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Impact of Socioeconomic Status on Dietary Intake in Adults Aged 60 and Over, in Northwestern Spain: A Study of Community-Dwelling Older Adults Enrolled in a Municipal Active Aging Program

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ABSTRACT

Background: Unhealthy lifestyles and poor dietary habits pose a major challenge to global public health, contributing significantly to the burden of disease and mortality. This phenomenon has been connected to various sociodemographic and economic factors that negatively affect diet quality, particularly among older adults.

Objective: To evaluate the relationship between socioeconomic status and diet intake among community-dwelling adults aged ≥ 60 years enrolled in a municipal active aging program (PReGe) in Northwestern Spain.

Methods: A cross-sectional observational study was conducted in adults aged 60 years and older residing in Salamanca, Spain. Data collection included sociodemographic variables such as age, sex, and postal address, as well as nutritional variables assessed through a food frequency questionnaire.

Results: The sample consisted of 192 individuals. A positive association was observed between socioeconomic status and the intake of cereals and vegetables. In contrast, a negative association was observed with total fat and saturated fat intake ($p < 0.05$ for all).

Conclusion: A significant association is closely related between socioeconomic status and dietary quality, highlighting a higher intake of saturated fats among individuals with lower socioeconomic status and a greater intake of vegetables and cereals among those with higher socioeconomic status in community-dwelling adults aged ≥ 60 years enrolled in a municipal active aging program in Northwestern Spain (Salamanca).

Abbreviations: ANOVA, analysis of variance; BMI, body mass index; EFSA, European Food Safety Authority; FFQ, food frequency questionnaire; HSES, high socioeconomic status; LSES, low socioeconomic status; MSES, medium socioeconomic status; PReGe, Program Research on Active Aging with Preventive Physiotherapy; SD, standard deviation; SES, socioeconomic status.

1 | Introduction

Unhealthy lifestyles and poor dietary patterns are among the main global public health concerns, accounting for up to 11 million deaths worldwide in 2017 [1]. In particular, inadequate nutrition in older adults is associated with future health decline and increased mortality [2, 3].

Current evidence has identified several factors associated with better diet quality: female sex, older age, higher socioeconomic and educational status, and urban residence [4–6].

Regarding sex, women tend to adhere more closely to dietary guidelines than men [6, 7]. Several studies support this finding. For example, it was observed that only 0.5% of men who improved their income increased their vegetable consumption, compared to 9.1% among women who remained in the highest income group [8]. Similarly, it was concluded that being female and having a higher education level were associated with greater consumption of these foods [9]. Furthermore, evidence indicates that women display more positive attitudes toward healthy eating habits [10].

When comparing age groups, some studies have shown that individuals aged 60–69 demonstrate greater health awareness and higher adherence to the Mediterranean diet than those over 80 [11, 12]. However, overall data suggest that younger generations are less likely to follow this dietary pattern compared to older cohorts, which may have important implications for designing public health strategies that promote healthy eating throughout the life course.

Despite the fact that a considerable proportion of adults over 65 comply with recommendations for specific food groups (such as fruits, bread and cereals, and dairy products over 80% self-reported adherence), 89.6% still require dietary adjustments to achieve a balanced eating pattern, and only 8.2% can be considered globally adherent to a healthy diet [13].

Socioeconomic status (SES) stands out as one of the most influential factors in diet quality. Lower financial status is associated with poorer diet quality, characterized by higher intake of energy-dense, nutrient-poor foods. Specifically, individuals with low socioeconomic status (LSES) consume fewer fruits, vegetables, dairy products, whole grains, fiber, fish, and seafood, and more legumes, bread, sugary drinks, and pastries compared to those with high socioeconomic status (HSES) [12]. The latter group shows higher consumption of fish and seafood and lower intake of red and processed meats [4, 14–17]. Thus, SES is positively associated with the intake of proteins, fiber, vitamins, and minerals.

This disparity may have clinical implications [14] demonstrated that diet quality increased with socioeconomic level and that women with LSES showed higher rates of abdominal obesity and overweight compared to those with middle (MSES) or HSES. Similarly, lower SES was associated with reduced protein intake, often replaced by processed meats, increasing the risk of obesity and cardiovascular diseases [18, 19].

Furthermore, SES is closely linked to food insecurity in older adults, defined as limited or uncertain access to sufficient and adequate food. This condition may negatively affect nutritional status, leading to malnutrition due to restriction or poor-quality diets [20] and increase the risk of cognitive decline, as recent studies suggest [15, 21–23].

This study is particularly relevant because it is conducted in western Spain, specifically in the city of Salamanca, a region characterized by a high degree of demographic aging (27.9% of the population over 65 years in 2024), high life expectancy (84.4 years), and a socioeconomic level below the national average [24]. These conditions make this population particularly vulnerable to the effects of low-quality diets, due to economic, educational, and access-related constraints that may shape their food choices. Despite this, local evidence exploring the influence of SES on diet quality in this population segment is scarce. This highlights the need for context-specific research to support the development of tailored public health strategies adapted to the region's demographic and social characteristics.

