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RESEARCH

Adherence to the mediterranean diet and physical activity in relation to sarcopenia: a cross-sectional epidemiological cohort study

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Abstract

Background Adoption of healthy lifestyle habits has been proposed as successful strategies to counteract sarcopenia.

Aims To explore the association of physical activity (PA) and adherence to the mediterranean diet (MD), individually and synergically, with sarcopenia.

Methods The present cross-sectional study examined data of the Toledo Study of Healthy Ageing. Data of community-dwelling adults aged 65 + years were analyzed. Sarcopenia was defined according to the Foundation for the National Institutes of Health, standardized to our population (sFNIH) and the European Working Group on Sarcopenia (EWGSOP2). PA levels (Physical Activity Scale for the Elderly, PASE) and adherence to the MD (MEDiterranean Diet Adherence Screener-MEDAS) were estimated using self-reported instruments. Binary regression models were conducted to test associations.

Results Data of 1457 individuals (mean age 74.68 ± 5.77 years; 54.91% women) were analyzed. Among them, 331 (22.72%, sFNIH) and 202 (13.86%, EWGSOP2) met sarcopenia criteria. PA levels (ORs: 0.91–0.95, $p < 0.05$) and adherence to the MD (ORs: 0.82–0.86, $p < 0.05$) were significantly and negatively associated with the prevalence of sarcopenia, regardless of the definition used. Nevertheless, no significant interactions were observed among healthy lifestyle habits. According to sarcopenia-related domains, PA levels and adherence to the MD were negatively associated with dynapenia, meanwhile, PA levels were associated with low lean mass (sFNIH) and adherence to the MD was inversely associated with poor mobility.

Conclusions PA and adherence to the MD are independently associated with sarcopenia. Moreover, specific associations were observed between sarcopenia domains. Nevertheless, no significant interaction was observed between them.

Keywords Sarcopenia · Physical activity · Mediterranean diet · Low handgrip strength · Low gait speed · Low muscle mass

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Background

Preserving functional independence is a priority for successful aging [1, 2]. Sarcopenia is a disease [3] characterized by the presence of dynapenia, low muscle mass, and mobility impairment [4]. The prevalence of sarcopenia increases with age, reaching more than 20% of individuals aged 65 + years [5]. The progression of sarcopenia deserves concern, given its close association with the occurrence of multiple negative health events [6], such as falls [7], frailty [8, 9], disability [10, 11], and death [12].

The management of sarcopenia is a topic under intense debate. Currently, despite the efforts to explore possible biomarkers of sarcopenia [13, 14], there is no available pharmacological treatment that might effectively reduce its prevalence. On the other hand, the adoption of healthy lifestyle habits is widely mentioned by panels of experts, as a successful approach that might contribute to improvements in sarcopenic status [15, 16]. Among the myriads of healthy lifestyle habits, substantial attention has been given to physical activity (PA). For instance, a recent pooled analysis by Sánchez-Sánchez et al. [17] found that high PA levels were significantly associated with a lower prevalence of sarcopenia. Nevertheless, only three of the studies included examined sarcopenia according to the most recent guidelines [17]. Moreover, the extension by which PA is associated with specific sarcopenia-related domains still needs to be further explored [17]. These data are important to understand what type of complementary strategy would be necessary to effectively manage sarcopenia.

Compliance with healthy dietary patterns is another healthy lifestyle habit with cumulative synergistic effects on health in the development of different diseases [18–20]. Specifically, investigations have observed that a high adherence to the Mediterranean Diet (MD), characterized by a high consumption of olive oil, vegetables, fruit, moderate consumption of fish and poultry, and low consumption of red meat and sweets, as well as moderate consumption of wine at meals [19–21], is associated with specific domains of sarcopenia, such as muscle strength [22–24] and gait speed [24]. However, available evidence includes investigations conducting in non-Mediterranean populations and the assessment of the adherence to the MD using non-validated instruments. Furthermore, existing studies have provided conflicting results [25–28].

Notably, individuals with high PA levels might be more engaged in adhering to healthy nutritional habits [29]. Furthermore, it has been proposed that the significant associations observed between MD and health parameters might be a product of a mediterranean way of living, which includes, among other, regular practice of PA, instead of solely nutritional patterns. Taken together, this scenario suggests that a possible interaction between PA and adherence to the MD might exist.

Therefore, to expand the current knowledge, the present study aims to explore the individual and synergic (interactions) between PA and/or adherence to the MD with sarcopenia status and domains.

