Gorini *et al. Journal of Translational Medicine* (2025) 23:312
https://doi.org/10.1186/s12967-025-06311-x

Journal of Translational Medicine

RESEARCH

Open Access

Gender differences in eating habits and sports preferences across age groups: a cross-sectional study

Stefania Gorini[1,2†], Elisabetta Camajani[1,2†], Edda Cava[3], Alessandra Feraco[1,2], Andrea Armani[1,2], Isaac Amoah[4], Tiziana Filardi[1], Xinyan Wu[5], Rocky Strollo[1], Massimiliano Caprio[1,2], Elvira Padua[1] and Mauro Lombardo[1*]

Abstract

Background Gender differences in dietary habits, physical activity and body composition are key determinants of health and disease risk. Although these differences are well documented, their variation across age groups remains poorly explored. This study examines gender-specific patterns in eating behaviours, sport preferences and body composition metrics, with the aim of providing evidence for tailored public health interventions.

Methods A cross-sectional study was conducted on 2,276 participants (1,349 females and 927 males) aged 18–75 years. Recruitment combined an online survey and clinical assessments. Body composition was evaluated with bioelectrical impedance analysis (BIA) and eating habits were investigated with detailed weekly food diaries. Gender differences between five age groups were statistically analysed using chi-square and t-tests ($p \leq 0.05$). The study protocol was approved by the Lazio Area 5 Ethics Committee.

Results Significant differences in body composition were observed between genders: men had a higher lean mass and basal metabolic rate, whereas women showed a higher fat mass in all age groups. Eating habits varied significantly: men preferred salty and protein-rich foods, consumed alcohol more frequently and showed a higher prevalence of meal skipping and uncontrolled eating behaviour. Women showed greater meal regularity, a preference for sweet tastes and a higher likelihood of eating alone in the older age groups. Sports participation differs markedly in the age group 30–39 years, in which men were predominantly involved in team sports, while women favoured strength training and skill activities.

Conclusions This study highlights the strong gender disparities in dietary and lifestyle behaviour, which evolve with age. These findings underline that tailored public health strategies, responding to gender-specific requirements, are needed to promote healthier lifestyles and reduce inequalities. Future studies should use longitudinal designs to explore causal relationships.

†Stefania Gorini and Elisabetta Camajani contributed equally to this work.

*Correspondence:
Mauro Lombardo
mauro.lombardo@uniroma5.it

Full list of author information is available at the end of the article

Registered clinical studies The study is registered on ClinicalTrials.gov (NCT06661330; registered 22 October 2024, retrospectively). Available at: https://clinicaltrials.gov/study/NCT06661330.

Introduction

The interaction between gender and health behaviours, including physical activity, eating habits and body composition, plays a crucial role in shaping health outcomes across the lifespan. Although previous studies have documented these differences, their age-related evolution remains largely unexplored, limiting the development of targeted and effective health interventions [1]. Existing research has mainly focused on a single age group or specific lifestyle factors, without capturing the combined impact of gender and ageing on dietary patterns and sport preferences. Recent findings indicate that gender disparities in lifestyle behaviour tend to amplify with age, particularly with regard to dietary adherence and physical activity levels [2, 3].

Dietary habits, such as weekly protein consumption or preferences for sweet or salty foods, reveal specific patterns related to gender and age [4]. Investigating these aspects provides valuable information for planning personalized nutritional interventions, tailored to the needs of different demographic groups [5]. Furthermore, the analysis of consumption patterns, such as eating out or at home alone, can provide useful insights to understand dietary behaviors in different age groups [6]. Physical activity and sports preferences represent key components of lifestyle and can differ significantly between genders [7]. More precisely, the observed disparities in sports participation can be addressed through inclusive policies and strategies adapted to specific needs of each gender [8].

This study aims to fill the literature gap by adopting a comprehensive, age-stratified approach to analysing gender differences in eating habits, sports participation and body composition. Unlike previous studies, we examine these behaviours across multiple life stages, allowing us to identify how gender-specific preferences and lifestyle choices evolve with age [9, 10]. This perspective is crucial for designing personalized interventions that take into account biological and sociocultural influences on health. The expected results can provide a basis for the development of specific and targeted interventions, reducing disparities and promoting an overall improvement in population's health and well-being.