Although many studies have identified sociodemographic and economic variables associated with poorer diet quality, specific evidence on these factors in adults aged 60 years and older remains limited, despite the critical role of nutrition in this stage of life. In addition, while socioeconomic gradients in diet quality have been reported in several European cohorts, evidence is still scarce in smaller urban settings with pronounced population aging and below-average socioeconomic indicators, where structural constraints (income, access, and food literacy) may shape dietary choices differently. Furthermore, many previous studies have focused primarily on dietary patterns or adherence scores, with less emphasis on a nutrient-level characterization in older adults. Therefore, this study addresses these gaps by examining, in a highly aged urban population in Northwestern Spain, the association between SES and both food-group frequency and macro- and micronutrient intake, including adequacy interpretation based on EFSA reference values, using an area-based income estimate linked to residential address.

Therefore, the aim of this study is to evaluate the relationship between SES and diet intake among community-dwelling adults aged ≥ 60 years participating in the municipal active aging program (PReGe) in Salamanca, based on the analysis of macronutrient and micronutrient intake, as well as food consumption frequency.

2 | Materials and Methods

2.1 | Study Design

A cross-sectional observational study was conducted.

2.2 | Study Setting

The study was carried out in eight senior associations located in different neighborhoods of Salamanca (Spain), as well as in two municipal senior centers managed by the Salamanca City Council.

2.3 | Study Population

The sample consisted of 192 adults aged 60 and over who were participating in the program Research on Active Aging with Preventive Physiotherapy (PReGe), developed within the framework of the Collaboration Agreement between the Salamanca City Council and the University of Salamca [25]. Participants were selected through consecutive convenience sampling.

2.4 | Inclusion Criteria

Individuals aged 60 or older, retired or early-retired, residing in the municipality of Salamanca, who freely and voluntarily provided informed consent and did not meet any of the exclusion criteria.

2.5 | Exclusion Criteria

Subjects with clinically confirmed conditions that prevented them from completing the study questionnaires were excluded. The exclusion criteria were as follows: advanced serious illnesses, cognitive impairment, serious digestive disorders preventing food tasting, musculoskeletal disorders preventing walking, serious mental illness, or not planning to reside in the area for the duration of the intervention. Sixteen individuals presented an exclusion criterion for participation in the program.

2.6 | Sample Size Calculation

The sample size calculation was based on the average fat intake reported in the study by Julibert et al. [26], who analyzed a sample of older adults and determined a mean daily fat intake of 36.2% ± 6.1% of total energy intake. Based on these data, a sample of 192 individuals was deemed sufficient to estimate the population mean with a 95% confidence interval and a precision of ±3.7%, assuming a standard deviation of 6.1%. A 10% dropout rate was anticipated.

2.7 | Recruitment and Visit Structure

Researchers contacted participants from the PReGe program to offer them the opportunity to participate in the study. Those who agreed were subsequently called by phone to verify that they met the inclusion criteria. They were then scheduled for an in-person interview with the lead researcher. Each interview lasted approximately 60 min and included a detailed explanation of the study objectives and procedures. Informed consent was obtained, and the relevant questionnaires were administered.

2.8 | Variables and Measurement Tools

2.8.1 | Sociodemographic Variables

Data were collected on age, sex, marital status, household composition, educational level, and residential address.

2.8.2 | Anthropometric Variables

Measurements included body weight, height, and waist circumference.

2.8.3 | Nutritional Variables

Dietary intake and habits were assessed using a semiquantitative food frequency questionnaire (FFQ), validated in Spanish [27]. This FFQ consists of nine intake categories ranging from never to more than 6 times per day, allowing participants to estimate their frequency of consumption for each food item based on their intake over the previous year. These data were used to estimate daily intake of macro- and micronutrients.

2.9 | SES

SES was estimated based on the annual average income per person according to residential street, as reported by the Spanish National Statistics Institute. Participants were categorized into three income groups based on the 33rd and 66th percentiles of individual annual income: Low income < €25 384; Middle income €25 384–€28 900; and High income > €28 900.

2.10 | Statistical Analysis

The distribution of variables was assessed using the Kolmogorov–Smirnov test. Quantitative variables with a normal distribution were expressed as mean ± standard deviation and categorical variables as frequency and percentage.

The relationship between SES and intake of macro- and micronutrients was first analyzed using correlation analysis with continuous variables. The sample was then divided into three groups based on annual income, and intergroup differences were examined using analysis of variance (ANOVA) and Bonferroni post hoc tests. Given the predominance of women in the sample, the main SES comparisons were additionally repeated in women only. To address potential ecological misclassification, analysis of covariance (ANCOVA) models were performed including education level as a covariate. Furthermore, multivariable linear regression analyses were conducted for selected dietary outcomes, with SES as the main predictor and adjustment for age, sex, education, body mass index (BMI), and living conditions. A correlation analysis was also conducted for key variables, and results were visualized using a heatmap. Data were analyzed using IBM SPSS Statistics for Windows, version 28.0 (IBM Corp., Armonk, NY, USA). In all statistical tests, a significance level of $\alpha = 0.05$ was used.

3 | Results

3.1 | Sociodemographic and Anthropometric Characteristics of the Study Population

The sociodemographic and anthropometric characteristics of the study population are presented in Table 1. The sample consisted of 192 adults aged over 60 years residing in Salamanca, of whom 167 were women (87%) and 25 men (13%). The mean age was 75.4 ± 6.0 years, with no relevant differences between sexes. Regarding income level, men had slightly higher incomes (€29655.7 ± 4489.3) compared to women (€28116.9 ± 4238.5).

