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Adherence to the Mediterranean Diet and Carotid Intima-Media Thickness in University Students: A Cross-Sectional Study

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Abstract

Introduction: Subclinical atherosclerosis is increasingly recognized in younger populations, often progressing silently until the onset of overt cardiovascular events. Carotid intima-media thickness (CIMT) is a validated, non-invasive biomarker of early vascular alterations. Although the Mediterranean diet (MD) is well established as cardioprotective, its relationship with CIMT in young adults remains insufficiently studied. **Objective:** To assess sex-specific adherence to the Mediterranean diet and its association with carotid intima-media thickness in a cohort of university students. **Methods:** A cross-sectional study was performed involving 60 university students (50% male, aged 17–25 years), selected through stratified probabilistic sampling. Data were collected on sociodemographic characteristics, vascular risk factors, MD adherence via the PREDIMED questionnaire, and CIMT measured using a high-resolution carotid Doppler ultrasound. Statistical analyses included chi-square tests and descriptive statistics, with significance set at $\rho \leq 0.05$. **Results:** A notable 95% of participants showed low adherence to the Mediterranean diet. Significant sex differences in dietary patterns were identified: males consumed more red meat ($\rho = 0.023$), while females reported higher fish intake ($\rho = 0.037$). Despite behavioral risk factors, all CIMT values remained within normal ranges ($\leq$0.9 mm). No significant association was found between MD adherence and CIMT ($\rho = 0.554$). **Conclusion:** This exploratory study reveals a high prevalence of modifiable cardiovascular risk factors, including poor dietary adherence, among young adults, despite the absence of detectable vascular structural changes. Although no significant association was found, the findings reflect the dietary and behavioral profiles of a young, low-risk population.

Keywords: atherosclerosis; Mediterranean diet; cardiovascular risk factors; carotid intima-media thickness; Doppler ultrasound; young adults; university students

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1. Introduction

Cardiovascular diseases (CVDs) remain the leading cause of morbidity and mortality globally, representing a major public health burden across populations and health systems [1–3]. Atherosclerosis is widely recognized as the primary pathological mechanism underlying most CVD manifestations [4]. According to the World Health Organization (WHO), CVD accounted for approximately 17.9 million deaths in 2019, equating to 32% of all global deaths, with projections indicating an increase to 23 million annual deaths by 2030 [5,6]. In Portugal, CVD continues to be the leading cause of mortality, responsible for

28% of all deaths in 2020—an increase of 2.9% compared to 2019 and the highest recorded in the past decade [7,8]. Cerebrovascular disease, in particular, accounts for 9.2% of all deaths (111 per 100,000 inhabitants), disproportionately affecting women and older adults, with 93.9% of such deaths occurring in individuals aged ≥65 years [9].

Although traditionally associated with older adults, modifiable cardiovascular risk factors are increasingly prevalent among younger populations, especially university students [10,11]. While the etiology of CVD is multifactorial, atherosclerosis is universally accepted as the central pathological process that initiates and drives disease progression [12]. Elevated adiposity—particularly pericardial fat—has been independently associated with impaired left ventricular diastolic function [13], highlighting the need for the early screening of abdominal fat accumulation and waist circumference as key modifiable risk factors [12–14]. Although clinical manifestations of CVD typically emerge during middle age, there is compelling evidence that atherosclerotic changes may begin in utero and silently progress throughout life [15]. Atherosclerosis risk factors are broadly categorized as modifiable or non-modifiable [16].

In this context, the eCOR study, "Prevalence of Cardiovascular Risk Factors in the Portuguese Population" (2019), estimated the national burden of various risk factors, identifying an inadequate diet (71.3%), pre-obesity/obesity (62.1%), hypertension (43.1%), physical inactivity (29.2%), tobacco use (25.4%), and excessive alcohol consumption (18.8%) as the most prevalent [10]. In response, the Portuguese National Program for the Promotion of Healthy Eating (PNPAS 2022–2030) has outlined strategic interventions targeting these risk factors to improve population-level cardiovascular health [17].

The early identification of reliable, non-invasive markers is crucial for CVD prevention. The carotid intima-media thickness (CIMT) measurement has been widely validated as a surrogate marker for subclinical atherosclerosis [18]. Although robust evidence supports the cardiovascular benefits of the Mediterranean diet (MedDiet), its association with early vascular changes, such as CIMT, in young and asymptomatic individuals remains less well established.

