

PHYSICAL ACTIVITY, MEDITERRANEAN DIET AND SMOKING IN ADOLESCENTS FROM THE REPUBLIC OF KOSOVO

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Abstract

This study aimed to assess the relationship between physical activity, adherence to the Mediterranean diet (MD), and smoking habits among adolescents in Kosovo. A total of 322 high school students participated in the study, divided into two groups based on physical activity (103 active and 219 inactive) and smoking behavior (64 smokers and 247 non-smokers). Data collection utilized the IPAQ questionnaire to assess physical activity and the KIDMED questionnaire to evaluate adherence to the MD. Statistical analysis included descriptive statistics, T-tests, and chi-square tests to examine group differences. The results revealed significant differences in adherence to the MD between physically active and inactive adolescents. Physically active participants scored an average KIDMED index of 4.66, significantly higher than the inactive group's 3.53 ($p < 0.000$). Moreover, physically active adolescents showed a greater proportion with optimal and high KIDMED index values, emphasizing a positive association between physical activity and healthier dietary habits. In contrast, no significant differences were observed between smokers and non-smokers regarding their KIDMED index ($p = 0.326$), suggesting that smoking did not markedly influence adherence to the MD in this sample.

Key words: Mediterranean diet, physical activity, adolescents, health promotion

Introduction

The Mediterranean diet (MD) and its beneficial effects on health have been the subject of scientific research for decades, especially for its positive effect on long-term cardiovascular health and protection against chronic diseases. Historically, this diet is associated with countries of the Mediterranean region, such as Greece, Italy, Spain and southern France, where the use of fresh fruits and vegetables, fish, whole grains, legumes and olive oil as the main source of fat dominates. In recent years, research has confirmed its importance in promoting a healthy lifestyle among young people, including adolescents, who are at a critical point in their physical and psychosocial development.

In the modern context, adolescence is considered a period of rapid physiological changes and increased nutritional and energy requirements. At the same time, this period is critical for the formation of long-term health habits. However, a tendency towards adopting unhealthy eating patterns and reducing physical activity is increasingly observed, which significantly increases the risk of developing metabolic diseases, overweight and poor physical fitness (Sánchez-Sánchez et al., 2020). From this perspective, the Mediterranean diet and regular physical activity are considered fundamental elements in the promotion of a healthy lifestyle and disease prevention, especially in the context of adolescence.

The effects of the Mediterranean diet are particularly significant among young people, where its application is associated with improved cardiovascular and metabolic parameters. According to a study by Farajian et al. (2022), adolescents who regularly consume foods typical for the Mediterranean diet have a significantly lower risk of developing overweight and cardiometabolic disorders. This is due to the high content of antioxidants, monounsaturated fats and fibers that provide a reduction of inflammatory processes and an improvement of the lipid profile. In addition, the Mediterranean diet is rich in foods that are important for cognitive development, which is especially important for adolescents in the phase of education challenges.

In accordance with these findings, another study by Grosso et al. (2021) indicates a positive correlation between adherence to the Mediterranean diet and adolescent mental health, particularly in the context of

anxiety and depression. Young persons who adopt healthy eating patterns show improved cognitive function and better emotional regulation. These findings confirm not only the importance of adequate nutrition, but also the effect that it has on the overall psychosocial development of adolescents.

In addition to nutrition, physical activity plays a key role in maintaining the health of adolescents. According to the World Health Organization (WHO, 2021), adolescents should participate in at least 60 minutes of moderate to intense physical activity per day, which includes sports activities, walking, or other activities that contribute to cardiovascular health and development of the musculoskeletal system. These recommendations are of great importance because regular physical activity is associated with improved cardiorespiratory endurance, muscle strength, and improved metabolic parameters, including the reduction in the risk of type 2 diabetes and cardiovascular disease (Carson et al., 2022).