3.2 | Macronutrient and Micronutrient Intake According to SES

Table 2 presents the mean values of total energy intake, macronutrient intake (Table 2), and micronutrient intake (Table 3), stratified by low (LSES), middle (MSES), and high (HSES) SES.

Regarding total energy intake, the average caloric consumption in the overall sample was 2232.2 ± 458.1 kcal/day, with similar values across the three groups (range: 2208.8–2261.7 kcal/day). Carbohydrate intake accounted for 42.6% ± 5.7% of total energy. After stratification by SES, both the middle (43.9% ± 5.8%) and high (43.0% ± 5.8%) SES groups showed higher percentages than the low SES group (41.2% ± 5.2%). The difference was statistically significant ($p < 0.05$) between the low and middle SES groups.

The mean protein intake for the total sample was 97.8 ± 19.9 g/day, equivalent to 17.7% ± 2.5% of total energy intake. Protein intake remained similar across SES groups (range: 17.3%–18.1%), with no statistically significant differences.

Total fat intake in the sample averaged 38.7% ± 5.4% of energy. The LSES group showed a slightly higher percentage (40.1% ± 4.9%) compared to the HSES group (38.0% ± 5.4%), with a statistically significant difference between the low and middle SES groups. Regarding fat composition, saturated fat intake was significantly higher in the LSES group (27.8 ± 7.9 g/day; 11.1% ± 1.9%) compared to the MSES and HSES groups (24.4 ± 8.2 g/day, 9.9% ± 1.9%; and 24.4 ± 7.0 g/day, 9.7% ± 1.9%, respectively).

As for dietary fiber, the overall mean intake was 29.3 ± 7.0 g/day, showing an upward trend with increasing SES. The HSES group had a significantly higher intake (31.1 ± 7.9 g/day) than the LSES group (27.9 ± 5.3 g/day).

Micronutrient intake (Table 3) showed no relevant differences in fat-soluble vitamins across SES groups. Vitamin A intake averaged 1401.4 ± 517.5 μg/day, well above EFSA reference values [28]. Vitamin D intake averaged 6.6 ± 3.3 μg/day, which falls below EFSA recommendations for older adults [29], while vitamin E intake was 10.3 ± 2.5 mg/day, slightly below or within the reference range [30].

Among B vitamins, statistically significant differences were observed in vitamin B12 and folate intake. The LSES group had a higher intake of vitamin B12 than the MSES group (10.7 ± 4.8 vs. 8.6 ± 3.1 μg/day), although both values exceeded EFSA recommendations [31].

Folate intake was significantly higher in the HSES group (438.0 ± 109.2 μg/day) compared to the LSES group (387.7 ± 79.6 μg/day), with both above EFSA reference values [32]. Intake of other B vitamins (B1, B2, B3, and B6) was adequate and showed no significant differences between groups.

Among the minerals analyzed, magnesium was the only one that showed significant differences, being lower in the LSES group (399.7 ± 69.1 mg/day) compared to the HSES group (438.6 ± 97.1 mg/day). Iron, calcium, potassium, and zinc intake values were similar across all SES groups.

TABLE 1 | Sociodemographic and anthropometric characteristics of the study population.

	Men (*n* = 25)	**Women (*n* = 167)**	**Total (*n* = 192)**
Age (years)	76.1 ± 6.6	75.3 ± 5.9	75.4 ± 6.0
Annual income (€)	29655.7 ± 4489.3	28116.9 ± 4238.5	28317.2 ± 4291.3
Waist circumference (cm)	101.0 ± 8.3	95.9 ± 10.5	96.6 ± 10.3
BMI (kg/m^2)	28.7 ± 3.7	28.0 ± 5.5	28.1 ± 5.3
Living arrangement			
Alone	2 (8.0)	63 (37.7)	65 (33.9)
With spouse	22 (88.0)	84 (50.3)	106 (55.2)
With children	1 (4.0)	20 (12.0)	21 (10.9)
Educational level			
No formal	3 (12.0)	22 (13.2)	25 (13.1)
Primary	14 (56.0)	107 (64.7)	121 (63.0)
Secondary	5 (20.0)	18 (10.8)	23 (12.0)
University	3 (12.0)	20 (12.0)	23 (12.0)

Note: Values are expressed as mean ± standard deviation (SD) for quantitative variables, and as absolute and relative frequencies (%) for categorical variables.
Abbreviation: BMI, body mass index.

TABLE 2 | Macronutrient intake according to socioeconomic status.

