body's everyday functions. Known as the *Resting Metabolism*, this indicates how many calories someone needs to ingest to provide enough energy for their body to function. According to the presented distribution of the results, it is evident that the female students are located in three middle classes, indicating moderate inner-group differences among participants. In the zone of below-average values (1357.6 kCal) are distributed (42.86%) of the participants, while those (57.14%) are in the zone of above-average values. Therefore, the predicted daily BMR for individuals or groups of individuals aged 15-18 is between (1445-1490 kCal) for females. In that sense, on average, mean values in the current research for females are slightly below (1357 kCal) the values presented by that interval, except for the Max value (1474 kCal), according to Popović et al. (2023).

3.3 Health Status Parameters of the PE Female Students/Cardio-Vascular Risk Factors

Blood pressure measures the force exerted by flowing blood on the artery walls. Arterial blood pressure changes continuously during the cardiac cycle. The highest pressure in the cycle is called the systolic blood pressure, and the lowest is the diastolic blood pressure. Therefore, for the doctor to assess the patient's blood pressure, systolic and diastolic pressure results are necessary.

Arrhythmia is a condition in which the speed and rhythm of the heart are disturbed due to defects in the bioelectrical system that controls the heartbeat. Typical symptoms of this condition include skipping heartbeats, premature contractions, and an abnormally fast (tachycardia) or slow (bradycardia) pulse.

Blood pressure values vary significantly on a daily and seasonal basis. Oscillations can range from 30 to 50 mmHg, depending on various conditions throughout the day. In people with hypertension, the oscillations can be even greater. Usually, blood pressure rises when someone is active, while it falls to its lowest level during sleep.

Hypertension (high blood pressure) is a significant independent risk factor for cardiovascular diseases and the most important cause of mortality for stroke, resulting in more than seven million deaths per year worldwide. (WHO, 2002). The hypertension guidelines support measuring blood pressure at home and in doctors' offices to control hypertension effectively. (American Heart Association, 2018). If it does not heal, hypertension leads to secondary vascular changes reflected in the thickening of blood vessels, endothelial dysfunction, and arteriosclerosis in the large and medium-sized arteries.

Table 8. *Health status parameters/blood pressure values in female FSPE students (N=7)*

Variables	Mean±SD	Min – Max	K-S (Sig.)
SYS (mmHg)	122.00±10.55	112 – 143	.890
DIA (mmHg)	68.29±6.65	60 – 77	.985
RHR (bpm)	85.57±22.39	54 – 120	.872

Legend: Mean– average, SD– standard deviation, **Min**– minimum value, **Max**– maximum value, **K-S**– *Kolmogorov-Smirnov* test, **Sig.**– significance, **SYS**– systolic blood pressure, **DIA**– diastolic blood pressure, **RHR**– resting heart rate.

The WHO classification of blood pressure values (Table 9) shows the standards for assessing blood pressure regardless of a person's age, established by the World Health Organization (2002).

Table 9. *Classification of blood pressure (WHO, 2002)*

BP categories	SYSBP (mmHg/kPa)	DIABP (mmHg/kPa)	Actions to consider
Low (hypotension)	≤ 90	≤ 60	
Normal (normotension)	≤ 120	≤ 80	
Elevated	120–129 (12.0–18.5)	81–89 (8.0–11.9)	Self-measurement
Low (hypertension, stage 1)	130–139 (18.6–21.2)	90–99 (12.0–13.2)	Consult a doctor
Low (hypertension, stage 2)	140–159 (21.3–23.8)	100–110 (13.3–14.5)	Consult a doctor
Moderate hypertension	160–179 (23.9–24.0)	111–119 (≥14.6)	Consult a doctor
High (hypertension, stage 3)	≥180 (≥24.1)	≥120 (≥14.7)	Danger!

Systolic Blood Pressure (SYS)

Blood pressure (BP) is the force exerted by the blood on the internal surface of blood vessels. Although the size of the vessels is the same, BP depends on the size of the striking volume and the resistance that occurs during blood flow through the vessels.

Diastolic Blood Pressure (DIA)

Diastolic Blood Pressure occurs at the end of diastole, when blood flows out of blood vessels. Unit blood pressure was measured, and the millimeters of mercury of the pillar (mmHg) were measured. An interpretation of values and classification of blood pressure are in Tables 10 and 11.

However, the lower blood pressure value is more important in young people. In most people, the SBP value constantly increases with age due to increasing stiffness of large arteries, long-term accumulation of plaque, and increased incidence of heart and vascular disease (AHA, 2018), while DBP rises until about age 50, it tends to level off over the next decade. It can stay the same or fall later in life (NHLBI, 2004).