In combination with the Mediterranean diet, physical activity creates synergistic effects that strengthen the overall immune system and improve the physical condition of adolescents. For example, the study by Sotos-Prieto et al. (2021) shows that students who follow the principles of the Mediterranean diet and at the same time are engaged in regular physical activity show a significant improvement in parameters of body mass, cholesterol level and cardiorespiratory endurance.

In the context of public health policies, it is important to emphasize the need to direct educational programs towards encouraging the Mediterranean diet and physical activity among young people. According to the latest research, the responsibility for promoting these health habits falls on school institutions, parents and society as a whole. A multidimensional approach, which includes both nutritional habits and physical activity, can significantly contribute to reducing the risk of chronic diseases and increasing the quality of life of future generations (López-Gil et al., 2021).

In addition, it is necessary to develop new strategies for integrating these principles into the daily life of adolescents, especially in urban environments where there is a tendency towards fast and unhealthy food and a sedentary lifestyle. Adopting healthy habits at a young age creates a foundation for maintaining health and well-being throughout human's life.

The Mediterranean diet and physical activity represent key aspects of adolescent health, providing not only the prevention of physical ailments, but also the support of psychosocial development and mental health. As modern research shows, adherence to these health principles is key to forming positive and sustainable health habits among young people. Recognizing the importance of this period and creating appropriate interventions is crucial to the future of public health and individual well-being.

The aim of the work in our research was to determine if there is any significant statistical difference between the two groups of adolescents - the group that has regular physical activity and the inactive group with the KIDMED index, as well as the group of smokers and the non-smoker group with the KIDMED index.

Methods

The sample of respondents is described. These are adolescents - high school students: 1. Regarding physical activity: 103 - exercise regularly, and 219 - do not exercise regularly; and 2. regarding smoking (cigarette consumption): 64 - smoke and 247 - do not smoke.

Physical activity was assessed according to the IPAQ questionnaire.

Questionnaire for assessment of Mediterranean index (KIDMED index)

In the research the data were collected through an online questionnaire (Table 1). The KIDMED questionnaire consists of 16 questions (each question gives one point, positive or negative) that are related to the consumption of certain foods that are part of the Mediterranean diet. Based on the sum of those points, you can get the so-called Mediterranean diet index (KIDMED index), namely we can get a quantitative confirmation of food choices. So, if the KIDMED index has values of ≤ 3 , it means a very low value and shows that the Mediterranean diet is barely incorporated. It is optimal when the values of the KIDMED index are 4-7, and high - if the values are ≥ 8 .

Data collection and analysis / Statistical analysis

The questionnaire was conducted online.

The following basic descriptive statistical parameters were calculated for the applied variables in the research: arithmetic mean (X), standard deviation (SD) and level of significance. In order to determine whether there are differences between the physically active group and the inactive group in the value of the

KIDMED index, a T-test for independent samples was applied. Data processing was performed with contingency tables based on the values of the χ^2 test (chi-square test) and contingency coefficients, as well as testing their differences. The overall processing was carried out by the statistical package of SPSS for Windows.

Table 1. KIDMED questionnaire and index according to Torun and Yildiz

KIDMEDquestionnaire	Scoring
1. Consume fruit or fruit juice every day	+1
2. Consume fruit a second time every day	+1
3. Consume fresh or cooked vegetables every day	+1
4. Consume fresh or cooked vegetables more than once a day	+1
5. Consume fish regularly (at least 2-3 times a week)	+1
6. Consume fast food > 1 / week (hamburger)	-1
7. Consumes legumes > 1 / week (lentils, beans, peas)	+1
8. Consume pasta or rice almost every day (5 or > 5 / week)	+1
9. Consume cereals or seeds (bread, etc.) for breakfast	+1
10. Consume nuts (at least 2-3 / week)	+1
11. Use olive oil	+1
12. Skips breakfast	-1
13. Consumes dairy products for breakfast (yogurt, milk, etc.)	+1
14. Consume commercially produced pastries for breakfast	-1
15. Consume 2 yogurts and / or cheese (40g) per day	+1
16. Consume sweets and cakes several times a day	-1
KIDMEDindex:weak≤3;optimal4-7;high≥8	

Results

In order to determine whether there are differences between the group of adolescents who are physically active and the inactive group in the value of the KIDMED index was applied T-test for independent samples.