Methods

The present study examined data from the second wave of assessments (conducted between 2011 and 2013) of the Toledo Study of Healthy Ageing (TSHA) database [30]. The TSHA is a longitudinal population-based study that examined community-dwelling older adults aged 65 + years who lived in the province of Toledo, Spain. The TSHA was conducted according to ethical standards laid down in the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of the Toledo Hospital, Spain (ID:15072010.93). All participants agreed to be part of the study and voluntarily signed the informed consent prior to enrolment. In the present study, all participants with no missing data for the variables examined were included.

Sarcopenia

Sarcopenia was operationalized according to definitions created by experts' panels, including (a) the Foundation for the National Institutes of Health (FNIH) [31, 32], standardized to our population (FNIHs) [33]; and (b) the European Working Group on Sarcopenia in Older People (EWGSOP2) [4]. Participants were defined as sarcopenic if they had a combination of (i) dynapenia, operationalized according to isometric handgrip strength (IHG), (ii) low muscle mass, based on appendicular lean soft mass (aLM), and (iii) mobility impairments, estimated according to gait speed. This classification refers to the categories established by the FNIH guidelines and to severe sarcopenia, according to the EWGSOP2.

IHG was evaluated using a hydraulic Jamar (J. A. Preston Corporation, Clifton, NJ, USA) dynamometer. Participants were assessed according to standard procedures [34]. The highest performance (in kilogram) of three trials was recorded and used for analysis. One minute of resting was provided between attempts. aLM was assessed through a whole-body dual-energy X-ray absorptiometry (DXA) on a Hologic (Bedford, MA, USA) scanner. Body Mass Index (BMI) was obtained according to standard procedures (adjusted to the nearest 0.1) and then BMI- adjusted by ALM (aLM/BMI) was determined. For the gait speed test, participants were instructed to walk meters at their usual pace. The fastest of two trials (m/s) was analyzed.

Mediterranean diet

The Mediterranean Diet Adherence Screener (MEDAS) questionnaire [35] was used to estimate adherence to the MD. The MEDAS is a self-reported questionnaire in which individuals are asked 14 questions about the frequency and quantity of consumption of certain foods (i.e., olive oil, fruits and vegetables, legumes, fish and seafood, white, red and processed meats, butter, carbonated beverages, wine, nuts, sweets) and methods of cooking (sofrito). Each item is assigned a score of 0 or 1, resulting in a total possible score ranging from 0 to 14, with higher results indicating highest levels of adherence to the MD.

Physical activity

PA levels were assessed through the Physical Activity Scale for the Elderly (PASE) [36]. This tool possesses 10 questions that assess the duration, intensity and frequency of leisure, domestic and work activities performed by older adults in the last week. The final score is obtained by multiplying whether the individual participated in the activity, or the amount of time spent in the activity by the empirically derived item weights, which are summed. Due to the overall score ranges from 0 to 400 or more [36], we standardized the score by dividing it by 10.5, equivalent to increasing the time spent walking outside the home by 30 min per day.

Covariates

The presence of comorbidities (evaluated through the Charlson Comorbidity Index [37]), number of drugs intake, formal education (non-educated, non-finished primary education, and finished primary education/superior), the capacity to perform the basic (Katz Index [38]) and instrumental activities of daily living (Lawton and Brody Index [39]) and smoking status were considered as covariates.

Statistical analysis

Descriptive data was presented as mean (standard deviation) and N (percentages), respectively. Differences between groups according to the presence of sarcopenia were tested using Mann-Whitney for continuous variables and Chi-squared tests for the comparison between categorical variables.

Different models were conducted to test the associations between PA and/or adherence to the MD and sarcopenia. The association between these two variables were tested individually by performing logistic regression models adjusted for different covariates such as age, sex, comorbidity, number of drugs intake, educational level, Katz Index score, Lawton Index score and smoking status. Subsequently, we performed the same approach, but including both the PASE (divided by 10.5) and MEDAS scores from the first model. Next, we included the interaction variable of both independent variables in the model.

Statistical significance was set at p-value < 0.05. All the analyses were computed using R for windows version 4.1.2.

Results

The main characteristics of study participants according to sarcopenia status is shown in Table 1. Data of one thousand four hundred fifty-seven (mean age 74.68 ± 5.77 years; 54.91% women) older adults were examined. Among them, 331 (22.72%) and 202 (13.86%) were identified as sarcopenic according to sFNIH and EWGSOP2 definitions, respectively. Comparisons between participants with and without sarcopenia indicated that those sarcopenic were mostly women, were significantly older, had a higher prevalence of comorbidities, and lower PASE and MEDAS scores, suggesting low levels of PA and adherence to the MD.