Doppler ultrasonography has been used to assess vascular remodeling in response to various physiological stimuli, including physical activity. Studies have reported significant differences in the arterial velocity and vessel diameter between athletes and non-athletes, suggesting that exercise-induced vascular adaptations may contribute to cardiovascular protection [18]. Given its non-invasive nature and capacity to detect preclinical changes, Doppler ultrasound is particularly suitable for evaluating vascular health in young adults, where overt disease has not yet developed [4]. Carotid ultrasound allows for the quantification of CIMT, detection of atheromatous plaques, and assessment of vascular remodeling and functional changes, offering valuable insights into early subclinical pathology and potential systemic implications [5,19]. For example, studies on futsal athletes have demonstrated marked arterial and venous remodeling in the lower limbs, reflecting the vascular impact of high-intensity, intermittent physical activity [20].

Against this background, preventing atherosclerosis is a critical public health priority. Adopting healthy dietary patterns—particularly the Mediterranean diet—offers a comprehensive, evidence-based approach to mitigate modifiable risk factors and potentially slow or prevent the development of atherosclerosis [21].

The Mediterranean diet has been extensively studied for its effects on CIMT and carotid atherosclerosis. The NOMAS study demonstrated that long-term adherence to the MedDiet was associated with reduced CIMT and a lower incidence of cardiovascular events [22]. Similarly, the PREDIMED-Navarra trial investigated the impact of the MedDiet on subclinical atherosclerosis and found no significant short-term differences between groups; however, participants with higher baseline CIMT experienced regression, suggesting a potential benefit in higher-risk individuals [23]. Furthermore, recent evidence (2021) indicates significant CIMT reductions after 5–7 years of sustained adherence to the Mediterranean diet, reinforcing its long-term protective role [24]. Olive oil, a cornerstone of the MedDiet, has also been inversely associated with CIMT, as shown by Buil-Cosiales et al. [25]. Diets rich in fruits, vegetables, fish, and whole grains have similarly been linked to lower CIMT values [26].

Taken together, these findings highlight the potential of the Mediterranean diet to attenuate atherosclerotic progression, particularly in individuals at an elevated cardiovascular risk, and emphasize the importance of dietary strategies in cardiovascular disease prevention.

Accordingly, the primary aim of this study was to examine the relationship between adherence to the Mediterranean diet and carotid intima-media thickness (CIMT) in a sample of university students, with the consideration of sex-specific dietary differences. Secondary objectives included evaluating CIMT values by sex and assessing the prevalence of other vascular risk factors. While the main focus was the potential association between MedDiet adherence and CIMT, sex-based dietary patterns were analyzed as possible confounding variables.

We hypothesized that greater adherence to the Mediterranean diet would be associated with lower CIMT values and that female participants would demonstrate higher dietary adherence compared to their male counterparts.

2. Materials and Methods

2.1. Study Design

This cross-sectional study was conducted in September 2022 at a Higher School of Health, following approval from the institutional ethics committee (approval number 65 CE-IPCB/2022). The study aimed to investigate the association between adherence to the Mediterranean diet and carotid intima-media thickness (CIMT) among university students.

2.2. Participants and Setting

A total of 60 university students aged 17 to 25 years participated in the study. A stratified probabilistic sampling method was employed to ensure demographic representativeness across sex and academic programs. The age range was selected to capture individuals in a transitional phase between adolescence and adulthood, during which significant lifestyle behaviors impacting cardiovascular health are often established.

2.3. Inclusion and Exclusion Criteria

Eligible participants were those enrolled at the institution, who provided informed consent, completed the study questionnaire, and underwent a carotid Doppler ultrasound assessment. Students from any academic discipline were considered eligible. Exclusion criteria included refusal to participate or failure to complete the required procedures.

2.4. Initial Procedures

All participants were informed about the study's objectives, procedures, and confidentiality guarantees. Upon providing written informed consent, they completed a structured questionnaire comprising sociodemographic and health-related sections. All participants completed the questionnaires in a classroom setting under researcher supervision, following standardized instructions to minimize response bias. The ultrasound operator was blinded to the participants' dietary information to minimize measurement bias.