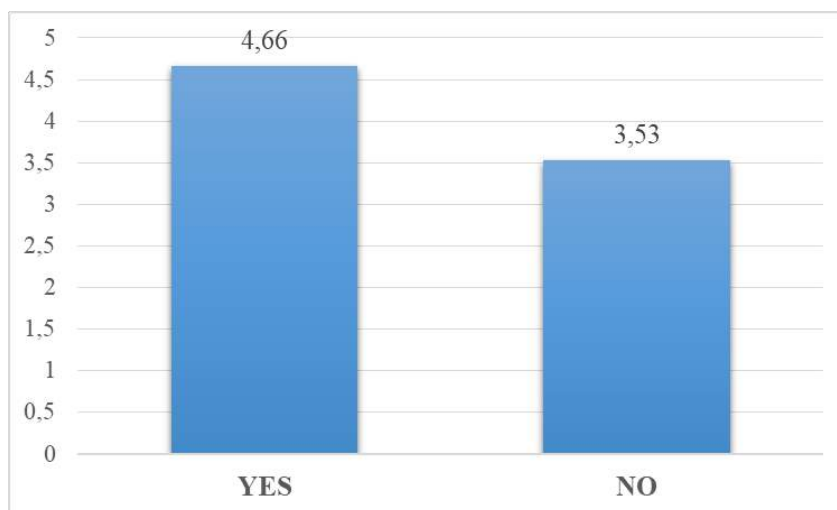
The analysis of the results of Table 2. clearly shows that there are statistically significant differences between the groups of adolescents who are physically active and those who are not involved in regular physical activity, while the values of the KIDMED index differ significantly ($p < 0.000$). These results suggest that physical activity is associated with higher scores on the KIDMED index, which is an indicator of the level of adherence to the Mediterranean diet. According to the obtained data, adolescents who regularly participate in physical activities have an average value of the KIDMED index of 4.66, which is significantly higher compared to those who are not physically active, where the average value of this index is 3.53.

These differences show that regular physical activity is not only associated with improved physical fitness, but also positively affects the choice of food habits, suggesting that physically active adolescents are more inclined towards a healthy diet. This positive correlation between physical activity and healthy diet emphasizes the need for interventions that promote an integrated approach to health among young people, in order to support the adoption of healthy lifestyle habits at an early age.

Table 2. Differences in the KIDMED index between groups (physical activity)

KIDMED Index		N	Mean	SD	T-test	dif	sig
Do you exercise regularly?	YES	103	4.66	2.36	3.99	195.23	0.000
	NO	219	3.53	2.33			

The statistical significance of the results confirms the importance of physical activity as a key factor in developing sustainable healthy habits. These findings are consistent with previous research showing that adolescents who lead a physically active lifestyle have better metabolic parameters and a lower risk of developing overweight and other health problems.

