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MEDITERANEAN DIET PRACTICES AND CARDIOVASCULAR RISK AMONG STUDENTS OF HEALTH STUDIES FROM MOSTAR, SARAJEVO AND SPLIT

Amina Šeta[1*], Senka Dinarević[2], Arzija Pašalić[3], Nihad Fejzić[4], Irena Drmić Hofman[5], Lutvo Sporišević[6], Ljerka Ostojić[2], Ivan Ćavar[7], Antonela Matana[5], Mario Merendić[5], Mirela Lisičić-Konaković[6], Anes Jogunčić[8], Aida Pilav[8]

[1]University SSST, Unimed Polyclinic, Hrasnička cesta 3a, 71210, Ilidža, Sarajevo, Bosnia and Herzegovina
[2]Academy of Arts and Sciences of Bosnia and Herzegovina, Bistrik 7, 71000 Sarajevo, Bosnia and Herzegovina
[3]University of Sarajevo, Faculty of Health Studies, Stjepana Tomića 1, 71000 Sarajevo, Bosnia and Herzegovina
[4]University of Sarajevo, Veterinary Faculty, Zmaja od Bosne 90, 71000 Sarajevo, Bosnia and Herzegovina
[5]University of Split, University Department of Health Studies, Ruđera Boškovića 35, 21000 Split, Croatia
[6]Health Center of Sarajevo Canton, Vrazova 11, 71000 Sarajevo, Bosnia and Herzegovina
[7]University of Mostar, Faculty of Medicine, Kralja Petra Krešimira IV. bb Bijeli Brijeg, 88000 Mostar, Bosnia and Herzegovina
[8]Institute for Public Health of the Federation of Bosnia and Herzegovina, Tahtali sokak 17, 71000 Sarajevo, Bosnia and Herzegovina

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Summary

Introduction: The Mediterranean diet has been demonstrated to confer significant benefits in the prevention of cardiovascular disease. This study represents the first collaborative effort between researchers from Bosnia and Herzegovina and Croatia to examine the effects of the Mediterranean and non-Mediterranean dietary patterns on cardiovascular risk factors within the student population. The primary objective was to identify specific dietary behaviors and patterns that may contribute to a cardiovascular risk reduction. Materials and Methods: This cross-sectional study was conducted in 2024 and included 473 students from health studies faculties in three cities: Sarajevo, Mostar, and Split. Independent variables in the study were diet type (Mediterranean vs. non-Mediterranean), physical activity, and smoking. Dependent variables included lipid profile (cholesterol, triglycerides), blood pressure, and blood glucose levels. Results: Students from Split exhibited the highest consumption frequency of olive oil, fish, vegetables, and legumes consumption, which was statistically significant compared to students from Mostar and Sarajevo ($\chi^2 = 11.488$, $p = 0.022$). A statistically significant difference was also found in the consumption of animal fats (butter, cream, margarine) across the cities ($\chi^2 = 19.860$, $p = 0.003$). The average adherence score to the Mediterranean diet was highest among students from Split (3.80 points) and lowest among those from Sarajevo (2.77 points). Significant differences in cholesterol and triglyceride levels were observed only among female students across the cities (Kruskal-Wallis test, $p < 0.05$). Conclusion: A significant difference in cardiovascular risk factors was observed between students following the Mediterranean diet and those adhering to a non-Mediterranean diet. The Mediterranean diet demonstrated a beneficial effect on cardiovascular risk, as evident in the lipid profile. In contrast, non-Mediterranean diet, characterized by higher intakes of vegetable and animal fats, was associated with increased cardiovascular risk.

Keywords: Mediterranean diet, student population, lipid profile, Croatia, Bosnia and Herzegovina

Introduction

In contemporary research, diet and its influence on human health have become central topics in numerous global studies. A recent review highlights that dietary habits play a pivotal role in the prevention and management of cardiovascular diseases, which remain the leading cause of death worldwide (Lu et al., 2024). The Mediterranean diet, characterized by a high intake of fruits, vegetables, fish, whole grains, and olive oil, has been consistently linked to a reduced risk of cardiovascular disease, as evidenced by several studies (Widmer et al., 2014; Pant et al., 2024). This diet emphasizes the reduction of added sugars found in baked goods, ice cream, some granola bars, and sugary beverages like fruit juices and sodas, as well as alcohol, high-sodium foods, saturated fats, refined carbohydrates (such as white bread and rice), processed cheeses, and fatty or processed meats. The Mediterranean diet has been shown to be beneficial in preventing cardiovascular diseases (Critselis et al., 2021). Research on the Mediterranean diet has consistently demonstrated its association with favorable health outcomes, including a reduced incidence of heart disease, hypertension, type 2 diabetes, and improved lipid profiles (Scholl et al., 2012; Rosato et al., 2017).