2.5. Data Collection Instruments and Variables

- Sociodemographic Data:
  Information regarding age, sex, and educational background was collected and used to categorize participants for subgroup analyses.
- Anthropometric Measurements:
  Weight and height were measured using standardized procedures. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2) and categorized according to WHO criteria.
- Assessment of Vascular Risk Factors:
  Participants reported on known cardiovascular risk factors, including smoking status, history of hypertension, diabetes, dyslipidemia, and prior dietary counseling. Smoking was categorized as current, former (cessation >12 months), or never. Hypertension was defined as a previous medical diagnosis or the use of antihypertensive medication. Dyslipidemia was considered present when participants reported a prior clinical diagnosis or were on lipid-lowering therapy.
- Dietary Habits and Mediterranean Diet Adherence:
  Adherence to the Mediterranean diet was assessed using the validated 14-item PREDIMED questionnaire [23,27,28]. Each affirmative response to a favorable dietary habit scores one point, for a total score ranging from 0 to 14. A score of ≥10 indicates good adherence; <10 indicates low adherence.
- Carotid Intima-Media Thickness (CIMT) Assessment:
  CIMT was evaluated using a Philips HD7 ultrasound system equipped with a 5–12 MHz linear transducer. Bilateral measurements of the common carotid arteries were performed with participants in the supine position and the neck slightly hyperextended to optimize visualization. Three measurements were obtained on each side and averaged to determine the mean CIMT. All measurements were performed manually at the far wall of the distal 1 cm of the common carotid artery, approximately 10 mm below the carotid bifurcation. CIMT values were classified as follows:
- ≤0.9 mm: normal;
- 1.0–1.4 mm: arterial wall thickening;
- ≥1.5 mm: presence of an atheromatous plaque.

2.6. Statistical Analysis

Data were analyzed using IBM SPSS Statistics, version 27. Descriptive statistics included means, standard deviations, and frequencies. The Kolmogorov–Smirnov test was applied to assess normality. Associations between categorical variables were tested using the chi-square test. Given the limited sample size and the categorical nature of most variables, no multivariate models were applied. Future studies with larger samples may benefit from regression or multivariate analysis to adjust for potential confounding factors.

Each artery was measured three times independently, and the average value was used for analysis. However, intra- and inter-observer variability were not formally assessed, which is acknowledged as a methodological limitation.

3. Results

The selection of participants was conducted through probabilistic and stratified sampling, ensuring an equitable and representative distribution. Confidence intervals (95%) were calculated for all major findings to account for the sample size limitations. Comparisons of CIMT values by gender and dietary adherence were included to enhance the visualization of results. The sample for this study consists of a total of 60 participants, with an equal distribution between sexes: 50% (n = 30) are female and 50% (n = 30) are male.

Regarding age, Table 1 shows that the sample is predominantly composed of young adults, with a mean age of 20.12 years and a standard deviation of ±1.91 years, ranging from 17 to 25 years (30 females sex and 30 males). In terms of body composition (Table 1), the average body mass index (BMI) was 22.63 kg per square meter (kg/m^2), with a standard deviation of ±2.99 kg/m^2. The lowest recorded BMI was 16.8 kg/m^2, while the highest was 30.8 kg/m^2. Overall, 95% of students exhibited low Mediterranean diet adherence, with no significant association between adherence and CIMT (p = 0.554).

Table 1. Characterization of age and body mass index (n = 60).

Age	**Total (n = 60)**
Average (mean value + standard deviation)	20.12 years ± 1.91 years
Minimum	17 years
Maximum	25 years
BMI (kg/m^2)	Total (n = 60)
Median (mean value + standard deviation)	22.63 kg/m^2 ± 2.99 kg/m^2
Minimum	16.8 kg/m^2
Maximum	30.8 kg/m^2

Legend: n = number of samples; BMI = body mass index (kg/m^2).

3.1. Modifiable Vascular Risk Factors

As observed in Table 2, the results revealed an absence of hypertension and diabetes mellitus among the participants. Dyslipidemia was present in only 1.7% (n = 1) of the individuals studied. Regarding smoking habits, 21.7% (n = 13) of the participants were smokers, and only 1.7% (n = 1) were former smokers. Additionally, obesity was observed in just 3.3% (n = 2) of the sample. Physical inactivity stood out as the most prevalent risk factor, with 43.3% (n = 26) of participants classified as physically inactive. Regarding modifiable vascular risk factors, physical inactivity was the most prevalent risk factor (43.3%), followed by smoking (21.7%).

Table 2. Prevalence of modifiable vascular risk factors among students (n = 60).