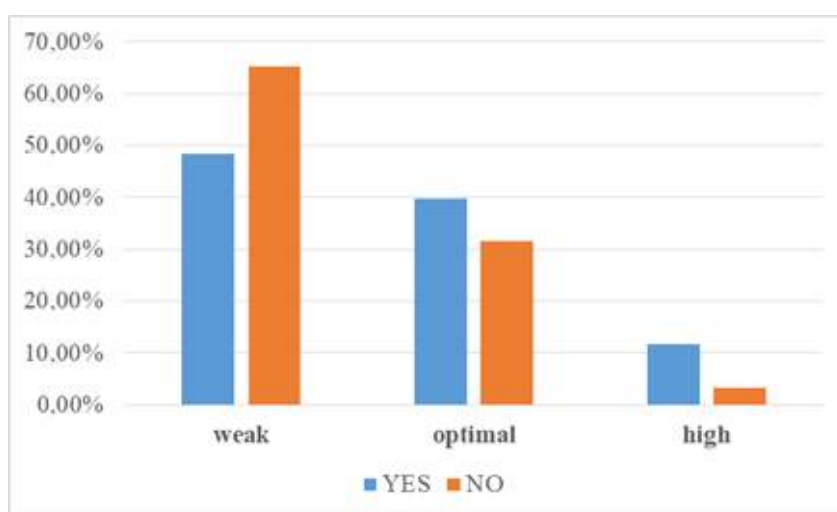


Graph 1. Do you exercise regularly?

Table 3. Proportional differences between groups that regularly exercise and do not exercise and KIDMED Index

		weak	optimal	high	Total
Do you exercise regularly?	YES	50	41	12	103
		48.50%	39.80%	11.70%	100.00%
	NO	143	69	7	219
		65.30%	31.50%	3.20%	100.00%
Total		193	110	19	322
		59.90%	34.20%	5.90%	100.00%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13,18	2	0.001
Likelihood Ratio	12.53	2	0.002
Linear-by-Linear Association	12,11	1	0.001
N of Valid Cases	322		



Graph 2. Do you exercise regularly?

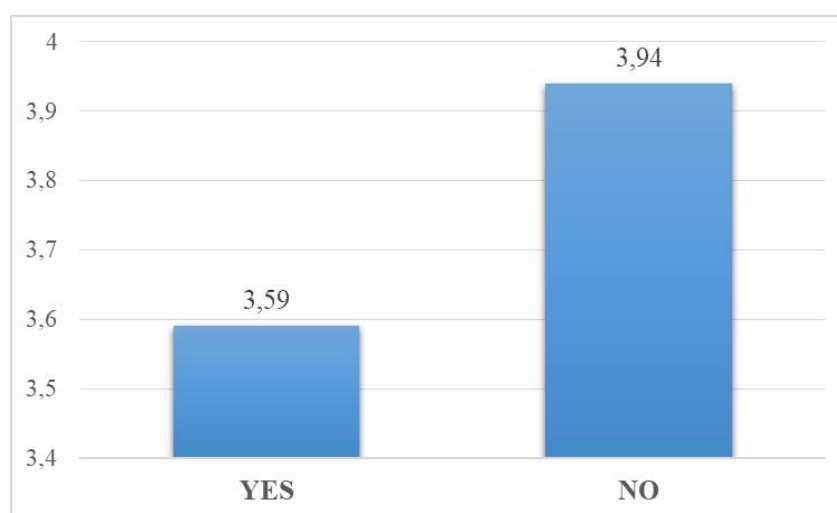
Proportional differences between the two groups, the group of adolescents who have regular physical activity (N = 103) and the inactive group (N = 219), and the KIDMED Index are presented in Table 3.

Previously, the respondents according to the values obtained from the survey to assess the Mediterranean diet were classified into three groups: a group with a high KIDMED Index (total points ≥ 8), a group with an optimal KIDMED Index (total points 4-7) and a group with a low KIDMED Index (total points ≤ 3).

The processing of the data was performed with contingency tables based on the values of the χ^2 square test and the contingency coefficients, as well as testing their differences. Contingency tables are constructed by crossing, on the one hand, the groups formed on the basis of the KIDMED Index (in rows - horizontally), numerically by frequencies (f) and percentage (%), and, on the other hand, the group that has regular physical activity and the inactive group also by frequencies (f), and percentage (%).

Table 4. Differences in KIDMED Index between groups (cigarettes)

KIDMED Index		N	Mean	SD	T-test	dif	sig
Do you smoke cigars?	YES	64	3.59	2.53	-0.99	93.33	0.326
	NO	247	3.94	2.36			



Graph 3. Do you smoke cigars?