In contrast, the non-Mediterranean diet, which is a traditional omnivorous diet rich in dairy products, meat, vegetables, and fruits, as well as characterized

*Corresponding author: aminagodinjak@gmail.com

by specific methods of food preparation and consumption, remains insufficiently explored in terms of its impact on cardiovascular health. While studies examining non-Mediterranean diets are limited, preliminary data suggest that they may offer potential health benefits, particularly when based on plant-derived sources and traditional preparation methods that minimize the use of processed foods (Hotz & Gibson, 2007). Given the relatively limited research in this area, there is a clear need for further investigation, underscoring the importance of conducting this study. Given the increasing global concern regarding cardiovascular diseases, particularly among younger populations, and the significant role of diet in their prevention and management, this study aims to contribute to the existing body of scientific knowledge by investigating the specific effects of Mediterranean and non-Mediterranean diets on cardiovascular risk factors among health studies students. Health science students were chosen for this evaluation due to their generally healthier dietary patterns and lifestyles compared to students in other academic fields (de-Mateo-Silleras et al., 2019). This study represents the first collaborative effort between researchers from Bosnia and Herzegovina and Croatia to explore the impact of Mediterranean and non-Mediterranean diets on cardiovascular risk among students in three cities: Split, a Mediterranean city on the Adriatic coast; Sarajevo, a non-Mediterranean city; and Mostar, situated between the two. Central and Eastern European countries, including those in the Balkans, exhibit the highest cardiovascular mortality rates in Europe (Townsend et al., 2016). In 2021, diseases of the circulatory system caused 1.71 million deaths in the European Union, accounting for 32.4% of all deaths. The cardiovascular disease death rate in Croatia was 36.8%, which is higher than the European average (Eurostat, 2017).

The findings of this research could have important implications for the development of dietary guidelines and the promotion of healthier lifestyles. The primary objective of this study is to identify specific dietary behaviors and patterns that contribute to the reduction of cardiovascular disease risk, as assessed through indicators such as blood pressure, lipid and glucose levels, and anthropometric measurements (e.g., body mass index and waist-to-hip ratio).

Materials and methods

This cross-sectional study was approved by the Ethics Committee of The Academy of Arts and Sciences of Bosnia and Herzegovina. A total of 473 students from health studies faculties in three cities participated in the research: Sarajevo (230 students; the University of Sarajevo-Faculty of Health Studies), Mostar (125 students: the University of Mostar-Faculty of Medicine), and Split (118 students; the University of Split-Faculty of Health Studies). The research was conducted between April and September 2025. Independent variables were: type of diet (Mediterranean vs. non-Mediterranean), physical activity, and smoking. Physical activity and smoking habits were determined by self-assesment. Dependent variables were: lipid profile (cholesterol, triglycerides), blood pressure, and blood glucose levels.

Type of Diet: Frequency of consumption of key components of the Mediterranean diet (e.g., fruits, vegetables, fish, olive oil) and the non-Mediterranean continental diet (e.g., red meat, dairy products, bread). The MEDAS Mediterranean Diet Adherence Screener (Annex 1) was used to assess dietary patterns. It is a valid and reliable tool for evaluating adherence to the Mediterranean diet across diverse populations (Schröder et al., 2011; Marendić et al., 2021; Bekar & Göktaş, 2023).

Biochemical analyses

Blood samples were collected in the early morning hours between 7:00 and 9:00 a.m. to reduce the influence of diurnal fluctuations on the physiological parameters. Participants instructed not to consume food, drink (except water) or smoke for at least 8 hours prior to testing. Capillary blood was used to measure fasting lipid status, i.e. total cholesterol, triglyceride and fasting glucose. Lipid status was measured with the Accutrend Plus device from Roche Diagnostics, Switzerland, according to the manufacturer's manual. Blood glucose was measured with the Accu-Chek device from Roche Diabetes Care GmbH, Germany, according to the manufacturer's instructions.

Body weight and height

Body weight was measured in the morning, before meals, and after emptying the bladder. A medical decimal scale with an accuracy of ±100 g was used to measure weight while the subject stands, without shoes and in light clothes, or in underwear.

Height is measured with an anthropometer consisting of a metal rod, so that the subject stands in an upright position on a flat surface, evenly distributed on both legs. The shoulders are relaxed, the heels are pulled up and the head is in the "frankfurt horizontal position".

Anthropometric measurement of waist and hip circumference

The waist and hip circumference is measured with a non-elastic measuring tape. The waist circumference

is measured midway between the lower ribcage and the front upper ribcage, with the subject standing evenly on both legs while breathing normally. It is recommended that the examiner sits opposite the subject so that the measuring point is at eye level. The hip circumference is measured at the level of the widest part of the gluteal muscle.

The waist-to-height ratio (WHtR)

The waist-to-height ratio (WHtR) is calculated as the ratio of body circumference in cm divided by body height in cm. The default value for WHtR is considered 'no increased risk' (WHtR <0.5); 'increased risk' (WHtR ≥0.5 to <0.6) and 'very high risk' (WHtR ≥0.6). The threshold value for WHtR is set at 0.5. Similarly, WC ≥90 cm for men and ≥80 cm for women were considered as 'cut-off values'.

Blood pressure

A mercury sphygmomanometer manufactured by Bokang (Wenzhou Bokang Instruments Co., Ltd., China) was used to measure blood pressure. The systolic and diastolic blood pressure values were measured with the device with the appropriate cuff size on the upper arm in a sitting position and after 5 minutes of rest. The blood pressure of each participant was measured twice at intervals of 1–2 minutes and the average of the values was calculated.

Statistical Analysis

Statistical methods were employed to examine the relationship between independent variables (diet type, physical activity, smoking) and dependent variables (lipid profile, blood pressure, blood glucose). Multivariable regression analysis and ANOVA were utilized to assess the impact of the Mediterranean and non-Mediterranean diets on cardiovascular risk factors. The level of significance was < 0.5. Additionally, adherence to the Mediterranean diet was evaluated using the MEDAS score.