Methods

Participants

Participants were recruited from an obesity treatment center in Rome, Italy, and via an online questionnaire distributed across digital platforms between January 2024 and December 2024. This recruitment strategy aimed to ensure a geographically diverse and representative sample. Initially, 2500 respondents completed the questionnaire. Eligible participants were adults aged 18–75 years who had fully completed the survey and provided informed consent. To maintain data reliability and relevance, participants were excluded if they had diagnosed cardiovascular or metabolic diseases, were pregnant or breastfeeding, or had participated in controlled weight loss programs in the past six months. 140 participants were excluded due to the presence of cardiovascular or metabolic diseases. 52 participants were excluded due to pregnancy or lactation. 32 participants were excluded due to recent participation in controlled weight loss programs. Following these criteria, a total number of 224 individuals were excluded, resulting in a final sample of 2276 eligible participants for analysis. The sample size was determined to ensure sufficient statistical power to detect significant differences in key variables, such as body composition and dietary habits, between age groups and genders. A power analysis indicated that a sample including at least 2000 participants would provide 90% power to detect small to moderate effect sizes (Cohen's $d = 0.3$) at a significance level of $p < 0.05$. The study was approved by the Lazio Area 5 Territorial Ethics Committee (Approval Code: N.57/SR/23, Approval Date: 7 November 2023), in accordance with the Declaration of Helsinki and its amendments. This study is registered on ClinicalTrials.gov (NCT06661330).

Survey

The questionnaire used in the present study was designed to collect detailed information on the participants' eating behaviour, physical activity and lifestyle habits. It included questions about: frequency and type of foods consumed; food preferences, such as preference for sweet or salty tastes; frequency of daily meals; food consumption behaviours, such as distracted eating, skipping meals or eating out; social contexts of consumption, such as eating alone or in company; particular habits, such as consumption of snacks, sugary drinks, alcohol and water, as well as eating behaviour at weekends; sports practices, including type of sport, frequency and weekly duration. The questionnaire was administered online and completed independently by participants. The questionnaire has not been validated but is similar to others already used in similar studies [11]. Strict controls were applied to identify and correct any incomplete or inconsistent data. Participants were also instructed to answer accurately and completely, following the guidelines provided. The collected data were subsequently validated and coded for statistical analysis. A crucial element of the survey was the use of weekly food diaries to calculate the frequency of protein-rich food consumption. Participants recorded in detail, for 7 consecutive days, all second courses consumed, specifying type of food (meat, fish, eggs, legumes), quantity, preparation method and time of consumption. These data were used to validate and supplement the answers given in the questionnaire, ensuring greater precision in the analysis of eating habits.

Body composition

BC was assessed using the Tanita BC-420 MA (Tanita Corporation, Tokyo, Japan) device, which allows for the accurate estimation of parameters such as fat mass (FM), fat free mass (FFM) and total body water (TBW). This method was chosen for its validated accuracy, ease of use and practicality in assessing large population samples. Previous studies have shown that Tanita BIA devices provide reliable estimates of body composition with strong correlation to dual-energy X-ray absorptiometry (DXA), particularly for the assessment of FM and FFM [12, 13]. Furthermore, its non-invasiveness and rapidity of measurement make it suitable for large-scale epidemiological and clinical research. Measurements were performed under controlled conditions to minimise possible variability in the results. Participants were instructed to comply with the following instructions: to be nil by mouth for at least three hours before BC measurement; to avoid physical activity in the preceding 12 h; to refrain from excessive consumption of food and drink the day before the measurement. During the measurement, participants were placed standing, barefoot and with no metal objects that could interfere with the device. All procedures were performed by an experienced operator, following standardised protocols to ensure the reliability of the data collected. BIA was chosen as the primary method because of its ability to provide rapid and non-invasive estimates of body composition.

Physical activity assessment

Participants' physical activity was assessed by means of self-administered questionnaires designed to collect detailed information on the type, frequency and duration of activities practised. Participants indicated: the sports practised (e.g. endurance sports, skill sports, strength training, team sports); the total weekly duration of the activities; the preferred times of day for physical activity. Sports were categorized into four main groups: (1) Endurance sports (e.g. running, swimming, cycling); (2) Strength training (e.g. weightlifting, resistance exercises); (3) Skill sports (e.g. gymnastics, martial arts, tennis); (4) Team sports (e.g. football, basketball, volleyball) as shown in Supplementary Table S1. This classification allowed for standardised comparisons between genders and age groups, ensuring consistency in the analysis of sports participation trends. The collected data were validated during clinical visits, where participants had the opportunity to provide additional details, including intensity of training sessions and participation in competitive activities. Only complete and consistent responses were included in the final analysis.

