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Review article

NUTRITIONAL LEVEL AND CARDIORESPIRATORY FITNESS IN THE STUDENT POPULATION - A SYSTEMATIC REVIEW

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Abstract. *The aim of this of systematic review paper is to determine whether there is a correlation between the level of nutrition and cardiorespiratory fitness in the student population. The collected papers date from the period between 2000 and 2018. The sample included both male and female students with different levels of nutrition. The analyzed studies determined the differences and changes in BMI in relation to cardiorespiratory fitness. The studies had a criterion that showed differences in nutritional level and cardiorespiratory fitness and changes in BMI and cardiorespiratory fitness. Research has shown that there are significant differences in the level of nutrition of students and their physical fitness. Students with higher BMI had poorer results on cardiorespiratory fitness tests. With the increase in BMI, the VO_{2max} values (maximal oxygen consumption values) are reduced. Higher BMI also adversely affects other physiological parameters. Moreover, there is a high correlation between BMI levels and cardiorespiratory endurance. Students included in the systematization, with their lower body composition values, showed better results on cardiorespiratory endurance tests. Increased body mass can lead to poorer results on physical fitness tests.*

Key words: *Physical Activity, Cardiorespiratory Fitness, $VO_{2max,}$ BMI, Students, Relationship*

INTRODUCTION

According to some recent data, it is estimated that 1 in 5 people are insufficiently physically active worldwide (Dumith, Hallal, Reis, & Kohl, 2011). People began to neglect physical exercise and its positive effects on all systems in the body, such as the cardiovascular, immune, respiratory, bone, and muscular system. Due to the sedentary

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lifestyle, the energy intake of foods is higher than energy consumption, which leads to excess body mass and obesity. These factors, overweight, and obesity represent a new global challenge for public health (Hajmer, 2010). The main goal of nutrition plans is for people to obtain the appropriate and necessary nutrition to remain healthy, to be physically prepared and to lead a healthy life. For this reason to promote the health level of a society, the attitudes of its people must be taken into account (Azizi, Aghaee, Ebrahimi, & Ranjbar, 2011). Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen, Powell, & Christenson, 1985). Cardiovascular diseases and obesity are a leading cause of mortality and pose a severe problem for humankind. (Setty, Padmanabha, & Doddamani, 2013). The research shows an increase in the physical inactivity of the student population (Vuillemin, Boini, Bertrais, & Tessier 2005; DeVahl, King, & Williamson 2005; Fogelholm, Stallknecht, & VanBaak, 2006). The results of the research conducted by Buntić (2006) showed significant differences in physical activities between the population of male and female students. Daskapan, Handan, Eker, & Eker (2006) investigated what usually prevents students from engaging in physical activity. The lack of time is the most common obstacle to engaging in physical activities, and the most common reason why they are physically inactive. The aforementioned research showed us that the level of student engagement in physical activities is at its minimum. The most common reasons are the lack of free time, obligations during studies, and the lack of knowledge about the significance and positive effects of physical activity. Every reduction and change in activity levels of US girls significantly affected changes in BMI and adiposity (Kimm et al., 2005). Authors who have studied the effects of physical activity on body composition believe that inclusion and engagement in certain physical exercise programs contribute to a decrease in adipose tissue levels. It also provides a sound basis for the prevention of cardiorespiratory and cardiovascular diseases (Kondo, Kobayashi, & Murakami, 2006; Dalibalta, Mirshafiei, & Davison, 2017). The physical activity of the student population and their health habits in youth can affect their health status in adulthood (Tirodimos, Georgouvia, Savvala, Karanika, & Noukari, 2009). Negative consequences and negative attitude toward physical exercise did not bypass the student population. The amount of free time students have depends on the duties and obligations they have, which impacts their attitude towards the selection of physical activity. A high level of body mass that directly affects the functional ability of an individual is the primary cause of reduced physical fitness (Zhang, Schumann, Huang, Tormakangas, & Cheng, 2018). Also, different obesity indicators, that is, anthropometric characteristics, are closely related to the level of physical fitness. High body fat levels can lead to cardiovascular problems, and hence the inability to deliver maximum achievements. (Nielsen & Andersen, 2003). Aires, Silva, Silva, Santos, Ribeiro, et al. (2010) have come to the results that show BMI inversely and significantly correlates with cardiorespiratory fitness (CRF). Low CRF is considerably related to body composition. These data indicate that an elevated body mass index (BMI) significantly affects the level of physical activity. Obese subjects showed a lower level of cardiorespiratory fitness compared to subjects who had normal body mass. Based on the obtained results Hingorjo, Zehra, Hasan, & Qureshi (2017) conclude that VO_{2max} (ml/kg/min) is inversely correlated with BMI, which means that higher BMI values adversely affect cardiorespiratory fitness. Students with higher BMI values showed lower results in VO_{2max} (ml/kg/min).