Results

The study included 473 health science students from three cities: Mostar (26.4%), Sarajevo (48.6%), and Split (24.9%). The gender distribution was predominantly female, comprising 87.3% of the participants, while 12.5% were male. Most students were in the 1st (30%), 2nd (31.5%), and 3rd (32.6%) years of study. The dietary habits and patterns of the studied student population are summarized in Table 1.

Table 1. General information about study participants

	Total	Sarajevo	Mostar	Split	p
Age	21.66 ± 4.3	21.2 ± 1.3	24.1 ± 7.2	19.9 ± 1.2	F=37.58 p<0.001
Sex *n, %* Male *n, %* Female *n, %*	473 (100) 59 (12.5) 414 (87.5)	33 (14.3) 197 (85.7)	10 (8.0) 115 (92.0)	16 (13.6) 102 (86.4)	x^2=3.16 p=0.206
Year at University I year *n, %* II year *n, %* III year *n, %* IV year *n, %* V year *n, %*	142 (30.0) 149 (31.5) 154 (32.6) 14 (3.0) 14 (3.0)	43 (18.7) 64 (27.8) 108 (47.0) 13 (5.7) 2 (0.9)	44 (35.2) 57 (45.6) 11 (8.8) 1 (0.8) 12 (9.6)	55 (46.6) 28 (23.7) 35 (29.7) 0 (0) 0 (0)	x^2=106.12 p<0.001
Smoking Yes *n, %* No *n, %*	149 (31.5) 324 (68.5)	62 (27.0) 168 (73.0)	48 (38.4) 77 (61.6)	39 (33.1) 79 (66.9)	x^2=5.090 p=0.078
Characteristics of smoking: Non-Smoker *n, %* Previous smoker *n, %* Social smoker *n, %* Smoker *n, %*	304 (64.3) 20 (4.2) 63 (13.3) 86 (18.2)	158 (68.7) 10 (4.3) 29 (12.6) 33 (14.3)	71 (56.8) 6 (4.8) 14 (11.2) 34 (27.2)	75 (63.6) 4 (3.4) 20 (16.9) 19 (16.1)	x^2=11.50 p=0.074
Physical activity* Never *n, %* Few times per month *n, %* Few times per week *n, %* Every day *n, %*	37 (7.8) 114 (24.1) 214 (45.2) 108 (22.8)	10 (4.3) 55 (23.9) 101 (43.9) 64 (27.8)	18 (14.4) 32 (25.6) 55 (44.0) 20 (16.0)	9 (7.6) 27 (22.9) 58 (49.2) 24 (20.3)	x^2=16.58 p=0.011

*at least one hour

Regarding the distribution across years of study, the majority of participants were in their second (31.5%) and third year (32.6%), followed by the first year (30.0%), with smaller proportions in the fourth (3.0%) and fifth year (3.0%). Among males, half were in their first year (50.8%), while fewer were in the second (20.3%), third (23.7%), and fourth year (5.1%), with no males in the fifth year. Female students were most frequently in the third year (33.8%) and second year (33.1%), followed by the first year (27.1%), with fewer in the fourth (2.7%) and fifth year (3.4%). The distribution across years differed significantly between males and females (χ^2 = 17.04, p = 0.002), indicating a statistically significant variation in year of study by sex.

Overall, 149 students (31.5%) reported that they smoke, while 324 (68.5%) were non-smokers. Among males, a significantly higher proportion were smokers (55.9%) compared to females (29.7%), (χ^2 = 4.923, p = 0.026).

When further examining smoking characteristics, 64.3% of the total sample were non-smokers, 4.2% were previous smokers, 13.3% were social smokers, and 18.2% were active smokers. Among males, 49.2% were non-smokers, while a larger portion reported active smoking (33.9%), and smaller proportions reported being social smokers (10.2%) or former smokers (6.8%). In contrast, 66.4% of females were non-smokers, 15.9% were active smokers, 13.8% were social smokers, and 3.9% were former smokers. The differences in smoking characteristics between male and female students were statistically significant (χ^2 = 9.576, p = 0.023).

Daily physical activity that lasted at least one hour, was most freaquent among students from Sarajevo, where almost third of them reported daily activities (p=0.011).

Regarding olive oil consumption, the student population from Split had the highest consumption frequency of olive oil (55.9%), which was statistically significant when compared to students from Mostar and Sarajevo (χ^2 = 7.92, p = 0.019). For vegetable consumption, Split also had the highest percentage of students consuming ≥2 servings of vegetables per day (33.9%), which was statistically significant in comparison to the students in Mostar and Sarajevo (χ^2 = 13.519, p = 0.009).

A statistically significant difference was found the for consumption of animal fats (butter, cream, margarine), which was the highest among students from Split (χ^2 = 19.860, p = 0.003). Regarding fish consumption (≥3 portions per week), Split had the highest consumption (21.2%), as compared to students from Sarajevo (13.2%), a statistically significant difference (χ^2 = 10.374, p = 0.035).

In terms of legume consumption, students from Sarajevo had the lowest frequency of legume consumption per week, which was statistically significant as compared to students from the other cities (χ^2 = 16.462, p = 0.036).

The consumption of sweetened beverages was statistically highest among students from Sarajevo, while those from Split had the lowest consumption (χ^2 = 42.888, p = 0.0006). There was also a statistically significant difference in the consumption of tomato sauce between students from Split and Mostar, as well as between Split and Sarajevo (χ^2 = 11.488, p = 0.022). However, no statistically significant differences was found in the consumption of fruits and nuts between students from all cities.