Risk Factors	**Yes**	**No**	**Doesn't Know or Does not Answer**
High blood pressure	0% (n = 0)	100% (n = 60)	0% (n = 0)
Diabetes *mellitus*	0% (n = 0)	100% (n = 60)	0% (n = 0)
Dyslipidemia	1.7% (n = 1)	93.3% (n = 56)	5% (n = 3)
Smoker	21.7% (n = 13)	78.3% (n = 47)	0% (n = 0)
Ex-smoker	1.7% (n = 1)	76.7% (n = 46)	0% (n = 0)
Obesity	3.3% (n = 2)	96.7% (n = 58)	0% (n = 0)
Physical inactivity	43,% (n = 26)	56.7% (n = 34).	0% (n = 0)

Legend: % = percentage; n = number of samples.

Modifiable Vascular Risk Factors by Sex

The comparative analysis of the presence of risk factors by sex (Table 3) revealed that neither female nor male participants exhibited hypertension or diabetes mellitus, with a prevalence of 0% (n = 0) in both cases. Regarding dyslipidemia, a prevalence of 3.3% (n = 1) was observed in females, while no cases were noted in males. It is noteworthy that 3.3% (n = 1) of females and 6.7% (n = 2) of males did not know or did not respond to the question about dyslipidemia.

Table 3. Prevalence of modifiable vascular risk factors between sexes (n = 60).

	Female Sex (n = 30)			Male Sex (n = 30)		
Risk Factors	**Yes**	**No**	**Does Not Know or Does Not Answer**	**Yes**	**No**	**Does Not Know or Does Not Answer**
High blood pressure	0% (n = 0)	100% (n = 30)	0% (n = 0)	0% (n = 0)	100%(n = 30)	0% (n = 0)
Diabetes *mellitus*	0% (n = 0)	100% (n = 30)	0% (n = 0)	0% (n = 0)	100% (n = 30)	0% (n = 0)
Dyslipidemia	3.3% (n = 1)	93.3% (n = 28)	3.3% (n = 1)	0% (n = 0)	93.3 (n = 28)	6.7% (n = 2)
Smoker	16.7% (n = 5)	83.3% (n = 25)	0% (n = 0)	26.7% (n = 8)	73.3%(n = 22)	0% (n = 0)
Ex-smoker	3.3% (n = 1)	80% (n = 24)	0% (n = 0)	0% (n = 0)	73.3%(n = 22)	0% (n = 0)
Obesity	0% (n = 0)	100% (n = 30)	0% (n = 0)	6.7% (n = 2)	93.3 (n = 28)	0% (n = 0)
Physical inactivity	60% (n = 18)	40% (n = 12)	0% (n = 0)	26.7% (n = 8)	73.3%(n = 22)	0% (n = 0)

Legend: % = percentage; n = number of samples.

Concerning smoking habits, a higher prevalence was found in males, with 26.7% (n = 8) identified as current smokers compared to 16.7% (n = 5) among females. Additionally, 3.3% (n = 1) of females were former smokers, while no male participants reported being ex-smokers.

Regarding obesity, 6.7% (n = 2) of males were classified as obese, whereas no cases of obesity were recorded among females. Lastly, physical inactivity was more prevalent in females, with 60% (n = 18) compared to 26.7% (n = 8) in males (Table 3).

3.2. Mediterranean Diet

Regarding dietary habits, the responses obtained through the PREDIMED questionnaire (Table 4) revealed a heterogeneous adherence to the components of the Mediterranean diet. Among the participants, positive behaviors with high adherence were noted: 90.2% (n = 55) used olive oil as their main cooking fat; 50.8% (n = 31) consumed fewer than one sugary or carbonated drink per day; 70.5% (n = 43) consumed seven or more glasses of wine per week; 73.8% (n = 45) preferred chicken, turkey, or rabbit over beef, pork, hamburgers, or sausages; and 96.7% (n = 59) regularly consumed vegetables, pasta, rice, or other dishes made with a sauté of tomato, onion, leek, or garlic and olive oil at least twice a week.

Table 4. Interpretation of responses to PREvention with MEDiterránea Diet (n = 60).