The analysis of Table 3. and the examination of the χ^2 test for the entire sample of respondents ($\chi^2 = 13.18$, $p = 0.001$) indicates that there are statistically significant proportional differences between the adolescent group that has regular physical activity and the inactive group and the KIDMED index. The percentage values show that in the group of adolescents who have regular physical activity 48.50% of the respondents are classified with a low KIDMED Index, 39.80% of the respondents are classified with a medium KIDMED Index and 11.70% of the respondents are classified with a high KIDMED Index. The percentage values show that in the group that is not physically active 65.30% of the respondents are classified with a low KIDMED Index, 31.50% of the respondents are classified with a medium KIDMED Index and 3.20% of the respondents are classified with a high KIDMED Index.

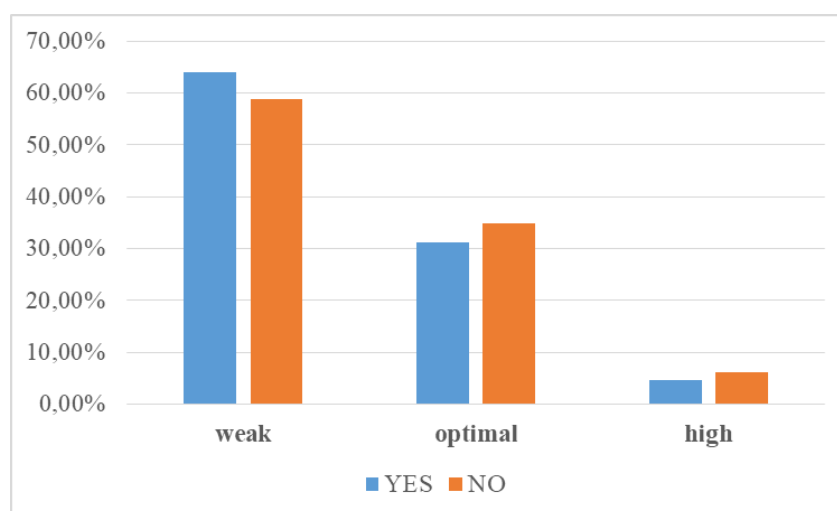
In order to determine whether there are differences between the group of adolescents who smoke and do not smoke cigarettes in the value of the KIDMED index, T-tests for independent samples were applied. From the review of Table 4., it can be seen that no statistically significant differences between groups were determined ($p = 0.326$).

The analysis of Table 5. and the examination of the χ^2 test for the entire sample of respondents ($\chi^2 = 0.62$, $p = 0.732$) indicate that there are no statistically significant proportional differences between the group of adolescent smokers and the group who do not smoke cigarettes and KIDMED Index. The percentage values show that in the group of adolescents who smoke cigarettes 64.10% of the respondents are classified with a low KIDMED Index, 31.30% of the respondents are classified with a medium KIDMED Index and 4.70% of the respondents are classified with a high KIDMED Index. The percentage values show that in the group of adolescents who do not smoke cigarettes 58.90% of the respondents are classified with a low KIDMED Index, 34.90% of the respondents are classified with a medium KIDMED Index and 6.20% of the respondents are classified with a high KIDMED Index.

Table 5. Proportional differences between smoking and non-smoking groups and KIDMED Index

		KIDMED Index			Total
		weak	optimal	high	
Do you smoke cigars?	YES	41	20	3	64
		64.10%	31.30%	4.70%	100.00%
	NO	152	90	16	258
		58.90%	34.90%	6.20%	100.00%
Total		193	110	19	322
		59.90%	34.20%	5.90%	100.00%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.62	2	0.732
Likelihood Ratio	0.64	2	0.727
Linear-by-Linear Association	0.62	1	0.431
N of Valid Cases	322		



Graph 4. Do you smoke cigars?