Table 2. Comparsion of dietary habits and patterns of students from Sarajevo, Split and Mostar

City	Respondents	% of total respondents
Consumption of olive oil as the main source of fat in the preparation of daily meals		
Mostar		
Yes	52	41,6
No	73	58,4
Total	*125*	*100*
Sarajevo		
Yes	69	30
No	161	70
Total	*230*	*100*
Split		
Yes	66	55,9
No	52	44,1
Total	*118*	*100*
χ2 =22.429 (df=2; p=0.000) p<0.05		
Vegetable consumption in daily diet (1 portion cca. 200 gr)		
Mostar		
>=2 portions	24	19,2
0 portion	10	8,0
1 portion	91	72,8
Total	*125*	*100,0*
Sarajevo		
>=2 portions	40	17,4
0 portion	15	6,5
1 portion	175	76,1
Total	*230*	*100,0*

Table 2. Continued...

Split		
>=2 portions	40	33,9
0 portion	7	5,9
1 portion	71	60,2
Total	*118*	*100,0*
χ2 =13.519 (df=4; p=0.009) p<0.05		
Consumption of animal fats (butter, margarine or cream) (1 portion cca. 12 gr)		
Mostar		
0 portion	33	26,4
1 portion	75	60,0
2 portions	15	23,0
3 portions	2	1,6
Total	125	100,0
Sarajevo		
0 portion	48	20,9
1 portion	157	68,3
2 portions	22	9,6
3 portions	3	1,3
Total	230	100,0
Split		
0 portion	49	41,5
1 portion	62	52,5
2 portions	5	4,2
3 portions	2	7,0
Total	118	100,0
χ2 =19.860 (df=6; p=0.003) p<0.05		
Weekly fish or seafood consumption (1 serving approx. 150 gr)		
Mostar		
0 portion	32	27,6
1 portion	67	55,8
2 portios	21	17,5
Total	*120*	*100,0*
Sarajevo		
0 portion	73	33,2
1 portion	118	53,6
2 portios	29	13,2
Total	*220*	*100,0*
Split		
0 portion	20	17,7
1 portion	69	61,1
2 portios	24	21,2
Total	*113*	*100,0*
χ2 =10.374 (df=4; p=0.035) p<0.05		
Consumption of legumes		
Mostar		
>=3 portions	19	15,3
0 portion	13	10,5
1 portion	49	39,5
2 portions	43	34,7
Total	*124*	*100,0*
Sarajevo		
>=3 portions	21	9,1
0 portion	43	18,7
1 portion	106	46,1/
2 portions	60	26,1
Total	*230*	*100,0*
Split		
>=3 portions	18	15,3
0 portion	14	11,9
1 portion	43	36,4
2 portions	43	36,4
Total	*118*	*100,0*
χ2 =16.462 (df=7; p=0.036) p<0.05		
Daily consumption of sweetened beverages (1 cup = 100ml)		
Mostar		
>=3 portions	12	9,6
0 portion	55	44,0
1 portion	30	24,0
2 portions	28	22,4
Total	*125*	*100,0*

Table 2. Continued...

Sarajevo		
>=3 portions	13	5,7
0 portion	54	23,5
1 portion	126	54,8
2 portions	37	16,1
Total	*230*	*100,0*
Split		
>=3 portions	6	5,1
0 portion	53	44,9
1 portion	49	41,5
2 portions	10	8,5
Total	*118*	*100,0*
χ2 =42.888 (df=6; p=0.000) p<0.05		
Weekly consumption of tomato sauce and olive oil		
Mostar		
>2 portions	84	67,2
0 portion	3	2,4
1 portion	38	30,4
Total	*125*	*100,0*
Sarajevo		
>2 portions	153	66,5
0 portion	6	2,6
1 portion	71	30.9
Total	*230*	*100,0*
Split		
>2 portions	98	83,1
0 portion	2	1,7
1 portion	18	15,3
Total	*118*	*100,0*
χ2 =11.488 (df=4; p=0.022) p<0.05		

The average body mass index (BMI) across both sexes and all cities was 23.37 ± 7.96 kg/m², which falls within the normal weight range. No statistically significant differences was found for body weight, height, hip circumference, waist circumference, waist-to-hip ratio (WHR), or blood pressure values between students from these cities (Table 2). Additionally, no significant difference in systolic and diastolic blood pressure were found across the cities (ANOVA test). Among men, no significant differences in glucose, total cholesterol, or triglyceride levels were observed between the cities (Kruskal-Wallis H test). However, in women, significant differences in total cholesterol and triglyceride levels were found across the cities (Kruskal-Wallis test, $p < 0.05$).