Question	**Answer**	**% (n)**	**Score (1 = Adherent)**
Do you use olive oil as your main cooking fat?	Yes	90.2% (55)	1
	No	8.2% (5)	0
How many tablespoons of olive oil do you consume daily (including cooking, salad dressing, etc.)?	≥4 tablespoons	6.6% (4)	1
	<4 tablespoons	91.8% (56)	0
How many servings of vegetables do you eat per day? (1 serving = 200 g, side dishes = ½ serving)	≥2 servings (at least one raw)	34.4% (21)	1
	<2 servings	63.9% (39)	0
How many pieces of fruit (including natural juices) do you consume per day?	≥3 pieces	24.6% (15)	1
	<3 pieces	73.8% (45)	0
How many servings of red meat, hamburgers or processed meats do you eat per day? (100–150 g)	<1 serving	13.1% (8)	1
	≥1 serving	85.2% (52)	0

Table 4. *Cont.*

Question	Answer	% (n)	Score (1 = Adherent)
How many servings of butter, margarine, or cream do you consume per day? (1 serving = 12 g)	<1 serving	34.4% (21)	1
	≥1 serving	63.9% (39)	0
How many sugary or carbonated drinks do you drink per day?	<1 drink	50.8% (31)	1
	≥1 drink	47.5% (29)	0
How many glasses of wine do you drink per week?	7 or more	70.5% (43)	1
	<7	27.9% (17)	0
How many servings of legumes do you eat per week? (1 serving = 150 g)	≥3 servings	44.3% (27)	1
	<3 servings	54.1% (33)	0
How many servings of fish or seafood do you eat per week? (100–150 g fish or 200 g seafood)	≥3 servings	24.6% (15)	1
	<3 servings	73.8% (45)	0
How often do you eat commercial pastries or sweets (cakes, cookies, biscuits)?	<3 times per week	36.1% (22)	1
	≥3 times per week	62.3% (38)	0
How many servings of nuts (e.g., walnuts, almonds, peanuts) do you consume per week? (30 g/serving)	≥3 servings	13.1% (8)	1
	<3 servings	85.2% (52)	0
Do you prefer to eat poultry (chicken, turkey, rabbit) over red or processed meats?	Yes	73.8% (45)	1
	No	24.6% (15)	0
How many times per week do you eat dishes made with sautéed tomato, onion, leek, garlic, and olive oil?	≥2 times/week	96.7% (59)	1
	<2 times/week	1.6% (1)	0

Legend: each response marked as "adherent" receives 1 point based on the original PREDIMED criteria. The total score ranges from 0 to 14. BMI = body mass index; n = number of participants.

Conversely, negative behaviors with high adherence were also recorded among participants: 91.8% (n = 56) consumed fewer than four tablespoons of olive oil per day; 63.9% (n = 39) consumed fewer than two servings of vegetables per day or less than one serving raw; 73.8% (n = 45) consumed fewer than three pieces of fruit per day; 85.2% (n = 52) consumed one or more servings of red meat, hamburgers, or processed meats per day; 63.9% (n = 39) consumed one or more servings of butter, margarine, or cream per day; 54.1% (n = 33) consumed fewer than three servings of legumes per week; 73.8% (n = 45) consumed fewer than three servings of fish or seafood per week; 62.3% (n = 38) consumed pastries or commercial sweets three or more times per week; and 85.2% (n = 52) consumed fewer than three servings of nuts per week.

The chi-square test indicated statistically significant differences in the use of olive oil as the main cooking fat and in the daily amount consumed, both with $\rho < 0.0001$; in the daily consumption of vegetables ($\rho = 0.020$) and fruits ($\rho < 0.0001$); in the intake of red meat, hamburgers, or processed meats ($\rho < 0.0001$); and in the weekly consumption of butter, margarine, or cream ($\rho = 0.020$), wine ($\rho = 0.001$), fish or seafood ($\rho < 0.0001$), pastries or sweets ($\rho = 0.039$), and nuts ($\rho < 0.0001$). The preference for chicken, turkey, or rabbit over red meats was also significant ($\rho < 0.0001$), as was the consumption of vegetables, pasta, rice, or other dishes made with sauté ($\rho < 0.0001$).

Mediterranean Diet by Sex

The comparative analysis of dietary habits between sexes, based on responses from the PREDIMED questionnaire, revealed several trends in positive and negative behaviors.

Positive behaviors included the following:

- 96.7% of females and 86.7% of males used olive oil as their main cooking fat.
- 60.0% of females and 56.7% of males consumed sugary or carbonated drinks less than once a day.
- 100% of females and 96.7% of males regularly consumed vegetables, pasta, rice, or sautéed dishes at least twice a week.