The aim of this review paper is to determine whether there is a correlation between the level of nutrition and cardiorespiratory fitness in the student population. The collected works covered the period between 2000 and 2018.

METHODS

The following electronic databases were used to search the literature: PubMed, MEDLINE, Google Scholar, and EBSCO from 2000 till 2018. The following keywords (independently or in combination with other keywords) were used in the search: physical activity, cardiorespiratory fitness, VO_{2max}, BMI, students, relationship. The search strategy was modified for each electronic database, where possible, to get more refined results. All titles and abstracts are reviewed in order to find the potential works that will be included in the systematic review. After a detailed review, relevant studies were taken into account if they met the inclusion criteria. Following systematization, criteria were included in the analysis: epidemiological and experimental, controlled randomized and non-randomized studies on differences in cardiorespiratory fitness written in English were included in the analysis.

The sample of study participants included the student population (young men and women) with different nutritional levels. Studies were reviewed only if the differences in the nutritional level in relation to cardiorespiratory fitness and the changes in BMI and cardiorespiratory fitness were shown. The exclusion criteria were: 1. Studies written in a different language, except English; 2. The participants did not meet the age criteria; 3. The effects a specific physical activity program had on the BMI.

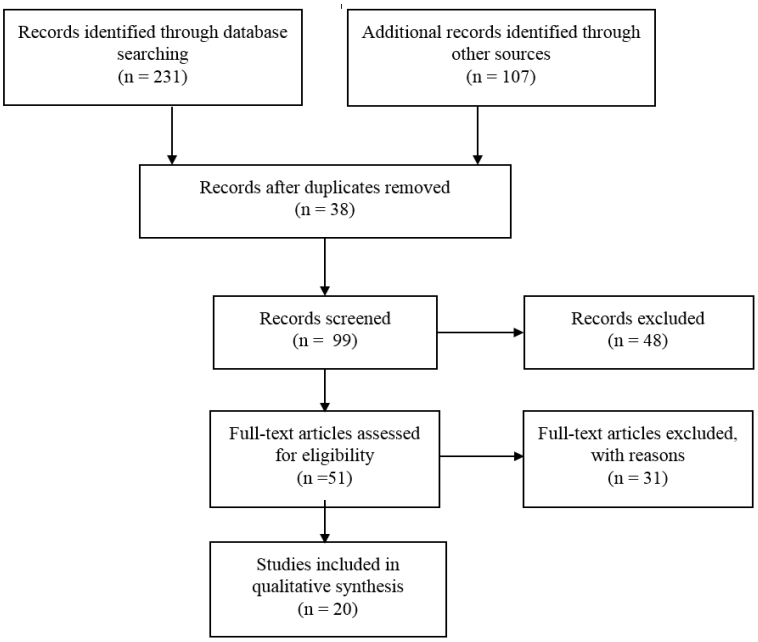

Diagram 1 PRISMA Flow Diagram for Systematic Reviews and the research related to a given topic