Table 3. Anthropometric, blood pressure, total cholesterol, triglyceride and blood glucose measurements of students from Mostar, Sarajevo and Split

		Split	**Mostar**	**Sarajevo**	**F**	**p**
Body weight (kg)	Male	82.9 ± 11.9	73.3 ±13.9	82.4 ± 12.8	2.169	0.124
	Female	63.9 ± 9.8	65.5 ± 10.7	65.1 ± 10.8	0.595	0.552
Body height (cm)	Male	184.1 ± 7.9	180.7 ± 12.46	183.1 ± 6.3	0.547	0.582
	Female	170.2 ± 5.42	168.9 ± 14.6	167.9 ± 6.6	2.042	0.131
BMI (kg/m2)	Male	24.5 ± 2.70	22.3 ± 2.99	24.5 ± 4.05	1.606	0.210
	Female	22.6 ± 3.52	23.3 ± 3.95	23 ± 3.64	1.382	0.252
Waist circumference	Male	87.5±9	80.8±12.7	86.5±12	0.983	0.381
	Female	73.1±9.4	74.7±9.4	72.4±8.7	2.988	0.052
Hip circumference	Male	106.8±6.4	98.4±9.2	102.9±9.9	2.029	0.141
	Female	96.6±9.2	100.6±18	96.5±10.2	4.63	0.010
WHR	Male	0.5±0.1	0.5±0.1	0.5±0.1	0.326	0.723
	Female	0.4±0.1	1.7±11.4	0.4±0.1	1.597	0.204
Systolic BP	Male	124.1±15.5	120.5±10.7	124.2±13.6	0.307	0.737
	Female	115.1±12.4	115.8±9.1	117.5±12	2.713	0.068
Dyastolic BP	Male	72.1±10.2	74.5±6.9	77.8±7.5	2.706	0.076
	Female	74.7±8.7	72±14.2	72.7±13.1	1.324	0.267
Glucose	Male	5.5±0.4	5.9±0.9	5.6±0.8	1.109	0.574
	Female	5.5±0.6	5.7±1.1	5.3±1.1	24.83	<0.001
Cholesterol	Male	3.9±0.6	4.5±0.9	4.6±1.2	3.235	0.198
	Female	4.2±0.5	4.1±0.6	4.6±1.1	27.871	<0.001
Triglycerides	Male	1.2±0.6	1.4±0.6	2.6±1.7	19.322	<0.001
	Female	1.4±1.2	1.2±1	2.4±1.8	75.953	<0.001

The student population from Split demonstrated the highest level of adherence to the Mediterranean diet, based on the MEDAS score, particularly in terms of olive oil use, vegetable intake, and fish consumption (Table 3). The ANOVA test was applied to the MEDAS scores, yielding an F-statistic of 0.0 and a p-value of 1.0, indicating no significant differences between the cities.

The odds ratio for fish consumption (Split vs. Sarajevo) was calculated as OR = 1.77, suggesting that students from Split have a 77% higher likelihood of consuming fish ≥3 times per week as compared to their counterparts from Sarajevo. The average MEDAS score was highest in Split (3.80 points) and lowest in Sarajevo (2.77 points). However, no statistically significant difference was found in the MEDAS scores between the cities.

Table 4. Adherence to the Mediterranean diet based on the MEDAS score between students from Mostar, Sarajevo and Split

	Mostar		**Sarajevo**		**Split**	
MEDAS score	Mean	SD	Mean	SD	Mean	SD
	3.37	1.93	2.77	1.78	3.80	1.83
	Median	*IQ range*	*Median*	*IQ range*	*Median*	*IQ range*
MEDAS score	3.0	(2.0-5.0)	2.0	(1.0-4.0)	4.0	(2.0-5.0)

Table 5. Categorisation of students from Mostar, Sarajevo and Split based on the adherence to the Mediterranean diet

City	**Low adherence**		**Moderate adherence**		**High adherence**	
Mostar	107	85,6%	17	13,6%	1	0,8%
Sarajevo	209	90,9%	21	9,1%	0	0,0%
Split	99	83,9%	17	14.4%	2	1,7%

Table 6. Categorization of nourishment status of students from Mostar, Sarajevo and Split based on their calculated Body Mass Index

	Mostar	**Split**	**Sarajevo**	**P**
Underweight	8 (6.5%)	5 (4.3%)	6 (2.6%)	x^2=12.019 p=0.062
Normal weight	88 (71.5%)	88 (75.9%)	164 (71.6%)	
Overweight	27 (22.0%)	19 (16.4%)	45 (19.7%)	
Obesity	0 (0%)	4 (3.4%)	14 (6.1%)	

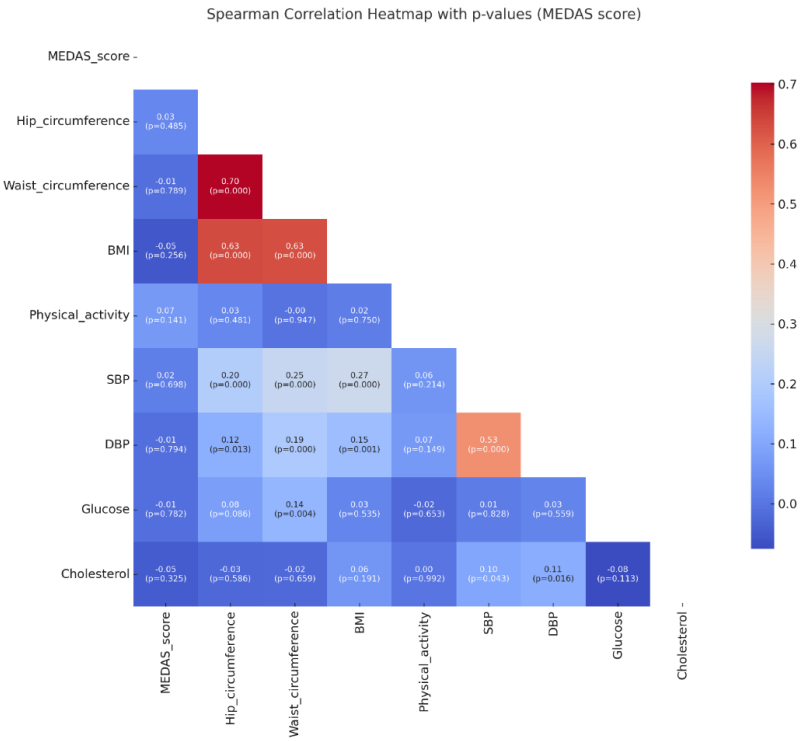

Figure 1. Correlation matrix of MEDAS score with antropometric values, blood preassure, glucose and cholesterol