Negative behaviors included the following:

- 76.7% of females and 96.7% of males consumed one or more servings of red meat, hamburgers, or processed meats daily.
- 50.0% of females and 60.0% of males consumed fewer than three servings of legumes per week.
- 63.3% of both sexes consumed pastries or sweets three or more times per week.

The chi-square test identified statistically significant differences in consumption patterns: males consumed significantly more red meat, hamburgers, or processed meats ($\rho = 0.023$), while females consumed significantly more fish or seafood ($\rho = 0.037$) and preferred chicken, turkey, or rabbit over red meats ($\rho = 0.001$) (Table 5).

Table 5. Interpretation of responses to PREvention with MEDiterránea Diet between sexes (n = 60).

Questions	Answers	Female (n = 30)	Male (n = 30)	*p*-Value
Do you use olive oil as your main cooking fat?	Yes	96.7% (n = 29)	86.7% (n = 26)	0.161
	No	3.3% (n = 1)	13.3% (n = 4)	
How much olive oil do you consume in a day (including use for frying, dressing salads, eating out, etc.)?	< 4 < 4 tablespoons	96.7% (n = 29)	90.0% (n = 27)	0.301
	≥ 4 ≥ 4 tablespoons	3.3% (n = 1)	10.0% (n = 3)	
How many servings of vegetables do you eat per day? (1 serving: 200 g; consider side dishes as half a serving)	< 2 < 2 portions or < 1 < 1 raw portion	66.7% (n = 20)	63.3% (n = 19)	0.787
	≥ 2 ≥ 2 portions or ≥ 1 ≥ 1 raw portion	33.3% (n = 10)	36.7% (n = 11)	
How many pieces of fruit (including natural fruit juices) do you consume per day?	< 3 < 3 per day	80.0% (n = 24)	70.0% (n = 21)	0.371
	≥ 3 ≥ 3 per day	20.0% (n = 6)	30.0% (n = 9)	
How many servings of red meat, hamburgers or meat products (ham, sausage, etc.) do you eat per day? (1 serving: 100–150 g)	< 1 portion per day	23.3% (n = 7)	3.3% (n = 1)	**0.023**
	≥ 1 ≥ 1 portion per day portion per day	76.7% (n = 23)	96.7% (n = 29)	
How many servings of butter, margarine, or cream do you consume per day? (1 serving: 12 g)	< 1 portion per day	23.3% (n = 7)	46.7% (n = 14)	0.058
	≥ 1 ≥ 1 portion per day portion per day	76.7% (n = 23)	53.3% (n = 16)	
How many sugary or carbonated drinks do you drink per day?	< < 1 per day	60.0% (n = 18)	43.3% (n = 13)	0.196
	≥ 1 ≥ 1 per day	40.0% (n = 12)	56.7% (n = 17)	
How many glasses of wine do you drink per week?	< 7 < 7 **glass per week**	20.0% (n = 6)	36.7% (n = 11)	0.152
	≥ 7 ≥ 7 glass per week	80.0% (n = 24)	63.3% (n = 19)	
How many servings of legumes do you eat per week? (1 serving: 150 g)	< 3 < 3 per week	50.0% (n = 15)	60.0% (n = 18)	0.436
	≥ 3 ≥ 3 per week	50.0% (n = 15)	40.0% (n = 12)	
How many portions of fish or seafood do you eat per week? (1 portion: 100–150 g of fish or 4–5 units or 200 g of seafood)	< 3 < 3 per week	63.3% (n = 19)	86.7% (n = 26)	0.037
	≥ 3 ≥ 3 per week	36.7% (n = 11)	13.3% (n = 4)	