Individual associations between MD, PA, and sarcopenia

Table 2 shows the association between PA levels and the adherence to the MD with sarcopenia. Adherence to MD [sFNIH OR (95%CI): 0.84 (0.77, 0.92), p-value < 0.001; EWGSOP2 OR (95%CI): 0.82 (0.74, 0.91), p-value < 0.001] and PA levels [sFNIH OR (95%CI): 0.94 (0.90, 0.97), p-value 0.002; EWGSOP2 OR (95%CI): 0.95 (0.90, 0.99), p-value 0.018] were negatively and significantly associated with the presence of sarcopenia, regardless of the covariates included in the model. The inclusion of adherence to MD or PA levels as adjustment variables in the models assessing its respective roles did not change the results (Table 3).

When the analysis was conducted according to specific sarcopenia domains, PA was significantly and inversely associated with dynapenia, regardless of the cut-off point used (Supplementary Table 1). It was also significantly and negatively associated with low muscle mass, when it was operationalized according to the sFNIH definition [OR (95%CI): 0.96 (0.93, 0.99), p-value 0.011], but not with the EWGSOP2 ($p > 0.05$ for all models). On the other hand, adherence to the MD was significantly and inversely associated with dynapenia and mobility impairments, but not with low muscle mass, regardless of the definition used to assess sarcopenia (Supplementary Table 2). Similar results were observed when PA and the adherence to the MD were included as covariates (Supplementary Table 3).

Table 1 Demographic characteristics of the participants according to the presence of sarcopenia

	Whole sample	sFNIH			EWGSOP2		
		No sarcopenia	Sarcopenia	*p*-value	No sarcopenia	Sarcopenia	*p*-value
N	1457	1126 (77.28%)	331 (22.72%)		1255 (86.14%)	202 (13.86%)	
Women, n (%)	800 (54.91%)	526 (46.71%)	274 (82.78%)	**<0.001**	695 (55.38%)	105 (51.98%)	**<0.001**
Age, mean (SD)	74.68 (5.77)	73.81 (5.50)	77.67 (5.69)	**<0.001**	73.96 (5.32)	80.01 (5.68)	**<0.001**
BMI, mean (SD)	29.20 (4.56)	28.66 (4.31)	31.05 (4.89)	**<0.001**	29.50 (4.57)	27.38 (4.03)	**<0.001**
Charlson Index score, mean (SD)	1.20 (1.66)	1.10 (1.56)	1.55 (1.93)	**<0.001**	1.10 (1.56)	1.55 (1.93)	**0.040**
PASE score, mean (SD)	81.93 (44.17)	86.87 (44.34)	65.13 (39.26)	**<0.001**	85.13 (43.96)	60.73 (43.64)	**<0.001**
MEDAS score, mean (SD)	7.50 (1.62)	7.57 (1.63)	7.24 (1.58)	**<0.001**	7.56 (1.61)	7.11 (1.67)	**0.002**
Time spent in complete 3-meters (ds), mean (SD)	43.51 (21.27)	38.39 (16.57)	60.95 (25.79)	**<0.001**	40.58 (17.80)	63.21 (29.13)	**<0.001**
IHS, mean (SD)	24.02 (9.21)	26.51 (8.81)	15.55 (4.12)	**<0.001**	25.27 (9.03)	15.96 (5.47)	**<0.001**
ALM/BMI, mean (SD)	0.614 (0.142)	0.651 (0.138)	0.489 (0.062)	**<0.001**	0.623 (0.144)	0.600 (0.117)	**<0.001**
Educative level							
Non-educated	417 (28.62%)	270 (23.98%)	147 (44.41%)	**<0.001**	321 (25.58%)	96 (47.52%)	**<0.001**
Non-finished primary education	443 (30.40%)	339 (30.11%)	104 (31.42%)	**<0.001**	380 (30.28%)	63 (31.19%)	**<0.001**
Finished primary education/superior	597 (40.97%)	517 (45.91%)	80 (24.17%)	**<0.001**	554 (44.14%)	43 (21.29%)	**<0.001**
Lawton index score, mean (SD)	6.93 (1.71)	7.05 (1.57)	6.50 (1.71)	**<0.001**	7.13 (1.47)	5.68 (2.41)	**<0.001**
Katz Index score, mean (SD)	5.79 (0.59)	5.85 (0.49)	5.56 (0.82)	**<0.001**	5.84 (0.48)	5.44 (0.99)	**<0.001**