	Total (n = 192)	LSES (n = 70)	MSES (n = 59)	HSES (n = 63)
Total energy (kcal/day)	2232.2 ± 458.1	2225.3 ± 366.5	2208.8 ± 561.9	2261.7 ± 447.3
Carbohydrates (g)	238.7 ± 64.5	228.8 ± 45.5	244.01 ± 79.1	244.9 ± 67.1
Carbohydrates (%)*	42.6 ± 5.7	41.2 ± 5.2	43.9 ± 5.8	43.0 ± 5.8
Proteins (g)	97.8 ± 19.9	97.8 ± 17.7	93.9 ± 21.6	101.4 ± 20.0
Proteins (%)	17.7 ± 2.5	17.6 ± 2.0	17.3 ± 2.8	18.1 ± 2.7
Fat (g)	95.8 ± 23.1	99.5 ± 22.2	92.0 ± 25.6	95.1 ± 21.2
Fat (%)*	38.7 ± 5.4	40.1 ± 4.9	37.7 ± 5.8	38.0 ± 5.4
Monounsaturated fat (g)	43.1 ± 10.6	44.9 ± 10.0	41.7 ± 11.8	42.3 ± 9.9
Monounsaturated fat (%)	17.5 ± 3.1	18.2 ± 3.0	17.2 ± 3.3	17.0 ± 3.0
Polyunsaturated fat (gr)	17.4 ± 6.1	17.3 ± 5.9	16.9 ± 6.3	17.9 ± 6.3
Polyunsaturated fat (%)	7.0 ± 2.1	7.0 ± 2.0	6.9 ± 2.0	7.1 ± 2.2
Saturated fat (g)[*,#]	25.6 ± 7.9	27.8 ± 7.9	24.4 ± 8.2	24.4 ± 7.0
Saturated fat (%)[*,#]	10.3 ± 2.0	11.1 ± 1.9	9.9 ± 1.9	9.7 ± 1.9
Cholesterol (mg)	417.2 ± 117.4	441.5 ± 86.3	398.0 ± 140.5	408.4 ± 120.9
Alcohol (g)	3.5 ± 8.3	3.3 ± 7.3	4.1 ± 11.2	3.0 ± 8.3
Fiber (g)[#]	29.3 ± 7.0	27.9 ± 5.3	29.0 ± 7.4	31.1 ± 7.9

Note: Values are expressed as mean ± SD. Macronutrients are reported both as a percentage of total energy intake and as absolute values in grams. Statistically significant differences between groups are indicated as follows: *$p < 0.05$ difference between low and middle SES groups and #$p < 0.05$ difference between low and high SES groups.

3.3 | Food Serving Frequency According to SES

Table 4 presents the mean number of daily or weekly servings consumed by participants according to SES. Average vegetable intake was 1.6 ± 0.5 servings per day, showing a progressive increase with higher SES, with a statistically significant difference between the low SES group (1.5 ± 0.4) and the high SES group (1.7 ± 0.5).

Fruit consumption averaged 3.2 ± 1.0 servings per day, with no relevant differences between income groups. Regarding cereals, an increasing trend was identified across SES levels. Intake was significantly lower in the low SES group (2.3 ± 0.6) compared to the high SES group (2.8 ± 1.2).

Dairy consumption was similar across all groups, with an overall average of 2.1 ± 0.9 servings per day. For white meats, no substantial differences were found between groups; the mean intake was 3.6 ± 1.6 servings per week, slightly higher in the low SES group. Fish consumption was high across the entire sample, averaging 5.2 ± 2.0 servings per week, with no notable differences between SES levels.

Nut consumption was also high, with a mean of 5.1 ± 4.0 servings per week. A slight increase was observed in the high SES group (5.5 ± 4.4), although the difference was not statistically significant.

Legume intake averaged 2.8 ± 1.1 servings per week, with no significant differences between SES groups. Olive oil was consumed consistently across all three groups, with a general mean of 3.9 ± 1.5 servings per day.

Red meat consumption averaged 2.9 ± 1.9 servings per week, with no statistically significant differences between groups. However, processed meats intake (e.g., sausages, cured meats, and cold cuts) was significantly higher in the high SES group (4.4 ± 2.8 servings per week) compared to the middle SES group (3.1 ± 1.8).

In a stratified analysis restricted to women, the main associations between SES and dietary intake remained consistent with the full-sample findings, particularly for saturated fat, fiber, vitamin B12, vegetables, cereals, and processed meats (Table S1). While some variables lost statistical significance in women, the overall pattern by SES was unchanged.

To assess the potential impact of ecological misclassification, additional ANCOVA models were conducted adjusting for education level. Overall, the adjusted analyses yielded results comparable to those obtained in the unadjusted ANOVA, with no substantial changes in the direction or magnitude of the observed associations. Given the similarity of the findings, these analyses are presented in Table S2.

3.4 | Multivariable Analysis of the Association Between SES and Dietary Intake

Multivariable linear regression analyses were conducted to examine the association between SES and key dietary variables,

TABLE 3 | Micronutrient intake according to socioeconomic status.