Table 5. *Cont.*

Questions	Answers	Female (n = 30)	Male (n = 30)	*p*-Value
How many times a week do you consume commercially available (not homemade) pastries or sweets, such as cakes, cookies, biscuits?	< 3 times per week	36.7% (n = 11)	36.7% (n = 11)	1.000
	≥ 3 ≥ 3 per week	63.3% (n = 19)	63.3% (n = 19)	
How many servings of nuts (walnuts, almonds, including peanuts) do you consume per week? (1 serving 30 g)	< 3 < 3 per week	86.7% (n = 26)	86.7% (n = 26)	1.000
	≥ 3 ≥ 3 per week	13.3% (n = 4)	13.3% (n = 4)	
Do you prefer to eat chicken, turkey or rabbit instead of beef, pork, hamburgers or sausages?	Yes	93.3% (n = 28)	56.7% (n = 17)	0.001
	No	6.7% (n = 2)	43.3% (n = 13)	
How many times a week do you eat vegetables, pasta, rice or other dishes made with a stir-fry (sauce made with tomato, onion, leek or garlic and olive oil)?	< 2 < 2 per week	0% (n = 0)	3.3% (n = 1)	0.313
	≥ 2 ≥ 2 per week	100% (n = 30)	96.7% (n = 29)	

Legend: % = percentage; n = number of samples.

We observe that 95% (n = 57) of university students demonstrated poor adherence to the Mediterranean diet, while only 5% (n = 3) showed good adherence. No female participants reported receiving dietary counseling, while only one male participant (3.3%) indicated having received such guidance.

3.3. Values of the Carotid Intima-Media Thickness

Regarding the CIMT, the average values were 0.626 mm (±0.1031 mm) in the right common carotid artery and 0.613 mm (±0.0957 mm) in the left common carotid artery. The minimum values were 0.4 mm and the maximum values were 0.9 mm, both observed in both carotid arteries. The comparative analysis of CIMT values between genders revealed that females recorded average values of 0.595 mm with a standard deviation of ±0.1025 mm in the right common carotid artery and 0.602 mm with a standard deviation of ±0.0850 mm in the left common carotid artery. In contrast, males not only exhibited higher average values, with 0.657 mm and a standard deviation of ± 0.0957 in the right common carotid artery and 0.625 mm with a standard deviation of ± 0.1056 mm in the left common carotid artery, but also recorded higher maximum values, reaching 0.9 mm in both carotid arteries, compared to 0.8 mm observed in females.

3.4. Adherence to the Mediterranean Diet and Carotid Intima-Media Thickness Values Between Genders

According to the data presented in Table 6, it was observed that among females, 96.7% (n = 29) had low adherence to the Mediterranean Diet (MedDiet), while 3.3% (n = 1) demonstrated high adherence. Regarding males, the results were similar, with 93.3% (n = 28) showing low adherence to the MedDiet, while 6.7% (n = 2) exhibited high adherence. In both genders, CIMT values remained equal to or below 0.9 mm, indicating that regardless of the level of adherence to the MedDiet, the values stayed within the normal range. The chi-square test indicated no statistically significant association between the degree of adherence to the MedDiet and CIMT in both genders (ρ = 0.554).

Table 6. Correlation between adherence to the Mediterranean diet and carotid intima-media thickness values between genders (n = 60).

CIMT (Right and Left)	**Low Adherence to the MedDiet**		**High Adherence to the MedDiet**		***p*-Value**
Reference Values	**Female (n = 30)**	**Male (n = 30)**	**Female (n = 30)**	**Male (n = 30)**	
$\leq$0.9 mm	96.7% (n = 29)	93.3% (n = 28)	3.3% (n = 1)	6.7% (n = 2)	0.554
1 a 1.4 mm	0% (n = 0)	0% (n = 0)	0% (n = 0)	0% (n = 0)	NA
$\geq$1.5 mm	0% (n = 0)	0% (n = 0)	0% (n = 0)	0% (n = 0)	NA

Legend: NA = not applicable; % = percentage; n = number of samples.

4. Discussion

4.1. Key Findings

To our knowledge, this is one of the few studies evaluating the association between adherence to the Mediterranean diet (MedDiet) and carotid intima-media thickness (CIMT) in a young university population. Despite 95% of students presenting low adherence to the MedDiet, CIMT values remained within normal ranges, with no statistically significant association between dietary adherence and subclinical atherosclerosis (ρ = 0.554).

Physical inactivity emerged as the most prevalent modifiable risk factor, especially among females, confirming the gender-based disparities previously reported in similar cohorts. Esteves et al. (2017) found that 35% of university students were physically inactive due to barriers such as time constraints and financial limitations [29–32]. These results are consistent with Sinclair [33] and Goje et al. (2014), who also reported lower physical activity levels among females [34].

Smoking was the second most prevalent behavior, particularly among males—aligning with the findings of Carvalho et al. (2017) and Pimentel et al. (2013), which documented increased smoking rates and initiation among university students upon entering higher education [35,36].