Spearman correlation analysis revealed significant positive associations between BMI, waist circumference, and hip circumference, indicating interdependence among anthropometric measures. Both systolic and diastolic blood pressure were positively correlated with BMI and waist circumference. The MEDAS score (formerly labeled as the KIDMED index) showed no significant correlations with other variables. Physical activity demonstrated weak correlations with most variables, with no statistically significant associations observed.

Discussion

The results of our study enhance the understanding of how specific components of the Mediterranean and non-Mediterranean diets contribute to the prevention or risk of cardiovascular disease. Students from Split demonstrated better adherence to the Mediterranean diet compared to the other cities (Sarajevo and Mostar).

Regarding olive oil consumption, students from Split exhibited the highest frequency of olive oil use, as well as higher vegetable and fish consumption, which correlates with favorable laboratory and anthropometric parameters. Previous studies have shown that the incidence of major cardiovascular events is lower among individuals following a Mediterranean diet supplemented with extra-virgin olive oil or nuts, compared to those on a reduced-fat diet (Estruch, 2018).

The health science students from Sarajevo, a continental city, exhibited the highest statistical consumption of animal-derived fats (such as butter, cream, and margarine), the highest intake of sweetened beverages, and the lowest frequency of legume consumption. Students' diet in Sarajevo can be characterized as a hybrid of a partially Westernized diet and a traditional omnivorous dietary pattern.

While the average anthropometric and blood pressure values of students from Sarajevo were within normal ranges, the average cholesterol and triglyceride levels were elevated in women, suggesting a potential need for improvements in dietary habits and a reduction in cardiovascular risk factors.

Our analysis revealed significant positive associations between BMI, waist circumference, and hip circumference, indicating interdependence among anthropometric measures. Both systolic and diastolic blood pressure were positively correlated with BMI and waist circumference, suggesting a potential link between increased body mass and cardiovascular risk. The MEDAS score showed no significant correlations with other variables, implying a limited influence of adherence to the Mediterranean diet on the measured biometric and metabolic parameters in this sample. Physical activity demonstrated weak correlations with most variables, with no statistically significant associations observed.

An earlier study conducted on the student population in Rijeka, a city located on the Adriatic coast, revealed weak to moderate adherence to the Mediterranean diet (Pavičić Zezelj et al., 2019). In comparison, Sarajevo demonstrated even lower adherence to the Mediterranean diet, which may be partly attributed to its geographic location and the cultural differences influencing local dietary patterns.

Notable researchers in this field include Ancel Keys, a pioneer in investigating the Mediterranean diet and its impact on cardiovascular diseases, and Walter Willett and Frank Hu, who significantly advanced the understanding of the relationship between diet and chronic diseases (Hu & Willett, 2002; Aboul-Enein et al., 2017). Research on non-Mediterranean diets is less comprehensive, highlighting the need for further investigation in this area (Lugo-Morin & Bhat, 2022; Ghosh et al., 2023).

Previous research has demonstrated that high adherence to the Mediterranean diet is associated with a reduced incidence of all-cause mortality, fatal and non-fatal major cardiovascular diseases (CVD), type 2 diabetes, weight gain, metabolic syndrome, depression, cognitive decline, and nephrolithiasis. It is also linked to a lower average heart rate, mitigation of the harmful effects of overweight/obesity on CVD risk, and attenuation of the effects of obesity on type 2 diabetes. Additionally, there is evidence suggesting that the Mediterranean diet may enhance fertility (Carlos et al., 2017). The Mediterranean diet has consistently been shown to be a healthy dietary pattern in terms of morbidity and mortality (Sofi et al., 2013; Dinu et al., 2018), and it is widely recommended for the prevention of chronic and vascular diseases (Liyanage et al., 2016).

Previous studies have established a link between the consumption of animal fats and disturbances in lipid profiles (An et al., 2022). Additionally, a lower intake of legumes has been correlated with higher blood lipid levels (Zhang et al., 2010). Increased consumption of sweetened beverages has also been shown to elevate blood fat levels, posing a significant cardiovascular risk (Haslam et al., 2012).

Despite the well-documented health benefits of the Mediterranean diet, its adoption has been declining, even within countries around the Mediterranean Basin (Quarta et al., 2021). A global study on diet popularity ranked the Mediterranean diet 16th (Kamiński et al., 2020), which may be attributed to the indirect effects

of social and cultural changes, increasing urbanization, and the globalization of food systems within Mediterranean countries (Bonaccio et al., 2014). This shift has resulted in a greater preference for Western-style diets, characterized by reduced fruit and vegetable consumption and an increased reliance on processed, convenient foods (Statovci et al., 2017). One potential solution to this unfavorable trend is a gradual return to Mediterranean dietary habits. This could involve promoting healthy lifestyle behaviors, such as increased consumption of fruits, vegetables, legumes, cereals, nuts, olive oil, and seafood, along with an emphasis on consuming fresh, local, and seasonal products. Furthermore, adopting regular moderate physical activity and promoting communal eating practices are essential components of a holistic approach to health.