Discussion

The research highlights key aspects of the relationship between the Mediterranean diet, physical activity and health parameters among adolescents from the Republic of Kosovo. The results confirm that physical activity plays a key role in the formation of healthy eating habits, which is consistent with the existing literature findings (Carson et al., 2022). At the same time, the analysis shows that adolescents who practice regular physical activity have a higher KIDMED Index, which indicates a better adherence to a healthy diet.

One of the significant aspects of this research is the determination of statistically significant differences between physically active and inactive adolescents. According to the obtained data, the physically active respondents show a significantly higher average KIDMED Index (4.66) compared to the inactive ones (3.53). These differences highlight the importance of physical activity not only as a means of maintaining physical fitness, but also as a catalyst for positive dietary changes, which was also confirmed in the study by López-Gil et al. (2021).

The research further examines proportional differences between groups. Among physically active adolescents 11.7% are classified with a high KIDMED index, while among inactive adolescents this number is only 3.2%. These data suggest that regular physical activity supports healthy nutritional choices, which is consistent with the World Health Organization (WHO, 2021) recommendations on the association between physical activity and healthy habits.

In contrast, regarding smoking, the results show that there are no statistically significant differences in the KIDMED Index between smokers and non-smokers ($p = 0.326$). This result is interesting because it is inconsistent with expectations that smokers might have less healthy eating habits because of risky behavior. Perhaps this nonsignificance is the result of sociocultural factors or limitations in methodology, such as sample selection. Further research with a larger and more representative sample could provide a clearer picture of this aspect.

In addition, the results show that 48.5% of physically active adolescents have a low KIDMED Index, which indicates that despite physical activity, many of them still do not adopt enough healthy nutritional habits. This highlights the need for interventions that combine physical activity and nutrition education, which is in line with the recommendations of Sánchez-Sánchez et al. (2020).

Integrating the Mediterranean diet and physical activity is also supported by data showing synergistic effects on cardiovascular and metabolic health. The study by Sotos-Prieto et al. (2021) confirms this correlation, emphasizing that students who follow these principles show improvement in body mass, lipid profile and cardiorespiratory endurance. These results emphasize the importance of a comprehensive approach to the health of young people.

This research also contributes to the understanding of the role of socioeconomic and cultural factors in the formation of healthy habits among adolescents. In the context of the Republic of Kosovo, it is necessary to develop localization strategies that will encourage the adoption of the Mediterranean diet and physical activity. Such an approach can target school programs, families, and the community, as suggested by Grosso et al. (2021).

In conclusion, this research confirms that the Mediterranean diet and physical activity are essential components for maintaining adolescent health and well-being. At the same time, research points to the need for multidisciplinary interventions that integrate nutrition, physical activity and education, in order to create sustainable health habits.

Conclusion

The results of the research confirm that the Mediterranean diet, combined with regular physical activity, plays a significant role in improving health parameters among adolescents. Adolescents who are physically active show a higher KIDMED Index, which indicates a higher inclination towards healthy nutritional habits, and thus a better cardiovascular and metabolic state. The proportional differences between physically active and inactive adolescents are significant, which further emphasizes the importance of physical activity as a critical factor in supporting a healthy lifestyle.

Also, research indicates that adolescents who practice a Mediterranean diet and physical activity have better results not only in terms of physical health, but also in the context of psychosocial health and mental well-being. Developing healthy habits as early as adolescence can have long-term positive effects on health, reducing the risk of chronic diseases in later years.

In this direction, educational institutions and families should play a central role in the promotion of the Mediterranean diet and regular physical activity as part of the daily life of young people. Interventions aimed at increasing awareness of the importance of healthy habits and providing access to healthy food products and physical activities can significantly contribute to improving the quality of life of adolescents and future generations.

Therefore, the results of this research confirm the recommendations of global health organizations for the implementation of measures that will support the adoption of the Mediterranean diet and physical activity as a basis for health prevention and promotion of well-being.

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