In bold: p-value < 0.05. ALM/BMI: Appendicular Lean Mass divided by Body Mass Index. EWGSOP2: European Working Group on Sarcopenia in Older People. IHS: Isometric Handgrip Strength. sFNIH: PASE; Physical Activity Scale for the Elderly

Table 2 Associations between physical activity and adherence to the mediterranean diet with two definitions of sarcopenia

	Model 1		Model 2		Model 3		Model 4	
sFNIH	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**
MEDAS score	0.84 (0.77, 0.91)	**<0.001**	0.85 (0.78, 0.92)	**<0.001**	0.85 (0.77, 0.92)	**<0.001**	0.84 (0.77, 0.92)	**<0.001**
PASE score	0.91 (0.88, 0.94)	**<0.001**	0.93 (0.89, 0.96)	**<0.001**	0.94 (0.91, 0.98)	**0.004**	0.94 (0.90, 0.97)	**0.002**
EWGSOP2	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**
MEDAS score	0.83 (0.75, 0.91)	**<0.001**	0.83 (0.75, 0.92)	**<0.001**	0.82 (0.74, 0.91)	**<0.001**	0.82 (0.74, 0.91)	**<0.001**
PASE score	0.92 (0.89, 0.96)	**<0.001**	0.93 (0.89, 0.97)	**0.001**	0.95 (0.91, 1.00)	**0.031**	0.95 (0.90, 0.99)	**0.018**

Model 1: adjusted by age and sex. Model 2: Model 1 + Charlson Index score and number of drugs intake. Model 3: Model 2 + Katz Index score and Lawton Index score. Model 4: Model 3 + educational level, and smoking status

Table 3 Associations between physical activity and adherence to the mediterranean diet with two definitions of sarcopenia considering both independent variables

	Model 1		Model 2		Model 3		Model 4	
sFNIH	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**
MEDAS score	0.84 (0.77, 0.92)	**<0.001**	0.85 (0.78, 0.92)	**<0.001**	0.85 (0.78, 0.92)	**<0.001**	0.84 (0.77, 0.92)	**<0.001**
PASE score	0.91 (0.88, 0.95)	**<0.001**	0.93 (0.90, 0.97)	**<0.001**	0.95 (0.91, 0.99)	**0.008**	0.93 (0.90, 0.98)	**0.002**
EWGSOP2	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**
MEDAS score	0.83 (0.75, 0.91)	**<0.001**	0.83 (0.75, 0.92)	**<0.001**	0.82 (0.74, 0.91)	**<0.001**	0.82 (0.74, 0.91)	**<0.001**
PASE score	0.93 (0.89, 0.96)	**<0.001**	0.93 (0.89, 0.97)	**0.001**	0.91 (0.91, 1.00)	0.059	0.95 (0.90, 0.99)	**0.028**

Model 1: adjusted by age, sex, MEDAS score and PASE score. MEDAS score was used as an adjustment variable in the models assessing the role of PASE score, while PASE was used as such adjustment variable was in the models assessing the role of adherence to MD. Model 2: Model 1 + Charlson Index score and number of drugs intake. Model 3: Model 2 + Katz Index score and Lawton Index score. Model 4: Model 3 + educational level, and smoking status

Interactions between MD and PA, and associations with sarcopenia

Table 4 shows the results for the interaction between PA and the adherence to the MD, and its association with sarcopenia. No significant interactions were observed. Similar findings were observed when each sarcopenia domain was tested individually (Supplementary Table 4).

Discussion

The main findings of the present study indicate that PA and adherence to the MD were negatively and significantly associated with sarcopenia. Moreover, PA and MD were significantly associated with specific sarcopenia domains. Indeed, PA was negatively associated with dynapenia and loss of muscle mass, while adherence to the MD was inversely

Table 4 Associations between physical activity, adherence to the mediterranean diet and its interaction with two definitions of sarcopenia