Resting Heart Rate (RHR)

Heart Rate frequency (HR-pulse) represents the number of beats (contractions) in a unit of time, and the pulse reflects cardiac work on the peripheral arterial blood vessels. Pulse is a readily available parameter that provides information about various bodily changes and is considered a "key biological informative system."

Some authors (Alhalabi et al., 2017) as cited in Purenović et al. (2022), consider heart rate at rest a marker of an individual's overall well-being and cardiovascular health, so it is a parameter of particular interest.

In resting conditions, this parameter shows considerable variations that depend on gender, age, training level, external environment temperature, body position, diet and hydration level, caffeine presence in the blood, medication use, altitude height, emotional state, and severe diseases.

In healthy young people, cardiac frequencies at rest (RHR- Resting Heart Rate) typically start at 60-80 (bpm) and decrease with age. In well-trained athletes, the pulse is lower due to increased stroke volume and parasympathetic activity. In physically inactive persons, it is higher due to a smaller stroke volume of the heart and a dominant sympathetic system. In endurance sports athletes, RHR can go below 40 beats/min (bradycardia); in a sedentary person, it can be higher than 100 beats/min (tachycardia). The classification of RHR is in Table 10.

Table 10. *Classification of Resting Heart Rate/pulse (beats/min)*

Bradycardia	0 (standard value)	+ (higher value)	++ tachycardia
≤ 60	60 – 80	80 – 100	≥ 100

3.4 Intercorrelation between Body Composition characteristics and Cardiovascular risk factors parameters

Table 11 is an intercorrelated matrix of all applied variables of physically active PE students. He identifies numerous positive and statistically significant correlations (p<0.001), predominantly of medium to high strength.

Body Mass of the physically active PE female students has a statistically significant positive correlation with the Body Mass Index (r=.871*, p<0.05), Resting Metabolic Rate (r=.985**, p<0.001), Body Fat % (r=.790*, p<0.05), VF – visceral fat level (r=.902**, p<0.001) and negative with DIA – diastolic blood pressure, (r=-.811*, p<0.05), of the physically active female PE students.

Body Mass Index is statistically significantly, positively correlated with the RMR – resting metabolic rate (r=.798*, p<0.05), and VF visceral fat level (r=.912**, p<0.001), with negative correlation with RHR – resting heart rate (r=-.855*, p<0.05), and DIA – diastolic blood pressure DIA mmHg (r=-.775*, p<0.05).

RMR – Resting Metabolic Rate is statistically significantly, positively correlated with the VF visceral fat level (r=.865*, p<0.05) and with a negative correlation with DIA – diastolic blood pressure (r=-.803*, p<0.05).

RHR – Resting Heart Rate is statistically significantly and negatively correlated with the BF% - relative body fat (r = -.810*, p<0.05, and VF visceral fat level (r = -.761*, p<0.05). BF% - relative body fat has a statistically significant negative correlation with the SM% - relative skeletal muscle mass (r = -.914**, p<0.001) and SYS systolic blood pressure (r =-.767*, p<0.05).

Health status parameters, proposed as cardiovascular risk factors (CVR), such as SYS blood pressure, are negatively and significantly correlated only with relative body fat (BF%) (r = -.767*, p < 0.05). DIA blood pressure is negatively, significantly correlated with Body Mass (-.811*, p<0.05), Body Mass Index (-.775*, p<0.05), and Resting Metabolic Rate (-.803*, p<0.05).

Table 11. *Intercorrelation matrix of all of the examined variables in FSPE female students*

Variables	Age	BH	BM	BMI	RMR	RHR	BF%	SM%	VF	SYS	DIA
Age	1.00										
BH	-.382	1.00									
BM	-.028	.533	1.00								
BMI	.201	.049	.871*	1.00							
RMR	-.074	.629	**.985****	.798*	1.00						
RHR	-.171	-.014	-.723	-.855*	-.616	1.00					
BF%	-.034	.451	.790*	.670	.708	-.810*	1.00				
SM%	.119	-.524	-.524	-.315	-.455	.592	**-.914****	1.00			
VF	.084	.266	**.902****	**.912****	.865*	-.761*	.667	-.340	1.00		
SYS	.077	-.244	-.578	-.526	-.488	.532	-.767*	.697	-.320	1.00	
DIA	.144	-.321	-.811*	-.775*	-.803*	.658	-.554	.298	-.628	.579	1.00