On a global scale, research indicates that consumption of balanced diets and essential nutrients is often suboptimal. Significant gaps between current and optimal intake were observed for nuts and seeds, milk, and whole grains, with current consumption at only 12%, 16%, and 23%, respectively, of the recommended levels. Conversely, consumption of unbalanced diets, such as sugar-sweetened beverages and processed meats, significantly exceeds optimal levels, with global intake of processed meat exceeding optimal recommendations by 90% (Afshin et al., 2019).

Adopting a healthier lifestyle, while preserving cultural dietary traditions, is crucial to maximizing the health benefits of the Mediterranean diet, which has been shown to promote overall well-being and reduce the risk of chronic diseases (Bach-Faig et al., 2011). Additionally, the plant-based nature of the Mediterranean diet offers considerable environmental benefits, including reductions in greenhouse gas emissions (72%), land use (58%), and energy consumption (52%), along with a more moderate decrease in water consumption (33%). In contrast, adherence to a Western dietary pattern is linked to increases in these environmental impacts (Saez-Almendros et al., 2013).

Education on the importance of nutrition for cardiovascular health is essential for both students and the wider community. Implementing educational programs and workshops focused on healthy eating habits and their role in reducing the risk of cardiovascular diseases is critical. Previous studies have shown that lower adherence to the Mediterranean diet correlates with poorer health outcomes among students, including higher risks of depression. Alarmingly, many students, including those from medical and nutritional disciplines, demonstrate inadequate knowledge regarding healthy dietary practices (Antonopoulou et al., 2020).

Conclusion

The primary finding of our study is the low adherence to the Mediterranean diet among students, regardless of where they live. Their general health indicators are within the normal ranges and suggest no cardiovascular risk. Considering their age and the high proportion of students with low adherence to the Mediterranean diet, coupled with the observed dietary patterns, they may be at increased risk of health issues later in life, especially if they continue practicing the same lifestyle.

References

Aboul-Enein, B.H., Puddy, W.C., Bernstein, J. (2020): Ancel Benjamin Keys (1904-2004): His early works and the legacy of the modern Mediterranean diet, *J. Med. Biogr.* 28(3), 139-147.

Afshin, A., Sur, P.J., Fay, K.A. et al. (2019): Health effects of dietary risks in 195 countries, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017, *Lancet* 393(10184), 1958–1972.

An, J., Wang, Q., Yi, S. et al. (2022): The source of the fat significantly affects the results of high-fat diet intervention, *Sci. Rep.* 12, 4315.

Bach-Faig, A., Berry, E.M., Lairon, D. et al. (2011): Mediterranean diet pyramid today: Science and cultural updates, *Public Health Nutrition* 14(12A), 2274-2284.

Bekar, C., Goktas, Z. (2023): Validation of the 14-item Mediterranean diet adherence screener, *Clinical Nutrition ESPEN.* 53, 238-243.

Bonaccio, M., Di Castelnuovo, A., Bonanni, A. et al. (2014): Decline of the Mediterranean diet at a time of economic crisis: Results from the Moli-sani study, *Nutr. Metab. Cardiovasc. Dis.* 24, 853–860.

Carlos, S., De La Fuente-Arrillaga, C., Bes-Rastrollo, M. et al. (2018): Mediterranean diet and health outcomes in the SUN cohort, *Nutrients* 10(4), 439.

Critselis, E., Kontogianni, M.D., Georgousopoulou, E. et al. (2021): Comparison of the Mediterranean diet and the Dietary Approach to Stop Hypertension (DASH) in reducing the risk of 10-year fatal and non-fatal CVD events in healthy adults: The ATTICA study (2002-2012), *Public Health Nutr.* 24(9), 2746-2757.

de-Mateo-Silleras, B., Camina-Martín, M.A., Cartujo-Redondo, A. et al. (2019): Health perception according to the lifestyle of university students, *J. Community Health* 44(1), 74–80.

Dinu, M., Pagliai, G., Casini, A. et al. (2018): Mediterranean diet and multiple health outcomes: An umbrella review of meta-analyses of observational studies and randomized trials, *Eur. J. Clin. Nutr.* 72(1), 30–43.

Estruch, R., Ros, E., Salas-Salvadó, J. et al. (2018): Primary prevention of cardiovascular disease with a Mediterranean diet supplemented with extra-virgin olive oil or nuts, *N. Engl. J. Med.* 378(25), e34.

Eurostat (2017): Health in the European Union – facts and figures. Online publications. Retrieved from http://ec.europa.eu/eurostat/statistics-explained/index.php/Health_in_the_European_Union_%E2%80%93_facts_and_figures. Accessed 27.03.2025.

Ghosh, S., Meyer-Rochow, V.B., Jung, C. (2023): Embracing tradition: The vital role of traditional foods in achieving nutrition security, *Foods* 12(23), 4220.

Haslam, D.E., Peloso, G.M., Herman, M.A. et al. (2020): Beverage consumption and longitudinal changes in lipoprotein concentrations and incident dyslipidemia in US adults: The Framingham Heart Study, *J. Am. Heart Assoc.* 9(5), e014083.

Hotz, C., Gibson, R.S. (2007): Traditional food-processing and preparation practices to enhance the bioavailability of micronutrients in plant-based diets, *The Journal of Nutrition* 137(4), 1097-1100.

Hu, F.B., Willett, W.C. (2002): Optimal diets for prevention of coronary heart disease, *JAMA* 288(20), 2569-2578.