	Total ($n=192$)	LSES ($n=70$)	MSES ($n=59$)	HSES ($n=63$)
Vit A (μg RE)	1401.4 ± 517.5	1476.4 ± 559.1	1310.1 ± 464.7	1403.7 ± 510.9
Vit D (μg)	6.6 ± 3.3	6.4 ± 3.1	6.2 ± 3.0	7.1 ± 3.8
Vit E (mg)	10.3 ± 2.5	10.3 ± 2.6	10.0 ± 2.4	10.6 ± 2.3
Vit C (mg)	264.8 ± 103.5	244.8 ± 71.2	275.2 ± 143.9	277.3 ± 85.3
Vit B1 (mg)	2.9 ± 0.8	2.9 ± 0.9	2.7 ± 0.6	2.9 ± 0.7
Vit B2 (mg)	2.3 ± 0.7	2.3 ± 0.6	2.3 ± 1.0	2.3 ± 0.6
Vit B3 (mg NE)	41.0 ± 9.2	40.5 ± 7.8	40.0 ± 10.4	42.4 ± 9.4
Vit B6 (mg)	2.5 ± 0.6	2.5 ± 0.5	2.5 ± 0.7	2.7 ± 0.6
Vit B12 (μg)*	9.8 ± 4.1	10.7 ± 4.8	8.6 ± 3.1	9.9 ± 3.7
Acfol (μg)*,#	410.4 ± 119.8	387.7 ± 79.6	407.7 ± 159.9	438.0 ± 109.2
Ca (mg)	1192.5 ± 351.5	1227.8 ± 320.7	1137.0 ± 379.9	1205.2 ± 355.8
Fe (mg)	16.6 ± 3.7	16.1 ± 2.9	16.4 ± 4.1	17.5 ± 4.0
Mg (mg)#	415.2 ± 92.4	399.7 ± 69.1	408.5 ± 106.9	438.6 ± 97.1
K (mg)	4769.9 ± 1050.0	4618.8 ± 773.0	4718.3 ± 1338.8	4986.2 ± 989.3
I (μg)	408.9 ± 183.1	424.2 ± 144.3	388.4 ± 210.2	411.2 ± 195.4
Se (μg)	100.8 ± 22.6	99.3 ± 20.6	98.0 ± 23.1	105.0 ± 24.2
Zn (mg)	12.1 ± 2.5	12.1 ± 2.2	11.8 ± 2.8	12.6 ± 2.5
P (mg)	1832.2 ± 400.3	1846.3 ± 375.5	1758.9 ± 434.7	1885.2 ± 389.7

Note: Values are expressed as mean ± SD. Vitamins and minerals are reported in micrograms (μg) or milligrams (mg), as appropriate. Statistically significant differences between groups are indicated as follows: *$p < 0.05$ difference between low and middle SES groups; #$p < 0.05$ difference between low and high SES groups. Abbreviations: AcFol, folic acid; NE, niacin equivalents; RE, retinol equivalents; Vit, vitamins.

TABLE 4 | Frequency of intake of food group servings stratified by socioeconomic status.

	Total ($n=192$)	LSES ($n=70$)	MSES ($n=59$)	HSES ($n=63$)
Vegetables (servings/day)#	1.6 ± 0.5	1.5 ± 0.4	1.5 ± 0.5	1.7 ± 0.5
Fruits (servings/day)	3.2 ± 1.0	3.1 ± 1.0	3.2 ± 1.0	3.3 ± 1.1
Cereals (servings/day)#	2.6 ± 1.0	2.3 ± 0.6	2.6 ± 1.0	2.8 ± 1.2
Dairy products (servings/day)	2.1 ± 0.9	2.2 ± 0.8	2.0 ± 1.0	2.1 ± 1.0
Legumes (servings/week)	2.8 ± 1.1	2.9 ± 0.7	2.5 ± 1.1	2.9 ± 1.4
White meats (servings/week)	3.6 ± 1.6	3.7 ± 1.6	3.6 ± 1.8	3.4 ± 1.4
Fish (servings/week)	5.2 ± 2.0	5.3 ± 2.0	5.0 ± 1.5	5.2 ± 2.3
Nuts (servings/week)	5.1 ± 4.0	4.8 ± 3.8	5.1 ± 3.9	5.5 ± 4.4
Red meats (servings/week)	2.9 ± 1.9	3.1 ± 1.6	2.7 ± 2.0	3.0 ± 1.9
Processed meats (servings/week)$	3.7 ± 2.3	3.5 ± 2.1	3.1 ± 1.8	4.4 ± 2.8
Olive oil (servings/day)	3.9 ± 1.5	4.1 ± 1.5	3.8 ± 1.5	3.8 ± 1.4

Note: Values are expressed as mean ± SD of daily or weekly servings (as appropriate). #Significant difference between low and high SES groups. $Significant difference between middle and high SES groups.

with adjustment for age, sex, education level, BMI, and living conditions (Table 5).

SES was inversely associated with total fat intake (% of energy; $\beta = -0.149$, $p = 0.048$) and saturated fat intake, both expressed in grams ($\beta = -0.196$, $p = 0.010$) and as a percentage of total energy ($\beta = -0.255$, $p = 0.001$). No significant associations were observed between SES and carbohydrate intake or fiber intake after adjustment.

Regarding micronutrients, SES was not significantly associated with vitamin B12 or magnesium intake. A positive trend was

TABLE 5 | Multivariable linear regression analysis of the association between SES and dietary intake, adjusted for age, sex, education level, body mass index, and living conditions.