Table 1 Research overview

The name of the first author, year	Partici-pants			Experimental program			
	The number of partici-pants	Age	Gender	Categorization according to BMI	Examined variables	Results	Conclusion
Zar, A. (2017)	220	Students	F	6.8% low BM 72.7% normal BM 17.3 % overweight 3.6% obese	Physical tests, BMI, and flexibility tests.	There is a connection between tests that examine physical fitness and BMI ($p < 0.05$), but there was no significant relationship between BMI and flexibility	Results show that higher BMIs adversely affect the parameters of physical fitness. The results of the obese and overmass were significantly worse than the group with normal BM.
Kim, J.W. (2013)	726		M	BMI and waist circumference according to the WHO Asia-Pacific standard report. Four groups: ▪ overweight according to BMI (BOG); ▪ overweight according to the waist circumference (WOG); ▪ overweight according to BMI and circumference (BMOG) and ▪ normal body mass (NG).	Cardiorespiratory endurance, cardiovascular function, muscular endurance, muscular strength, flexibility, agility, and balance	The BOG group spent significantly more time running the 1.5 km distance in comparison to the NG ($p < 0.001$). Groups BMOG ($p < 0.001$) and WOG ($p = .009$) showed significantly higher vital capacity in comparison to the NG group. The BOG group performed significantly fewer push-ups in comparison to the NG group ($p = 0.024$)	We concluded that all three groups of obese participants (BOG, WOG, and BMOG) showed a decrease in cardiorespiratory and muscular endurance, but the increase in strength and vital capacity.
Setty, P. (2013)	60	18-22	M	BMI is calculated as $kg/m^{2,}$ and the MEAN value for the participants was 21.92 ± 3.32	VO_{2max} in correlation to BMI.	The negative correlation between obesity and VO2 max ml/kg/min ($p<0.05$) ▪ BMI ≤20 and VO_{2max} ml/kg/min (50-55) ▪ BMI ≤25 and VO_{2max} ml/kg in (40-45)	We concluded that all three groups of obese subjects (BOG, WOG, and BMOG) showed a decrease in cardiorespiratory and muscular endurance, but the increase in strength and vital capacity.

Ozcelik, O. (2004)	60	20.5	M-F	BMI is calculated as kg/m^2 MEAN (25.8±1.3)	Maximum operating speed (Wmax) Aerobic Capacity (WAT) BMI Heart rate reserve	Negative correlation between BMI and W_{max} M=(p=0.0001) F=(p=0.0001) Negative correlation between BMI and WAT M=(p=0.0001) F=(p=0.0001) Heart rate reserves negatively correlate with the BMI rise M=(p=0.0001) F=(p=0.0001)	The increase of aerobic fitness in people with high BMI should be considered to prevent further mass gain. W_{max}, WAT, and heart rate depend on the BMI level. With the rise in BMI, the values of W_{max} and WAT are reduced, and the heart reserve increases.
Laximi, C.C. (2014)	100	18-22	M	BMI = kg/m^2	The correlation between BMI and VO_{2max}	There is a significant negative correlation between BMI and VO_{2max} (ml/kg/min) (r=-0,48, p <0.01).	Excessive body fat negatively impacts cardiac function and oxygen intake. LowVO_{2max} in young adults with higher BMI can pose a risk for the development of diseases.
Aires, L. (2010)	111	Around 18 years	M-F	BMI is calculated as kg/m^2 and categorized by gender and age into two groups: normal BM and overweight	BMI, CRF and Physical Activity Level (PA) correlation	BMI inversely and significantly correlates with CRF ($p < .05$)	Low CRF strongly correlates with BMI, which underlines the importance of increasing CRF.
Zhang, M. (2018)	383	18-24	M-F	BMI was calculated by InBody 720. Two groups are in the range from 18.5 to 23.9 kg/m^2. Normal BM. (NWO) and the participants with normal BM, but with increase muscles mass (NWNO)	The level of physical fitness of the NWO group should be examined, and then the differences between the physical fitness of NWO and NWNO should be assessed.	The NWO group showed a significant difference in the Anderson test and the 5x5 shuttle run test compared to the NWNO group ($p < 0.001$)	The authors believe that the NWO group had poorer results due to less muscle mass in comparison to the NWNO group. Reduced muscle mass can partially contribute to poorer performance in physical fitness tests.
Nielsen, G.A. (2003)	13,557	15-20	M-F	BMI is calculated as kg/m^2 for boys and girls. Two groups: BMI ≥ 25 kg/m^2 and BMI < 25 kg/m^2	Correlation between VO_{2max} and blood pressure (BP) and hypertension	Girls with BMI ≥ 25 kg/m^2 had lower levels of physical fitness and hypertension in comparison to the girls with lower BM.	Physical fitness and BMI independently correlate with BP. BMI was an excellent indicator of hypertension in those with lower levels of physical fitness.