Legend: BH– body height, **BM**– body mass, **BMI**– body mass index, **RMR**– resting metabolic rate, **RHR**– resting heart rate, **BF%**– relative body fat, **SM%**– relative skeletal muscle mass, **VF**– visceral fat level, **SYS**– systolic blood pressure, **DIA**– diastolic blood pressure.
*significant at the p<0.05 level, **significant at the p<0.001 level

Discussions

The measurements of individual segments of anthropological status in athletes, as well as the determination of the constitution, somatotype, and body composition of the high-level athletes, are essential in the process of the primary selection, as well as secondary selection to the particular sport, or discipline orientation, for monitoring and evaluating the training process, for objective assessment of general physical development, control of the athlete's nutritional status (Popović, Popović, & Popović, 2020). Moreover, they monitor the athlete's recovery in the rehabilitation process (Popović, Aleksić-Veljković, Urenović-Ivanović, & Popović, 2019).

Besides talent, adequate morphological characteristics, body composition, and good health status are prerequisites for success in sports and the study of physical education, which is very complex. Thus, in addition to meeting all the requirements for entry into any other faculties, the entrance exam for the FSPE study has to check physical abilities, actual health status, as well as the assessment of specific parameters of the body posture and technical preparation in some sports or disciplines within them (Popović, 2015).

Health Status parameters, which may be considered cardiovascular risk factors, are also vital because of the high load of the training process during the study period (Purenović-Ivanović et al., 2022).

Body composition is largely genetically predisposed, but within defined limits in particular segments. It is also subject to the impact of environmental factors (the degree of sensitivity to the external environment is also hereditarily preconditioned), as noticed by Purenović-Ivanović et al. (2013).

Female FSPE students in their first year of study (N=7) form a homogeneous group in terms of age, as they all belong to the corresponding generation when enrolling in the Physical Education study. However, the average age of the respondents (19.3) is calculated, with a small interval of 1 year. When we compare this data with that of different female FSPE (University of Niš) students, this sample is the youngest, considering the first year of study, indicating their greater homogeneity regarding generational affiliation (Popović, et al. 2020).

Durnin, 1981, as cited in Bubanj et al., 2013, considers adolescence as a difficult period to assess with great precision regarding the *individual basal metabolism rate (BMR)*. The predicted daily BMR for individuals or groups of individuals aged 15-18 ranged between 1445 and 1490 kcal for females. In that sense, mean values in the current research for females (N-7) are slightly below (1357 kCal) the values presented by Durnin, and those of younger (N-12) and older age (N-30), as presented in Table 2 of the current study. The published data show a well-established difference in values for males and females. The difference may be due to the larger adipose tissue mass in women. However, in the days immediately prior to menstruation, in the female cycle, there may be a 2–5% increase in metabolic rate so that for at least part of the normal menstrual cycle, there will be insignificant differences between men and women, as noticed by Bubanj et al. (2013).

The results show the expected intra-group differences in body characteristics, which are not inherited conditionally, for all of the selected body composition parameters (except BMI). However, although most of the values were in the standard range, the low percentages of high body fat (BF) and body mass index (BMI), as well as relative skeletal muscle mass values (M%), indicate the heterogeneity of the student population, their sports orientation, and their level of physical activity. Therefore, the reasons for this can be malnutrition or poor diet habits (they studied outside their birthplace). Also, the reasons for this may be the range of conducting the entrance exam and even the insufficiently high criteria for enrollment in the PE studies (except for active and former athletes). The enrollment requirements can also overcome members of the general population and non-athletes, according to Purenović-Ivanović et al. (2013).

Therefore, it is necessary to find a more appropriate evaluation system for the entrance exam to the PE study than the applied (point) system, which limits in a significant way the possibility of the adequate assessment of applied candidates, especially those with a range of values, whether in terms of minimum or maximum results. In this manner, it may be noted that justified dissatisfaction with the declared candidates, who are limited by an inadequate rating scale on a specific part of the entrance exam, without a previously proven way of awarding points, favors the results achieved in previous education, which become primary factors in the formation of rankings for the admission of candidates, according to (Popović, 2015).

When it comes to blood pressure, the highest percentage of respondents (57.14%, or 4/7) have normal tension (90< SBP <120 mmHg), two respondents (28.6%) have increased blood pressure (120< SBP <129 mmHg), and have 1st stage hypertension (130< SBP <139 mmHg), and one (14.3%) have 2nd stage hypertension (SBP>140 mmHg), with the blood pressure classified in this category at the expense of both SBP and DBP values (BP is 143/77 mmHg). Such data are not surprising because, in young adults, diastolic blood pressure is a better predictor of cardiovascular disease than systolic (contrary to older adults).