Dependent variable	Unstandardized coefficients, β	Standard error	Standardized coefficients, β	t	Sig.	95% CI for B (lower–upper)
Macronutrients						
Carbohydrates (%)	0.001	0.001	0.058	0.742	0.459	−0.001 to 0.003
Fat (%)	−0.001	0.000	−0.149	−1.994	0.048	−0.002 to 0.000
Saturated fat (g)	0.000	0.000	−0.196	−2.607	0.010	−0.001 to 0.000
Saturated fat (%)	0.000	0.000	−0.255	−3.373	0.001	0.000–0.000
Fiber (g)	0.000	0.000	0.101	1.335	0.183	0.000–0.000
Vitamins and minerals						
Vit B12 (μg)	0.000	0.000	−0.037	−0.470	0.639	0.000–0.000
Acfol (μg)	0.004	0.002	0.144	1.882	0.061	0.000–0.008
Mg (mg)	0.002	0.002	0.086	1.127	0.261	−0.001 to 0.005
Food group servings						
Vegetables (servings/day)	0.000	0.000	0.163	2.135	0.034	0.000–0.000
Cereals (servings/day)	0.000	0.000	0.225	3.008	0.003	0.000–0.000

Abbreviations: AcFol, folic acid; Mg, magnesium; Vit, vitamin.

observed for folic acid intake, although it did not reach statistical significance ($p = 0.061$).

In terms of food group consumption, higher SES was significantly associated with greater intake of vegetables ($\beta = 0.163$, $p = 0.034$) and cereals ($\beta = 0.225$, $p = 0.003$).

3.5 | Correlations Between SES and Nutrient Intake

Figure 1 shows the correlations between SES and the intake of various nutrients, as well as the consumption of different food groups. Significant correlations were observed between SES and several indicators of diet intake, including macronutrient and micronutrient intake, as well as food group consumption frequency.

Regarding macronutrients, SES showed a negative correlation with the percentage of total fat intake ($r = -0.173$; $p < 0.05$), monounsaturated fat ($r = -0.147$; $p < 0.05$), and saturated fat, both in grams ($r = -0.172$; $p < 0.05$) and as a percentage of energy intake ($r = -0.261$; $p < 0.01$). This increase affects not only saturated fat content but also monounsaturated fats, as both are present in lipid-rich foods. In contrast, a positive correlation was observed between SES and fiber intake ($r = 0.168$; $p < 0.05$).

As for micronutrients, SES was significantly and positively associated with folic acid intake ($r = 0.180$; $p < 0.05$), iron ($r = 0.161$; $p < 0.05$), and magnesium ($r = 0.153$; $p < 0.05$). No significant correlations were found for other vitamins or minerals.

Regarding food groups, a positive correlation was identified between SES and the consumption of vegetables ($r = 0.194$; $p < 0.01$) and cereals ($r = 0.277$; $p < 0.01$). Interestingly, a significant correlation was also observed with processed meats consumption ($r = 0.147$; $p < 0.05$).

4 | Discussion

Overall, the results indicate that the intake of carbohydrates, proteins, and fats in the older population of this study does not fully align with the recommendations issued by the European Food Safety Authority (EFSA) [33]. This imbalance is reflected in slightly lower-than-recommended carbohydrate intake and higher fat intake. However, among participants in the HSES group, macronutrient distribution was closer to recommended values, highlighting the relevance of SES in promoting a more balanced and EFSA-aligned diet [34–36].

Compared to Spanish and European dietary guidelines, fruit consumption in the sample was adequate (mean of 3.2 servings/day); similarly, dairy intake averaged 2.1 servings/day, aligning with recommendations of 2–3 daily servings.

Despite the fact that vegetable intake was insufficient across all groups, averaging 1.6 servings/day—below the minimum of 2 servings/day recommended [37] and cereal consumption averaged 2.5 servings/day, falling below the recommended range of 4–6 daily servings, particularly in the LSES group; a positive correlation was identified between SES and the consumption of vegetables and cereals, indicating a dietary pattern more aligned with Mediterranean diet recommendations. This explains the positive