	Model 1		Model 2		Model 3		Model 4	
sFNIH	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**
MEDAS score	0.85 (0.78, 0.93)	**<0.001**	0.86 (0.79, 0.94)	**0.001**	0.86 (0.78, 0.94)	**0.001**	0.85 (0.78, 0.94)	**0.001**
PASE score	0.91 (0.88, 0.95)	**<0.001**	0.93 (0.89, 0.97)	**<0.001**	0.95 (0.91, 0.99)	**0.012**	0.94 (0.90, 0.98)	**0.004**
MEDAS*PASE	1.01 (0.99, 1.04)	0.281	1.01 (0.99, 1.04)	0.295	1.01 (0.99, 1.04)	0.208	1.02 (0.99, 1.04)	0.177
EWGSOP2	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**
MEDAS score	0.83 (0.74, 0.92)	**<0.001**	0.83 (0.74, 0.92)	**0.001**	0.82 (0.74, 0.92)	**<0.001**	0.82 (0.74, 0.92)	**<0.001**
PASE score	0.92 (0.88, 0.96)	**<0.001**	0.93 (0.89, 0.97)	**0.001**	0.96 (0.91, 1.00)	0.078	0.95 (0.90, 1.00)	**0.036**
MEDAS*PASE	1.00 (0.97, 1.02)	0.942	1.00 (0.97, 1.02)	0.923	1.00 (0.98, 1.03)	0.905	1.00 (0.98, 1.03)	0.868

Model 1: adjusted by age, sex, MEDAS score, PASE score and the interaction between them. Model 2: Model 1 + Charlson Index score and number of drugs intake. Model 3: Model 2 + Katz Index score and Lawton Index score. Model 4: Model 3 + educational level, and smoking status

associated with dynapenia and mobility impairments. Nevertheless, these findings were only observed when PA and MD were examined individually, given that no significant interactions were observed between these variables.

Although a theoretical background allows the assumptions that the adoption of healthy lifestyle habits might contribute to counteracting the genesis and progression of sarcopenia, empiric data are still lacking to support these expectations. Notably, investigations examining the association between adherence to the MD and sarcopenia and sarcopenia-related domains have shown controversial results. In one of the few investigations that examined Mediterranean populations, Cacciatore et al. [22] noted that Italian older adults with high adherence to the MD were less likely to present probable sarcopenia. Our findings are also in line with the observations of Hashemi et al. [40] who found significant associations between adherence to MD and the prevalence of sarcopenia in Iranian middle-aged and older adults. Authors also reported that individuals with the highest adherence to the MD had less mobility limitations. On the other hand, Chan et al. [41] reported no significant associations between adherence to the MD and the prevalence of sarcopenia in high-functioning Chinese older adults. These findings were further expanded by Stanton et al. [42], who observed no associations between MD and sarcopenic domains in Australian older adults with no sarcopenia. Results of pooled analysis are also conflicting, with significant associations found between MD and walking speed [24, 28], whereas associations between MD and sarcopenia were not significant [28].

Differences between these studies might be explained by sample characteristics (middle-aged vs. older adults, physical status), sarcopenia operationalization methods, MD adherence score, and geographical location. For instance, there are currently at least 28 different instruments to assess adherence to the MD [43]. These instruments differ regarding their conceptual background (e.g., MD pyramid, diet quality index), place in which it was validated (mediterranean versus non-mediterranean countries), and psychometric properties. In the present study, adherence to the MD was operationalized using the MEDAS method, which has been cross-culturally adapted, tested against negative outcomes, and validated in different populations [43]. However, there is insufficient information about the properties of many of the MD adherence scores used in other investigations [43]. Then, comparisons among instruments are difficult to perform.

Regarding the geographical location, most of the aforementioned investigations were conducted in non-mediterranean countries (i.e., Iran, China, and Australia). There are considerable attempts to adapt the MD to non-mediterranean countries [44]. However, adapted versions are frequently based on erroneous interpretations regarding many characteristics of the MD, such as the type of diet (e.g., vegetarian), food groups (e.g., Mediterranean versus general), alcohol intake, which is expected to be based on red wine during meals, olive oil, the main source of fat, and cooking methods [44, 45]. This scenario led some authors to propose that many investigations have not specifically examined MD [45].

Findings of the present study indicate that older adults with higher PA levels were less likely to be sarcopenic, have dynapenia, and low muscle mass. These findings are in line with several other investigations [17] and support current recommendations that PA might be an important complementary instrument to counteract the genesis and development of sarcopenia [46]. Indeed, the practice of PA and regular exercise emerge as adjustable factors influencing functional outcomes in older adults, reducing age-related oxidative stress and pro-inflammatory markers, stimulating muscle protein synthesis and mitochondrial biogenesis pathways, consequently promoting muscle anabolism and potentially contribute to the maintenance of sarcopenia related parameters [47, 48]. Taking this into account, in our population, the observed association between adherence to the Mediterranean diet and physical activity with a decreased risk of sarcopenia is likely more related to antioxidant and anti-inflammatory mechanisms [47, 49–51] than to factors such as loss of appetite, dysphagia, or other nutrition-related conditions.