Statistical analysis

Statistical analyses were conducted using SPSS version 28 software (IBM Corporation, Armonk, NY, USA). Descriptive statistics, including frequencies, were calculated to delineate participants' food preferences and consumption patterns, analysed both collectively and stratified by gender. The chi-square test was used to determine differences between genders in the categorical variables, with a significance level set at $p \leq 0.05$. For continuous variables, independent samples t-tests were applied to compare male and female groups. Textual responses relating to complex variables, such as the time of the day when hunger is felt or the speed of meal consumption, were analysed by means of a structured process. More precisely the answers were grouped by gender and age group, calculating the relative frequencies for males and females. Subsequently, the mean percentage difference (delta: M - F) between the relative frequencies was calculated and used to represent the overall differences for each category. Categorical variables, such as taste preferences, consumption of water, alcoholic and sugar-sweetened beverages, and weekend eating habits, were analysed. For each age group, responses were grouped by gender and relative frequencies were calculated for males and females. Again, the mean percentage difference (delta: M - F) between the relative frequencies was used to represent the overall differences, and the chi-square test was used to identify statistically significant differences ($p < 0.05$).

Results

A total of 2,276 participants were included in the present study, 1,349 females and 927 males (59.3% F, 40,7% M). The study population comprised a balanced distribution of males and females in five distinct age groups (Table 1). No significant differences were found in the prevalence of smoking between men and women ($p = 0.5600$). Significant differences were observed between males and females with regard to BMI ($p < 0.0001$) and physical activity levels ($p < 0.0001$), with males reporting higher BMI and greater engagement in physical activity in the younger age groups.

Body composition differed significantly between genders in all measured variables (Table 2). Males showed higher mean weight, lean body mass, water content and basal metabolic rate than females, while females had

Table 1 Descriptive characteristics of the study population by gender and age group

Age Group	Total Participants (Females)	Total Participants (Males)	Age (Mean ± SD, Females)	Age (Mean ± SD, Males)	BMI (Mean ± SD, Females)	BMI (Mean ± SD, Males)	Smokers (% Females)	Smokers (% Males)	Physical Activity (% Females)	Physical Activity (% Males)
18-29	288	247	24.5 ± 3.1	24.2 ± 3.3	25.3 ± 4.5	26.1 ± 4.9	29.9%	29.1%	66.0%	74.9%
30-39	368	279	34.5 ± 2.8	34.6 ± 2.8	26.1 ± 4.4	28.2 ± 5.3	29.1%	25.8%	46.7%	64.9%
40-49	342	203	44.5 ± 2.9	44.2 ± 2.9	28.0 ± 5.5	29.1 ± 5.3	21.9%	19.2%	44.2%	51.7%
50-59	214	129	53.4 ± 2.8	54.1 ± 2.8	28.4 ± 5.7	30.7 ± 5.2	21.5%	17.8%	41.1%	39.5%
60-69	104	48	63.4 ± 2.7	63.2 ± 2.8	31.2 ± 6.5	32.4 ± 6.0	19.2%	18.8%	41.3%	39.6%
70-79	33	21	72.6 ± 2.1	73.0 ± 2.5	29.4 ± 4.6	29.8 ± 4.5	6.1%	23.8%	18.2%	38.1%

Descriptive characteristics of the study population stratified by sex (males and females) and age group. The results include mean values ± standard deviations for age and BMI, as well as the percentages of smokers and participants practising physical activity. P-values were calculated using Welch's t-test for continuous variables and the chi-square test for categorical variables. The p-value for age (M vs. F) is 0.02, BMI (M vs. F) is <0.0001, smokers (M vs. F) is 0.56, physical activity (M vs. F) is <0.0001 and number of participants (M vs. F) is 0.0036. Significant differences are indicated where $p < 0.05$

a higher FM both in absolute terms (kg) and as a percentage. These differences were consistent across all age groups, with p-values for all comparisons lower than 0.0001.

Table 3 reveals significant differences between the sexes in body composition trends with age. Weight increases in both sexes, with a more pronounced trend in males (slope 2.8) than in females (slope 2.31). BMI follows a similar trend, increasing significantly in both sexes, with slopes of 1.29 in males and 1.21 in females. Fat mass increases with age in both sexes at comparable rates, with slopes of 2.61 in males and 2.5 in females. Despite this similarity, females show a higher percentage of fat mass in all age groups. Fat mass shows no significant change in males ($p = 0.7939$), whereas females show a slight decrease ($p = 0.1219$). Water content decreases significantly with age in females ($p = 0.0085$), while it remains stable in males ($p = 0.5782$). The basal metabolic rate decreases in both sexes, with a more marked reduction in females (slope = -11.19) than in males (slope = -5.12).

Significant differences, in accordance with age group, were also observed in weekly food consumption between males and females. Males aged 18–29 showed significantly higher meat and fish consumption than females ($p < 0.05$). However, differences in later age groups diminished or varied based on the variable considered. Figure 1 illustrates these results, with delta representing the mean gender differences for each variable and age group.