Kamiński, M., Skonieczna-Żydecka, K., Nowak, J.K. et al. (2020): Global and local diet popularity rankings, their secular trends, and seasonal variation in Google Trends data, *Nutrition* 79–80, 110759.

Liyanage, T., Ninomiya, T., Wang, A. et al. (2016): Effects of the Mediterranean diet on cardiovascular outcomes: A systematic review and meta-analysis, *Plos. One* 11(8), e0159252.

Lu, L., Jing, W., Qian, W. et al. (2024): Association between dietary patterns and cardiovascular diseases: A review, *Current Problems in Cardiology* 49(3), 102412.

Lugo-Morin, D.R., Bhat, R. (2022): Future Foods. Chapter 29 - Restoring the values of traditional foods. (pp. 515-525). Academic Press.

Marendić, M., Polić, N., Matek, H. et al. (2021): Mediterranean diet assessment challenges: Validation of the Croatian version of the 14-item Mediterranean Diet Serving Score (MDSS) Questionnaire, *Plos. One* 16(3), e0247269.

Pant, A., Chew, D.P., Mamas, M. et al. (2024): Cardiovascular disease and the Mediterranean diet: Insights into sex-specific responses, *Nutrients* 16(4), 570.

Pavičić Zezelj, S., Dragas Zubalj, N., Fantina, D. et al. (2019): Adherence to Mediterranean diet in University of Rijeka students, *Paediatr. Croat.* 63(1), 24–30.

Quarta, S., Massaro, M., Chervenkov, M. et al. (2021): Persistent moderate-to-weak Mediterranean diet adherence and low scoring for plant-based foods across several Southern European countries: Are we overlooking the Mediterranean diet recommendations?, *Nutrients* 13(7), 1432.

Rosato, V., Temple, N.J., La Vecchia, C. et al. (2019): Mediterranean diet and cardiovascular disease: A systematic review and meta-analysis of observational studies, *Eur. J. Nutr.* 58(1), 173-191.

Saez-Almendros, S., Obrador, B., Bach-Faig, A. et al. (2013): Environmental footprints of Mediterranean versus Western dietary patterns: Beyond the health benefits of the Mediterranean diet, *Environ. Health* 12(1), 118.

Scholl, J. (2012): Traditional dietary recommendations for the prevention of cardiovascular disease: Do they meet the needs of our patients?, *Cholesterol* 2012, 367898.

Schröder, H., Fito, M., Estruch, R. et al. (2011): A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women, *J Nutr.* 141(6), 1140-1145.

Sofi, F., Macchi, C., Abbate, R. et al. (2014): Mediterranean diet and health status: An updated meta-analysis and a proposal for a literature-based adherence score, *Public Health Nutr.* 17(12), 2769-2782.

Statovci, D., Aguilera, M., MacSharry, J., Melgar, S. (2017): The impact of the Western diet and nutrients on the microbiota and immune response at mucosal interfaces, *Front. Immunol.* 8, 838.

Townsend, N., Wilson, L., Bhatnagar, P. et al. (2016): Cardiovascular disease in Europe: Epidemiological update, *Eur. Heart J.* 37(42), 3232–3245.

Widmer, R.J., Flammer, A.J., Lerman, L.O. et al. (2015): The Mediterranean diet, its components, and cardiovascular disease, *Am. J. Med.* 128(3), 229-238.

Zhang, Z., Lanza, E., Kris-Etherton, P.M. et al. (2010): A high legume low glycemic index diet improves serum lipid profiles in men, *Lipids* 45(9), 765-775.

Annex 1.

INDEX MEDAS- MEDAS questionnaire on Mediterranean nutrition (Mediterranean Diet Adherence Screener)

QUESTIONS	CRITERION FOR 1 POINT
Do you use olive oil as your main source? fat in cooking? (when preparing at least 2 meals a day, e.g. salads, cooked vegetables, meat or fish)	Yes
Which quantity olive oils use daily (including oil for salad, use during thermal processing of food, etc.)?	> 48 g
How much total serving vegetables you consume daily? (*1 serving = 1 cup fresh or cooked carrots, 1 cup cooked broccoli, spinach, 2 cups lettuce)	≥2
How much total serving fruit do you consume daily? (*1 serving = 1 piece fruit medium size, 1 cup strawberry, 1 banana)	≥3
How many total servings of red meat and/or meat products (dried meat, sausage and (fig.) you consume daily? (*1 serving = 100 - 150 g)	<1
How many total servings of butter, margarine or cream do you use daily? (*1 serving = 12 g or 1 tablespoon)	<1
How much carbonated and/or drinks with added sugar you consume daily?	<1
How much serving legumes (bean, peas, lens) you consume weekly? (*1 serving = 150 g)	≥ 3 servings
How many servings? fish and/or seafood you consume a week? (*1 serving = 100 - 150 g)	≥ 3 servings
How much times weekly you eat cakes and sweets?	< 3
How much total serving weekly you consume nuts fruits (almonds, walnuts, hazelnuts, peanuts)? (*1 serving = 30 g)	≥ 3 servings
You prefer whether rather consumption chicken, turkeys of red meat (veal, beef)?	That
How much times weekly you consume vegetables, pasta or rice?	≥ 2

Result: to 5 points indicates low compliance with MP (Mediterranean diet)., 6-9 indicates moderate compliance with MP
10 points and more indicates on high level adherence principles MP.