Balaraman, T. (2017)	103	17-30	M-F	BMI = kg/m^2 32% of obese	Correlation of BMI, waist circumference, and blood pressure with VO_{2max}.	Body mass index ($p < 0.01$) and systolic blood pressure (male p 0.05, female $p < 0.01$) negatively correlates with low cardiorespiratory fitness.	The negative effect of BMI on VO_{2max} involves measures to improve cardiorespiratory fitness to reduce the risk of overmass and high blood pressure.
Nabi, T. (2015)	57	18-24	M-F	BMI = kg/m^2 Normal BM = BMI from 18.5 to ≤ 22.9 Underweight = BMI <18.5 Overweight = BMI from 23 to ≤24.9 Obese = BMI ≥ 25	The differences for the VO_{2max} and BMI between the groups.	Higher VO_{2max} values were found in men who were not obese (46.1+ 8.8 ml / kg / min) compared to obese (44.7 + 9.6 ml / kg / min) and non-obese women (38.16 + 3,9 ml / kg / min) versus the obese ones (37.12 + 5.6 ml / kg / min).	The results of the study suggest that students with higher BMI values have poorer results in VO^{2max} ml kg/min. They indicate that they are adequate physical activity professionals should be involved in curriculum and educational curricula.
Pribis, P. (2010)	5,101	Students	M-F	Muscle mass and BMI were used for the assessment of body composition. BMI is calculated as kg/m^2, and muscle mass is obtained through skinfolds (chest, abdomen, and thighs) for M and (triceps, thighs, suprailiac) for F.	The correlation between VO_{2max} and BMI	Significant decrease of VO_{2max} in male and female $p < 0.001$. The linear trend of BMI increase was not significant for both genders M= (p=0.772) and F= (p=0.253). There is a significant indirect correlation between BMI and VO_{2max} ($p < 0,.01$)	The results show that BMI is increasing through the years, and VO_{2max} is decreasing.
Nogueira, E. C. (2016)	4,237	18-30	M	BMI = kg/m^2 30.8% normal BM 54.3% overweight 14.7% obese	The correlation between BMI and VO_{2max}.	VO_{2max} was lower in the obese participants in comparison to the participants with normal BM $p < 0.001$	The strong correlation between VO_{2max} and BMI was found when higher BM negatively influenced the cardiorespiratory fitness level. The obese participants had the lowest VO_{2max} values.

Deliens, T. (2015)	340	18.0 ± 0.6	M-F	BMI = kg/m^2 Measurements were made in the first semester, after the first semester and after a year and a half.	The changes in BM, body composition, and fitness levels.	There were no changes in BMI among the female participants, and the students gained 2.7 kg and showed the level of 0.7/m^2 BMI is increased after a year and a half. The strength of arm muscles increased in the male (3.8 kg; p <0.001) and female participants (1.4 kg; p <0.001). There is no correlation, and fitness level does not change through time.	The observed changes in body composition did not coincide with changes in the fitness levels.
Clark, B.R. (2015)	1,075	19	M-F	BM status is classified according to CDC (The Centers for Disease Control and Prevention) criteria for BMI in relation to the age: obesity (<5th percentile) normal mass (5th to <85th percentile) overweight (85th to < 95th percentile) and obese (95th percentile).	Anthropometry, aerobic endurance, participation in physical activities, and blood pressure.	Male students showed greater physical fitness; 61.4% of men met the FITNESSGRAM HFZ criteria, and only 35.4% of the women. 53.7% had normal BM, and 24.4% were obese.	Students in urban areas have a high risk of obesity, overmass, and low aerobic ability.
Hingorjo, M. R. (2017)	133	17-24	M-F	BMI = kg/m^2 10-22% of male students and 20-32% of female students had normal BM	The correlation between VO_{2max} and BMI.	VO_{2max} showed a significant inverse relationship between VO_{2max} and BMI. The relationship between VO_{2max} and BMI p <0.001	The results show lower levels of cardiorespiratory fitness in both genders and a strong effect of BMI on VO_{2max}.