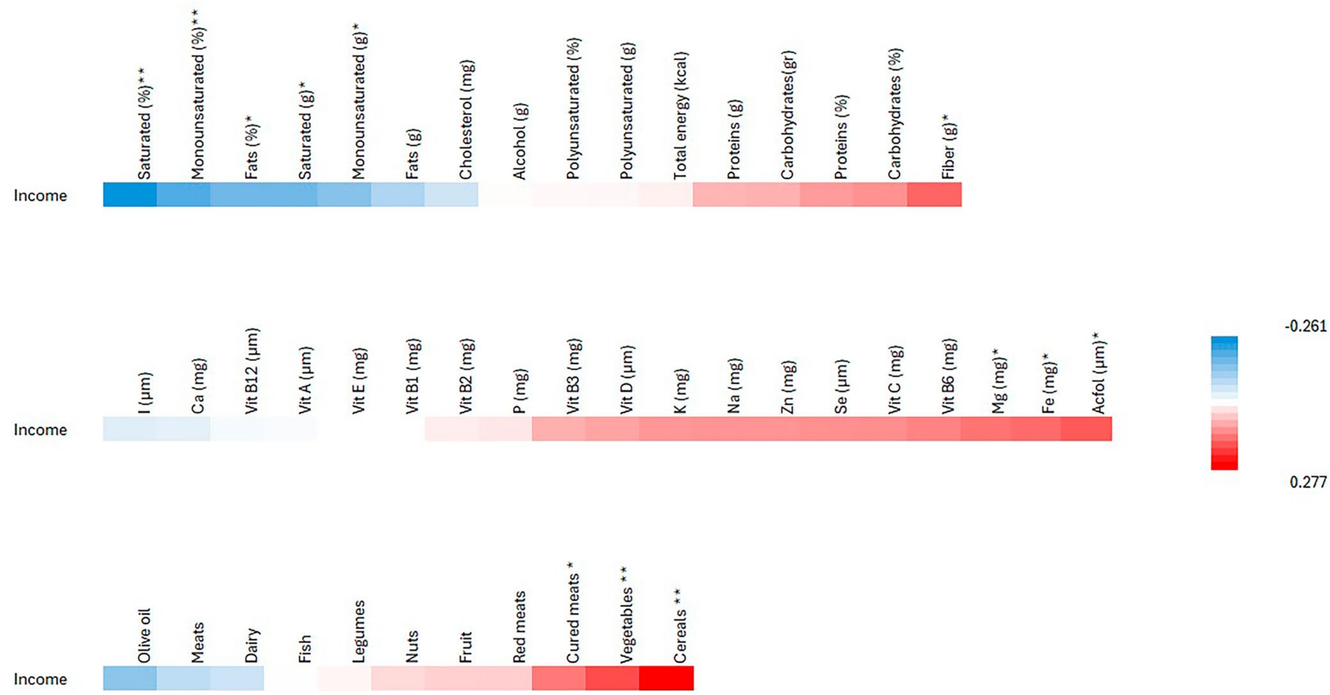

FIGURE 1 | Heatmap of correlations between socioeconomic status and nutritional intake variables.

correlation between SES and fiber intake, found in foods such as fruit, vegetables, whole grains, and nuts, supporting the idea of higher nutritional quality among individuals with higher SES.

White meat consumption was 3.6 servings/week, within the recommended range (3–4 servings/week), as was fish intake, which averaged 5.2 servings/week, exceeding the minimum recommendation of 3–4 servings.

Nut consumption averaged 5.1 servings/week, considered appropriate according to guidelines encouraging 3–7 servings per week, provided they are neither fried nor sweetened.

Olive oil intake averaged 3.9 servings/day, consistent with guidelines recommending daily use as the primary added fat, both raw and in cooking [37].

Although most food group intakes demonstrated were close to an acceptable adherence to nutritional recommendations, it is worth noting the high consumption of red meat (2.9 ± 1.9 servings/week), at the upper limit of recommendations, and an excessive intake of processed meats, especially among participants in the HSES group, exceeding four servings per week. Despite the fact that these patterns should be considered in future nutritional education interventions, given their impact on metabolic and cardiovascular risk in older adults [37], it is important to note that SES showed a negative correlation with the percentage of total fat, monounsaturated fat, and saturated fat intake from lipid-rich foods, such as processed meats, suggesting that they are consumed more frequently in contexts associated with lower overall dietary quality.

Significant differences were identified between SES groups, particularly in carbohydrate intake, saturated fats, vitamin B12, folic acid, and magnesium, with the LSES group showing a less favorable nutritional profile and reinforcing the hypothesis that higher SES is linked to greater availability and consumption of key micronutrients. Likewise, higher intakes of vegetables, cereals, iron, and fiber were observed among those in the HSES group, although this group also reported greater processed meats consumption, revealing a mixed dietary pattern, with both positive and suboptimal components. In line with European evidence showing socioeconomic differences in diet quality, our results further contribute by combining nutrient-level estimates with food-group frequency, thereby complementing pattern-based studies and helping to identify the specific components driving inequalities (e.g., saturated fat vs. fiber/folate/magnesium). Importantly, the coexistence of higher intakes of some favorable components with higher processed meat consumption in the HSES group suggests that greater purchasing power does not necessarily translate into uniformly healthier choices, reinforcing the need for interventions that combine accessibility with nutrition education and culturally tailored guidance.

The findings of this study may reinforce the significant influence of SES on diet intake among adults aged 60 and over in Salamanca, as supported by studies conducted in other regions [12]. The fact that key macronutrient and micronutrient intakes, particularly fiber, complex carbohydrates, saturated fats, folic acid, magnesium, and vitamin B12, varied significantly across SES groups is correlated with a pattern of dietary inequality consistent with the existing literature [4, 15].

This nutritional imbalance in lower SES groups can be partly explained by limited access to higher-quality foods such as fresh fruits, vegetables, and fish, which typically require greater economic resources [38]. However, it is important to note that in the HSES group, a simultaneous increase in the consumption of certain processed foods (e.g., cured meats) was observed, suggesting that higher financial capacity does no choices [18]. This finding highlights the need for nutritional interventions that not only address issues of food accessibility but also consider sociocultural factors and individual preferences that may lead to suboptimal dietary patterns despite higher purchasing power.

Although no substantial differences in total energy intake were observed, differences in nutrient density and macronutrient distribution were considerable—underscoring that total caloric intake may mask poor dietary quality. Previous studies support this trend, suggesting that the availability of low-cost, energy-dense, micronutrient-poor foods contributes to higher consumption of saturated fats and free sugars among low-income populations [39]. In contrast, individuals with medium or high SES tend to include more foods typical of the Mediterranean diet—a pattern associated with higher education and family income [15, 40]. However, our data suggest that higher SES does not necessarily translate into uniformly healthier choices. The higher processed meat intake observed in the HSES group may reflect local cultural and social eating patterns in Salamanca/Castile and León, where cured meats (e.g., jamón, chorizo, and salchichón) are commonly consumed in tapas and dining-out contexts that may be more frequent among higher-income individuals. Thus, greater purchasing power may increase participation in these settings and/or the purchase of premium cured-meat products that remain "processed" nutritionally. Similar mixed SES patterns have been reported in Mediterranean settings, supporting the need for interventions that combine access to healthy foods with culturally sensitive nutrition education targeting socially embedded practices.