Figure 2 highlights significant gender differences in various eating habits across age groups. Notably, the 'How Many Times' variable showed significant differences in the 30–39, 40–49, and 60–69 age groups, while the 'When Hungry' variable revealed significant differences within the 40–69 age range. Significant gender differences in meal-skipping frequency ('Miss Meals') were observed primarily in the 18–29 and 30–39 age groups. The 'Eat Distracted' variable showed differences in the 40–49 and 60–69 brackets, while 'Eat Fast' revealed notable differences between the ages of 30 and 59.

Figure 3 illustrates gender differences in eating behavior. Men showed a greater tendency to eat meals outside the home ('Eat Out') in the 30–39, 40–49, and 50–59 age groups. Significant differences in the 'Eat Alone or Together' variable were observed in the 30–39 and 60–69 age groups, with women more likely to eat alone. Uncontrolled eating revealed differences from ages 18 to 49, with men displaying a stronger tendency toward uncontrolled eating. For snacking, differences were concentrated in the 18–29 bracket, while for 'Wake Up to Eat' they emerged in the 30–39 bracket.

Figure 4 displays gender differences in food preferences and consumption. Males showed a stronger preference for salty tastes in the 18–29, 30–39, and 40–49 age groups. Water intake was higher among males in younger age groups, while alcohol consumption differed significantly across all age groups, with males consuming more. Differences in 'Sugary Drinks' appeared in the 18–29 group, with higher consumption by males, and in the 40–49 group, with higher consumption by females.

Finally, Fig. 5 highlights gender differences in sport preferences. Males participate more frequently in team sports and endurance activities, while females show greater involvement in skill sports and strength training, particularly in the 30–39 age group. In the 30–39 age group, men show a negative delta in the 'No Sport' category, indicating fewer males report being inactive compared to females. In other age groups, no consistent or significant patterns emerge, although some variations in the percentage deltas are observed.

Discussion

Gender differences in health behaviors, body composition, and dietary habits represent a growing topic of interest, given their influence on the risk of developing chronic diseases and overall worsening the quality of life. Previous studies have highlighted how biological, cultural, and behavioral factors coact in shaping such differences, determining specific nutritional and physical needs for men and women [14, 15]. Understanding these

Table 2 Body composition characteristics of the study population by gender and age group

age_group	WEIGHT (mean ± SD) F	WEIGHT (mean ± SD) M	BMI (mean ± SD) F	BMI (mean ± SD) M	FM kg (mean ± SD) F	FM kg (mean ± SD) M	FM %(mean ± SD) F	FM % (mean ± SD) M	FFM (mean ± SD) F	FFM (mean ± SD) M	BODY WATER (mean ± SD) F	BODY WATER (mean ± SD) M	BMR (mean ± SD) F	BMR (mean ± SD) M
18-29	67.9 ± 13.0	82.2 ± 16.8	25.3 ± 4.5	26.1 ± 4.9	20.9 ± 9.2	17.6 ± 11.1	29.6 ± 8.0	20.1 ± 8.1	44.6 ± 5.0	61.7 ± 8.1	33.4 ± 4.3	45.7 ± 5.7	1457.2 ± 177.6	1937.1 ± 259.3
30-39	69.8 ± 12.8	88.5 ± 17.9	26.1 ± 4.4	28.2 ± 5.3	23.6 ± 9.3	22.1 ± 10.9	32.6 ± 7.3	23.8 ± 7.5	43.8 ± 4.3	62.9 ± 8.5	32.7 ± 3.6	46.6 ± 6.3	1412.5 ± 143.7	1962.9 ± 287.6
40-49	74.6 ± 15.1	90.4 ± 17.9	28.0 ± 5.5	29.1 ± 5.3	27.6 ± 10.6	24.4 ± 12.1	35.8 ± 6.9	25.8 ± 7.3	44.7 ± 5.4	62.9 ± 7.9	33.4 ± 4.5	46.5 ± 6.1	1433.6 ± 179.5	1938.6 ± 270.9
50-59	74.4 ± 16.4	93.4 ± 16.5	28.4 ± 5.7	30.7 ± 5.2	28.2 ± 11.3	27.0 ± 9.3	36.6 ± 7.1	28.3 ± 6.3	44.0 ± 6.1	63.1 ± 7.9	32.6 ± 5.1	46.9 ± 6.2	1410.6 ± 207.6	1950.7 ± 260.9
60-69	79.4 ± 16.7	95.9 ± 19.6	31.2 ± 6.5	32.4 ± 6.0	32.7 ± 11.6	30.2 ± 11.6	40.3 ± 6.5	31.2 ± 7.1	44.2 ± 5.8	61.4 ± 11.3	32.7 ± 4.9	46.3 ± 8.8	1420.4 ± 196.5	1941.3 ± 363.2
70-79	72.2 ± 10.3	87.5 ± 15.7	29.4 ± 4.6	29.8 ± 4.5	28.6 ± 7.7	24.6 ± 8.9	38.9 ± 5.7	27.2 ± 5.8	41.6 ± 3.6	59.8 ± 7.2	30.4 ± 3.0	44.0 ± 5.7	1338.7 ± 123.8	1835.6 ± 246.2