In terms of body composition, only 3.3% of participants were classified as obese—similar to the 7.7% prevalence reported by Odlaug et al. (2015) [37]. Males showed slightly higher BMI values, consistent with findings of Vijayalakshmi [38]. Notably, no participants had hypertension or diabetes mellitus, which differs from the studies by Silva and Theodoropoulos [39] and Freitas et al. [40], as well as others [41–44] that reported low, but measurable, rates of these conditions in similar populations.

Dietary analysis revealed marked differences by sex: males consumed significantly more red and processed meats (ρ = 0.023), while females reported higher consumption of fish (ρ = 0.037) and poultry (ρ = 0.001)—findings consistent with González-Sosa [44]. Although statistically significant, the clinical implications of these dietary differences remain limited in the absence of corresponding vascular abnormalities.

4.2. Interpretation of CIMT Results

All CIMT values were below 0.9 mm, indicating no arterial wall thickening or plaque formation. This likely reflects a floor effect, whereby the limited variability and normal range of CIMT measurements in this low-risk, young population mask potential associations. Chehuen Neto et al. (2021) also noted that atherosclerotic changes detectable via CIMT generally emerge after age 25, beginning with the progression from fatty streaks to plaque formation [30].

The slightly higher CIMT values observed in males may be attributable to sex-specific hormonal differences. Tan et al. (2009) and Meyer et al. (2006) suggest that estrogen plays a protective role in premenopausal women by reducing lipid accumulation and promoting vascular integrity [45,46].

4.3. Methodological Considerations and Limitations

Several limitations must be acknowledged. First, the relatively small sample size (n = 60) may limit statistical power and generalizability. A formal sample size calculation was not performed a priori. Second, the cross-sectional design precludes causal inference. Third, while CIMT measurements were repeated three times per artery and averaged, inter- and intra-observer variability were not formally assessed. The ultrasound operator was blinded to dietary data, reducing the risk of measurement bias.

Dietary adherence was assessed using the PREDIMED questionnaire, which, although validated in Mediterranean adult populations, was not specifically designed for young adults. All participants completed the questionnaire under supervision, with standardized instructions, yet recall and reporting biases cannot be excluded. The absence of biochemical markers or objective dietary assessments (e.g., 24 h recalls, plasma carotenoids, or fatty acid profiles) further limits the strength of dietary evaluation.

Finally, the exclusive use of chi-square tests to explore associations was driven by the categorical nature of the data and limited sample size. Future studies with larger cohorts should explore multivariate or regression models to adjust for confounders such as BMI, smoking status, and physical activity.

4.4. Public Health Implications

Despite the limitations, this study highlights concerning trends in health behaviors among university students, including poor dietary quality and sedentary lifestyles. While CIMT values were within normal ranges, the presence of multiple modifiable risk factors in this population suggests that early preventive strategies are warranted.

Universities represent an ideal setting for the implementation of targeted health-promotion programs, including nutrition education, physical activity campaigns, and collaborations with food providers to improve access to healthier options. Broader public health strategies might include mandatory health modules, the integration of lifestyle medicine into student services, and environmental changes that support healthy behaviors.

4.5. Future Perspectives

Future research should employ longitudinal designs to monitor the evolution of vascular health over time and to assess whether early lifestyle patterns predict changes in CIMT or cardiovascular outcomes later in life. The inclusion of validated tools for younger populations, objective dietary biomarkers, and more sophisticated statistical modeling will enhance the robustness of future findings.

5. Conclusions

This study highlights the alarmingly low adherence to the Mediterranean diet among university students, alongside a high prevalence of modifiable cardiovascular risk factors, particularly physical inactivity and smoking. Although no significant association was found between dietary adherence and carotid intima-media thickness (CIMT), these findings underscore the need for early, targeted public health interventions.

Nutrition education and lifestyle-modification programs should be integrated into university health services as part of comprehensive cardiovascular-risk-prevention strategies for young adults. Interventions focusing on promoting healthy dietary patterns and increasing physical activity levels are critical to prevent the early establishment of risk behaviors that contribute to future cardiovascular morbidity.

Although no significant association was observed between Mediterranean diet adherence and CIMT, the high prevalence of modifiable risk behaviors highlights the importance of early health promotion. However, given the cross-sectional design and the limited sample size, these findings should be interpreted with caution and further validated through longitudinal studies.

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