Besides, young adults who have untreated diastolic hypertension have a better prognosis than those with increased values of both systolic and diastolic blood pressure (Fang et al., 1995). These authors note that the stage of second hypertension (SBP>140 mmHg or DBP>90 mmHg) was identified in two respondents (3.85%), with one having established this stage of hypertension based on the combined expense value of both SBP and DBP (BP is 143/92 mmHg). A high percentage of adipose tissue (42.0%) was observed in that examinee. An increased value of the BMI (27.7 kg/m^2, pre-obesity), but all other parameters (WC, V-F, RHR) are in the borders of recommended values when it is about hypotension (SBP <90 mmHg and DBP<60 mmHg), the same was recorded only in one respondent (BP is 90/60 mmHg), and that is about the limit values themselves, noticed by Purenović-Ivanović, et al. (2022).

When it comes to the Resting Heart Rate of the PSPE female students on average, RHR was on the lower border of the healthy range (85.57 beats/min), which is higher than that recorded in non-athlete female students from America, in whom RHR, on average, was 78.7±12.9 beats/min (Pribis et al., 2010). However, within the majority of our respondents (4/7), or (57.14%), standard/below average RHR values were recorded; circa in (2/7) of female students athletes or (28.57%) slightly increased values (tachycardia) have recorded RHR; and bradycardia (54 beats/min), only in one female student (14.28%), and she practices field athletics.

Both bradycardia and tachycardia belong to cardiac arrhythmias and are present among the athletic population. Prolonged involvement in training leads to structural and electrical cardiac remodeling, a phenomenon known as *sports heart* (Prior & La Gerche, 2012), which is characterized by dilatation and hypertrophy in all four heart chambers and enhanced tone of the vagus in rest (Miljoen et al., 2019). Unfortunately, the sporting heart is a risk factor for developing atrial arrhythmias. One study on 85 athletes established that every second athlete has tachycardia, as reported by Miljoen et al. (2019). In the case of the PE female students, only one has tachycardia (120 beats/min). Nevertheless, as a fitness instructor, she was physically active and involved in many sports, according to Popović et al. (2023).

Resting heart rate (RHR) is easily accessible but also a very sensitive parameter, which shows significant variations in the state of rest (depending on gender, age, training level, environmental temperature, body position, diet, hydration level, presence of caffeine in the blood, use of drugs, emotional state, illness), according to Purenović-Ivanović et al. (2022).

Mišogoj-Duraković, Heimer, & Matković (1998), in the study on Morphological and functional characteristics of the student population at the University of Zagreb, add to the diversity of our sources, providing a unique perspective on the topic.

4. Conclusions

Testing of the female students of the Faculty of Sports and Physical Education (FSPE), University of Pristine in Kosovska Mitrovica was conducted on (the 16th to 18th of June, 2022nd), in the morning hours during the obligatory Curriculum Requirement in Outdoor Activities - Practical Course realized on the site of Gazivode Lake (Kosovo*).

The research examined the relationship between selected body composition parameters and some cardiovascular risk factors. The values of all the examined variables (general indicators and parameters of cardiovascular risk) and correlations of all investigated parameters are estimated by applying adequate statistical procedures. Based on the obtained results of the research, it is possible to set out the following conclusions:

- There exist statistically significant correlations between most of the estimated parameters of Body composition and those considered as cardiovascular risk factors, but not between all (there are absent statistically significant correlations between the visceral fat level (VF) and health risk factor parameters (SYS, DIA). Relative body fat (BF%) has only one statistically significant, moderate ($p<0.05$) negative correlation with SYS - systolic blood pressure ($r = - .767$).
- This study does not confirm the *hypothesis*: "*There are statistically significant*

relations within selected cardiovascular risk factors in physically active students."

➢ Moreover, there are established high positive, statistically significant correlations (p<0.001), with VF – visceral Fat level and BM – Body Mass (r = .902) and with BMI - body mass index (r = .912), and moderate correlations (p<0.05 level) with RMR – Resting Metabolic Rate (r = .865), and negative with RHR – Resting Heart Rate/Pulse (r = - .767).

➢ In this sample of FSPE students, reducing body mass at the expense of relative Body Fat and visceral fat and increasing the level and regularity of moderate physical activity is necessary to reduce the risk of cardiovascular incidents in overload training situations.

This cross-sectional study was conducted during the Outdoor Activities Practical Course on-site at Gazivode Lake after the relaxation of the two-year COVID lockdown restrictions, which may be the reason for the less expected results, as they are common for PE students.

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