Additionally, the positive correlation between SES and the intake of nutrients such as magnesium and folic acid is consistent with a dietary profile richer in plant-based products, whole grains, and higher-quality proteins, typically linked to greater economic resources and higher nutrition literacy [41]. These findings, in line with previous literature, underscore the importance of sustained, targeted nutrition education among low-SES populations, where a higher-quality diet may play a critical role in preventing and managing noncommunicable chronic diseases [15].

This study reinforces the need to develop public policies aimed at reducing health disparities, promoting dietary quality and food literacy as key tools for achieving healthy and sustainable aging. Local interventions, such as subsidized healthy cooking workshops and urban gardens, may prove effective in improving access to fresh food in lower-SES populations, thereby fostering long-term changes in eating behavior [42].

In summary, the results highlight the multidimensional relationship between economic capacity, education, access to nutritionally adequate food, and the cultural shaping of dietary preferences. This interdependence requires a comprehensive approach, from promoting redistributive policies that ease the financial burden of healthy eating to implementing educational strategies that raise awareness of diet intake—ultimately contributing to greater health equity among older adults.

5 | Study Limitations

This study has several limitations that should be considered when interpreting the results. First, it is a cross-sectional observational study, which prevents the establishment of causal relationships between SES and diet intake. Furthermore, the sample was selected through convenience sampling and consisted of older adults participating in a specific municipal program in the city of Salamanca, which may limit the generalizability of the findings to other populations or geographic contexts.

Additionally, dietary intake was assessed using a validated semiquantitative FFQ, which relies on participants' recall and may introduce memory bias or social desirability bias. Other potentially relevant variables, such as functional status, the presence of chronic diseases, or social support, were not included in the analysis, although they could influence dietary habits.

Moreover, due to methodological limitations of the dietary questionnaire used, it was not possible to accurately estimate total sodium intake, particularly sodium from added salt during food preparation or from processed foods. For this reason, sodium was not included in the analysis of results, despite its relevance to cardiovascular health and its strong association with overall diet intake.

6 | Conclusions

The results of this study reinforce a significant relationship between SES and diet intake among community-dwelling adults aged ≥ 60 years enrolled in a municipal active aging program (PReGe) in Northwestern Spain (Salamanca). Specifically, a higher intake of total fats and saturated fats was observed in lower SES groups. While the frequency of vegetable and cereal consumption was higher among HSES participants, this also coincided with increased consumption of processed meats.

These findings strengthen the idea that, although greater financial resources may facilitate access to healthier foods, they do not necessarily lead to the adoption of fully healthy dietary patterns. Overall, the results demonstrate that SES is significantly correlated with the dietary habits in this specific study population, affecting both the nutritional quality of the foods consumed and the frequency of intake of key components of a healthy diet.

These findings highlight the need to address socioeconomic and educational inequalities in order to promote healthy eating habits in older populations.

Author Contributions

Conceptualization: Ana María Murillo-Zaldívar, Susana González-Manzano, and Rosario Alonso-Domínguez. Methodology: Fausto José Barbero Iglesias, José Ignacio Recio-Rodríguez, and Jesús González-Sánchez. Formal analysis: José Ignacio Recio-Rodríguez and Rosario Alonso-Domínguez. Investigation: Ana María Murillo-Zaldívar, Susana González-Manzano, Rosario Alonso-Domínguez, Fausto José Barbero Iglesias, Teresa Vicente-García, José Ignacio Recio-Rodríguez, and Jesús González-Sánchez. Resources: Ana María Murillo-Zaldívar, Susana González-Manzano and Rosario Alonso-Domínguez. Data curation: Susana González-Manzano and Rosario Alonso-Domínguez. Writing – original draft preparation: Ana María Murillo-Zaldívar, Susana González-Manzano, and Rosario Alonso-Domínguez. Writing – review and editing: Ana María Murillo-Zaldívar, Susana

González-Manzano, Rosario Alonso-Domínguez, Fausto José Barbero Iglesias, Teresa Vicente-García, José Ignacio Recio-Rodríguez, and Jesús González-Sánchez. All authors have read and agreed to the published version of the manuscript.

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Ethics Statement

The study is authorized by the Ethics Committee for Research with Medications of the Salamanca Health Area on May 13, 2024. Approval number: PI 2024 05 1674.

Consent

Participants will be asked to sign informed consent after receiving the study information in accordance with the Declaration of Helsinki (World Medical Association, 2013). Confidentiality will be guaranteed in accordance with the provisions of Organic Law 3/2018 of December 5 on Personal Data Protection and Guarantee of Digital Rights and Law 14/2007 on biomedical research.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Women subgroup analysis: dietary intake across socioeconomic status (SES) groups. **Table S2:** (a) Macronutrient and micronutrient intake, and frequency of intake of food group servings according to socioeconomic status.