An interesting result of the present study is that PA and MD were significantly associated with specific sarcopenia domains. Notably, no significant associations were found between PA and mobility limitations, and between MD and low muscle mass. These observations are likely explained by the fact that, although participants were identified as physically active, it is possible that most of these activities were performed at low intensities. Indeed, most of the day-to-day activities mentioned in the PASE questionnaire are commonly performed at low intensities, or, at least, do not require longer periods of strength production, such as walking outside, light domestic work, and repairs in the house, which might not be sufficient to promote neuromuscular gains [52]. These premises are supported by observational data and a recent pooled, in which moderate-to-vigorous PA, but not light PA, was associated with physical performance [53].

The lack of associations between MD and muscle probably occurred due to the low intake of high-quality protein characteristic of this type of diet pattern. As a matter of fact, most protein present in the MD are from vegetal, instead of animal sources. The main difference between these protein sources regards the content and quality of amino acids (AA), given that animal protein is expected to provide higher contents of branched-chain amino acids (BCAA), and mainly leucine, which are acknowledged as major determinants of muscle protein synthesis [54].

A last important observation of the present study is the lack of interaction between MD and PA. For the best of our knowledge, this is the first investigation that examined this scenario in older adults. Results are surprising, given that people with high PA levels are expected to have better nutritional habits [29]. Moreover, some authors have discussed that the favorable health profiles observed in people with high adherence to the MD might reflect a mediterranean way of living, which includes, among other, regular practice of PA, instead of solely nutritional patterns. In addition, although our models were adjusted for comorbidity using the Charlson Comorbidity Index, it is possible that healthier lifestyle behaviors, such as high levels of physical activity and adherence to the Mediterranean diet, may have attenuated the negative impact of chronic conditions on muscle quality and function, independently of their statistical contribution. This potential moderating effect of healthy lifestyles underscores the relevance of promoting healthy behaviors, particularly among those individuals affected by chronic conditions.

One possible rationale for these results is the relative homogeneity in adherence to the MD observed among participants in this study. Notably, interaction analysis combines both dependent variables; therefore, substantial uniformity in one variable could lead to minimal or negligible effects on the other. Results might also be a product of limitations of the assessment tools. For instance, adherence to the MD was estimated according to the MEDAS. This scenario limits the conduction of deeper analysis adjusting the data according to important nutritional aspects, such as caloric and protein intake, that are quantified using dietary assessment tools.

Clinical applications.

The findings of this study highlight significant clinical implications for preventing and managing sarcopenia. We demonstrate that an increase of 10.5 points in the PASE score, equivalent to walking half an hour a day, decreases the risk of sarcopenia by 5–6%. This recommendation aligns with the general physical activity guidelines for older adults, which suggest at least 150 min of moderate-to-vigorous physical activity per week [55]. Clinicians can incorporate tailored physical activity recommendations, focusing on strength training and aerobic exercises, alongside dietary counseling that promotes Mediterranean diet principles—rich in fruits, vegetables, whole grains, healthy fats, and lean proteins. Furthermore, although we did not find an interaction between both variables, it is important for clinicians to reinforce both adherence to daily physical activity and adherence to the Mediterranean diet, as each seems to be associated with different aspects of sarcopenia. On the other hand, this manuscript opens the possibility that future studies may explore specific cut-off points of physical activity and adherence to the Mediterranean diet specific to prevent sarcopenia in different populations.

The present study involves other limitations that should be mentioned to contribute to a better interpretation of our data. First, PASE is a self-report scale and the possibility that different results might be acquired using objective PA assessment tools cannot be ruled out. Second, both PASE and MEDAS possess subdomains that might be analyzed individually. Third, we used a version of the MEDAS scale, which only involves 14 items, a fact that may underestimate the effect that some specific items may have on these associations. Future studies including the expanded version of this questionnaire (MEDAS Plus) or food frequency questionnaires (i.e., Food Frequency Questionnaire) could complement our findings. Fourth, our sample was composed of community-dwelling older adults and extrapolation to people in other conditions (e.g., hospitalized) should be carefully made. Finally, the cross-sectional design of this manuscript does not allow any inference on cause-effect relationships or on the impact of PA and adherence to the MD on the time course of sarcopenia and its different domains.

Conclusions

Physical Activity levels and adherence to the Mediterranean diet are independently associated with sarcopenia. Moreover, specific associations were observed between sarcopenia domains and these healthy style habits. Nevertheless, no significant interaction between them was observed.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

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