Ramírez-Vélez, R. (2018)	1,467	18-30	M-F	BMI = kg/m^2	The association between muscle strength and visceral fat level (MVF) and ideal cardiorespiratory health (CRH).	BM, waist circumference, body mass index (BMI), fat mass, fat mass index, and visceral fat level Significantly higher levels in the participants after the first measurement (lower MVF ratio) in comparison to the second, third, and fourth ($p < 0.001$). ($p < 0.001$).	A lower MVF ratio is associated with worse CRH metrics.
Correa-Rodríguez, M. (2018)	1,798	20.5	M-F	BMI = kg/m^2 Three groups: - 18.5–24.9 kg/ m^2 - 25.0–29.9 kg/ m^2 - ≥30 kg/ m^2	Correlation between muscle mass (NGS) and different indicators of high body mass with cardiometabolic risk factors (OR).	Men and women with lower NGS had an increased ratio of cardio-metabolic risk (OR) = 1.8, 95%. Both genders showed higher levels for all metrics of are also related to the higher risk for cardiometabolic disorders ($p < 0,001$).	Muscle strength and excess body mass are independently and jointly associated with increased cardio-metabolic risk in young people, which suggests that both variables are predictive.
Na, H.B. (2003)	158	22±0.3	F	BMI = kg/m2 BMI= <20 BMI= ≤20-<25 BMI= ≥25	Correlation between BMI and strength, flexibility and endurance.	BMI did not show statistically significant correlation with the strength and flexibility, but it was observed in the endurance test. The group with BMI = ≥25 showed significantly lower endurance. ($p < 0.040$)	Body composition is a very important parameter that affects the cardiorespiratory fitness. Increased BM has a negative effect on physical fitness.
Fogelholm, M. (2006)	951	29	M	BMI = kg/m2	CRF, muscle strength (NMF), BMI, and waist circumference (WC). Their connection and comparison.	Negative association between BMI and VO_{2max} (-0.12; $p < 0.05$), but positive association of $p < 0.01$ with strength (0.28), vertical jump (0.21) and pushups (0.55).	Although it is known that the reduced CRF has significant consequences on obesity, NMF deterioration also deserves special attention. CRF results are significantly lower in subjects with higher BMI.

Arabmokhtari, R. (2018)	30	22-30	M-F	BMI = kg/m2	The relationship between body composition and (VO_{2max})	The results show a reverse relationship between BMI and VO_{2max}, which means that higher BMI values have an impact on worse VO_{2max} results ≤ 0.05	Strong impact of adiposity on poor cardiorespiratory fitness of students. Additional physical activities are advised to prevent further growth of BM.

Legend: BM - body mass, BMI - body mass index, $VO_{2\ max}$ - maximal oxygen consumption, p - statistical significance, CRF - cardiorespiratory fitness, M - male, F - female

DISCUSSION

Based on the criteria, systematized research is divided into two groups: the correlation between body composition and cardiorespiratory fitness and the difference in body composition (BMI) and cardiorespiratory fitness. The correlation between body composition and cardiorespiratory fitness can be found in the following works: Zar, Karan, & Ahmadi (2017), Nielsen & Andersen (2003), Balaraman, Ramalingam, Kantharuban, & Surendran (2017), Deliens, Deforche, De Bourdeaudhuij, & Clarys (2015), Clark, White, Royer, Burlis, DuPont et al (2015), Ramírez-Vélez, Correa-Rodríguez, Izquierdo, Schmidt-RioValle, & González-Jiménez (2019), Fogelholm et al (2006). The difference in body composition (BMI) and cardiorespiratory fitness can be found in the following works: Kim, Seo, Swearingin, & So (2013), Setty et al (2013), Ozcelik, Aslan, Ayar, & Kelestimur (2004), Aires et al (2010), Zhang et al. (2018), Nielsen & Andersen (2003), Nabi, Rafiq & Qayoom (2015), Correa-Rodríguez, Ramírez-Vélez, Correa-Bautista, Castellanos-Vega, Arias-Coronel, González-Ruíz et al. (2018), Zar et al (2017), Laxmi, Udaya, & Vinutha Shankar (2014), Nogueira, Porto, Nogueira, Martins, Fonseca et al. (2016), Hingorjo et al (2017), Na, Kim, & Choi (2003), Arabmokhtari, Khazani, Bayati, Barmaki & Fallah (2018).

In addition to cardiorespiratory fitness, Zar, Karan, and Ahmadi (2017) examined the connection between BMI and flexibility in their study. The authors conclude that higher BMI has negative effects on physical fitness levels. The results for the group of obese and overweight participants were significantly worse in comparison to the group of participant with normal body mass. Nielsen & Andersen (2003) concluded that the group of girls with BMI≥25 kg/m^2 was diagnosed with hypertension in comparison to the group of girls with normal body mass. The results of this study suggest that higher BMI values can have a very bad effect on the body and the occurrence of health problems. Also, Balaraman, Ramalingam, Kantharuban, and Surendran (2017) showed a correlation between BMI and blood pressure and their effects on cardiorespiratory fitness. The results of the study show that individuals with higher BMI have a higher risk of high blood pressure. The authors recommend greater engagement in certain forms of physical exercise to reduce a further increase in BMI and prevent health problems. Deliens, Deforche, De Bourdeaudhuij, and Clarys (2015) tracked changes in body composition, muscle strength, and physical fitness among the participants. After a year and a half of studying, BMI increased in both male and female participants. Muscle strength also increased, but the difference in physical fitness was not observed during the period they were in college. The observed changes in body composition did not coincide with the changes in physical fitness. Clark, White, Royer, Burlis, DuPont, et al. (2015) examined aerobic fitness, participation in physical activity, and

blood pressure. Male students showed better results in aerobic fitness in comparison to the female students, but 24.4% of all the students were obese. They also found that higher BMI values have a negative effect on the onset of elevated blood pressure. Although male student, 61.4% of them, met the standards of aerobic fitness, urban students had a higher risk of obesity, overweight, and low aerobic fitness. Researchers Ramírez-Vélez, Correa-Rodríguez, Izquierdo, Schmidt-RioValle, and González-Jiménez (2019) concluded that a lower level of visceral fat is associated with poorer results in cardiovascular fitness. However, Fogelholm et al. (2006) studied the correlation between cardiorespiratory fitness, muscular strength, and BMI. BMI is inversely related to VO_{2max} but positively correlates to muscle strength, the vertical jump, and push-ups.

In a study conducted by Kim, Seo, Swearingin and So (2013) it was concluded that the group with obese participants based on BMI had significantly VO2max poorer results than the group of participants with normal mass. However, the group of obese participants, based on waist circumference and BMI, had significantly better vital capacity than the group of participants with normal mass. All three groups of obese participants had poorer results in cardiorespiratory fitness and muscular strength, but also better results in vital capacity. The participants classified in the group with excess body mass (BMI = MEAN 21.92 ± 3.32) in the research by Setty et al. (2013) had a negative correlation between BMI and VO_{2max}. Higher BMI can lead to more serious functional damage and health problems. The results of the research by Ozcelik, Aslan, Ayar, and Kelestimur (2004) showed that participants with BMI = MEAN (25.8±1.3) had a negative correlation with aerobic durability and maximum working speed. They also concluded that there was a negative correlation between the BMI increase and cardiac reserve. Aires et al. (2010) examined body mass index (BMI), cardiorespiratory fitness (CRF) and active physical activity (PA) in participants with excess body mass and participants with normal body mass. They concluded that BMI inversely and significantly correlated with cardiorespiratory fitness, which emphasized the importance of improving cardiorespiratory fitness. Zhang et al. (2018) researched the differences between the physical fitness of participants with normal body mass and participants with normal body mass and increased muscle mass. The group with normal body mass had poorer results in physical fitness tests compared to the group with higher muscle mass. Muscle mass could have great significance for the status and level of physical preparation. Nielsen & Andersen (2003) showed that girls with BMI $\geq$ 25 kg/m^2 had lower levels of physical fitness and hypertension in comparison to girls with normal body mass. Physical activity and body composition have proven to be excellent parameters for diagnosing health problems. They suggested that more attention should be paid to the level of physical activity in college. Higher VO_{2max} values were found in boys and girls with higher body mass and which can be considered obese in comparison to the ones with normal body mass. These results were obtained in the research by Nabi, Rafiq, and Qayoom (2015). It is recommended that adequate physical activity professionals should be included in the development of curriculum and curricula of educational institutions to reduce the risks of health problems. The authors Correa-Rodríguez, Ramírez-Vélez, Correa-Bautista, Castellanos-Vega, Arias-Coronel, González-Ruíz et al. (2018) examined the correlation of muscular strength and cardio-metabolic risk factors in three different groups. Higher levels of all parameters for excess body mass for both genders are associated with an increased cardio-metabolic risk. It is necessary to pay attention to physical fitness and the activity level to reduce the risks for cardiorespiratory and cardiovascular diseases. Zar et al. (2017) examined the difference

between four groups, sorted by obesity level and physical fitness tests. There was a connection between the results of physical fitness and tests and BMI. A group with normal body mass had the best results on physical fitness tests. Based on the results, it is concluded that higher BMI levels adversely affect the parameters of physical fitness. Laxmi, Udaya, & Vinutha Shankar (2014) researched the BMI and VO_{2max} relation. The results indicate that there is a significant negative correlation between the body mass index (BMI) and VO_{2max} (ml/kg/min). Balaraman et al. (2017) investigated the correlation between BMI and VO_{2max}. A negative correlation with the cardiorespiratory condition levels was established in 32% of obese participants. BMI has a negative impact on VO_{2max} and cardiorespiratory fitness. Nogueira, Porto, Nogueira, Martins, Fonseca, et al. (2016) examined the BMI and VO_{2max} ratio in three different mass groups. Their research showed that VO_{2max} was lower in the obese compared with a group with normal body mass. The correlation between BMI and VO_{2max} was also studied by Hingorjo et al. (2017), and they showed the reverse relationship between VO_{2max} and BMI and a strong BMI effect on VO_{2max}. Na, Kim, & Choi (2003) examined the correlation between BMI and endurance in their study. The group of participants with BMI ≥25 showed significantly lower endurance compared to the other two groups that had lower BMI values. Excess body mass has a negative effect on physical fitness. The results that Arabmokhtari, Khazani, Bayati, Barmaki, & Fallah (2018) got when they examined the relationship between body composition and cardiorespiratory fitness showed the reverse relationship between BMI and VO_{2max}, which means that higher BMI values have an impact on poorer VO_{2max} results.

CONCLUSION

The included systematization of the research had the purpose of showing the connection between the level of nutrition and the cardiorespiratory fitness in the student population. The following conclusions were drawn: 1. Most researchers concluded that there were significant differences in the level of nutrition of students and their physical fitness; 2. Higher BMI levels adversely affect the development of cardiorespiratory fitness. Students with higher BMI values had significantly lower scores in cardiorespiratory endurance tests and lower VO_{2max} values; 3. People with higher BMI values have a higher risk of hypertension. The results of such studies indicate that high BMI values may have a negative effect on the body and the occurrence of health problems. Authors prove in their research the inverted correlation between cardiorespiratory endurance tests and obesity. Based on their results, it is concluded that higher levels of body mass and BMI adversely affect the parameters of physical fitness.

Students who had lower values in relation to body composition showed better results in tests of cardiorespiratory endurance.

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NIVO UHRANJENOSTI I KARDIORESPIRATORNI FITNES STUDENTSKE POPULACIJE – PREGLEDNO ISTRAŽIVANJE

Cilj ovog rada preglednog karaktera je da se utvrdi povezanost između nivoa uhranjenosti i kardiorespiratornog fitnesa kod studentske populacije. Prikupljanje radova obuhvatalo je period između 2000. i 2018. godine. Uzorak ispitanika obuhvatio je i muškarce i žene (studentske populacije) koji su bili različitog nivoa uhranjenosti. Istraživanja koja su uzeta u analizu utvrđuju razlike i promene BMI-a na kardiorespiratorni fitnes. Studije su imale kriterijum koji je prikazivao razlike u nivou uhranjenosti i kardiorespiratornog fitnesa i promene BMI i kardiorespiratornog fitnesa. Istraživanja su pokazala da postoje značajne razlike u nivou uhranjenosti studenata i njihovoj fizičkoj kondiciji. Studenti koji su imali viši nivo BMI-a imali su lošije rezultate na testovima kardiorespiratornog fitnesa. Sa porastom BMI-a smanjuju se vrednosti VO2 max. Viši nivo BMI-a negativno utiče i na druge fiziološke parametre. Takođe, velika povezanost između nivoa BMI-a i kardiorespiratorne izdržljivosti. U obuhvaćeoj sistematizaciji studenti koji su imali niže vrednosti telesne kompozicije pokazali su bolje rezultate u testovima kardiorespiratorne izdržljivosti. Povećana telesna težina može dovesti do lošijih rezultata u testovima fizičke kondicije.

Ključne reči: *fizička aktivnost, kardiorespiratorni fitness, potrošnja kiseonika, BMI, studenti, odnosi.*