Body composition characteristics of the study population stratified by sex (male and female) and age group. Metrics include mean values ± standard deviations for weight, BMI, fat mass (kg and %), fat-free mass (FFM), water content and basal metabolic rate (BMR). P-values for gender differences were calculated using Welch's t-test, with significant differences indicated by $p < 0.05$. The p-values for weight, BMI, fat mass in kg and %, FFM, water content and BMR were all $p < 0.0001$

variables is essential for developing targeted health promotion interventions, particularly to address the decline in metabolic and muscular health associated with aging [16]. This analysis seeks to examine how these gender differences evolve across the lifespan, providing valuable insights for designing personalized, evidence-based strategies to mitigate age-related health issues.

The results of our study highlight significant gender differences in body composition, physical activity and dietary behaviors. Men, especially in the 18–29 and 30–39 age groups, reported higher BMI and higher levels of physical activity than women, a result highlighting a stronger male inclination towards an active lifestyle. Data in Table 3 show significant differences in body composition between age groups and genders, reflecting both aging and gender-specific physiological changes. While men maintain a stable FFM with age, women experience a progressive decline, which is linked to reduced postmenopausal estrogens levels, negatively affecting muscle maintenance [17, 18]. The reduction in body water content, significant only in women, further confirms muscle tissue loss [19]. While body water content decreases significantly with age in women, it remains stable in men. The previously described loss in FFM in women appears to be partly associated with the loss of muscle hydration, a phenomenon supported by other studies [20, 21]. Addiotionally, BMR decreases with age in both genders, but with a more significant reduction in women.

Oura data highlight significant and consistent differences between men and women in eating habits, which vary across different age groups. These results provide relevant insights into the cultural, social and biological factors influencing eating behaviors, allowing for comparison to recent literature. Previous research has shown that gender differences in eating habits can be influenced by broader socio-environmental contexts, including periods of interruption such as the COVID-19 pandemic. A study conducted in the Galician population observed significant changes in food consumption during confinement, with differences in meal patterns and preferences between men and women [22]. Furthermore, cross-sectional studies in different populations have confirmed that men tend to consume more energy-dense foods, while women often present healthier eating patterns and greater adherence to dietary recommendations [23, 24]. With regard to meal frequency, women tend to eat meals more frequently than men, especially in the 30–39 and 60–69 age groups. This behaviour, associated with smaller portions and regularity of diet, is in line with other studies [25, 26], which attribute it to greater food awareness in women, often linked to weight control. Recent evidence has further emphasised how gender differences in food choice intersect with body composition and metabolic factors, with women generally adhering

Table 3 Trends in body composition metrics across age groups by gender

Metric	Slope (Total)	*P*-Value (Total)	Slope (Males)	*P*-Value (Males)	Slope (Females)	*P*-Value (Females)
WEIGHT (kg)	2,01	<0.0001	2,8	<0.0001	2,31	<0.0001
BMI (kg/m^2)	1,2	<0.0001	1,29	<0.0001	1,21	<0.0001
FM (kg)	2,63	<0.0001	2,61	<0.0001	2,5	<0.0001
FM (%)	2,68	<0.0001	2,36	<0.0001	2,37	<0.0001
FFM (kg)	-0,69	0.01	0,06	0.7939	-0,17	0.1219
WATER (kg)	-0,55	<0.0001	0,09	0.5782	-0,24	0.0085
BMR (KCAL/die)	-25,17	<0.0001	-5,12	0.4764	-11,19	0.0026

Trends (slopes) for body composition metrics including weight, body mass index (BMI), fat mass (FM) in kilograms (kg) and percentage (%), fat-free mass (FFM), water content and basal metabolic rate (BMR) in kilocalories per day (kcal/day). The slope represents the rate of change of each metric with increasing age, calculated using linear regression models. A positive slope indicates an increase, while a negative slope reflects a decrease in the metric with age. P values indicate the statistical significance of these trends, with values less than 0.05 considered significant

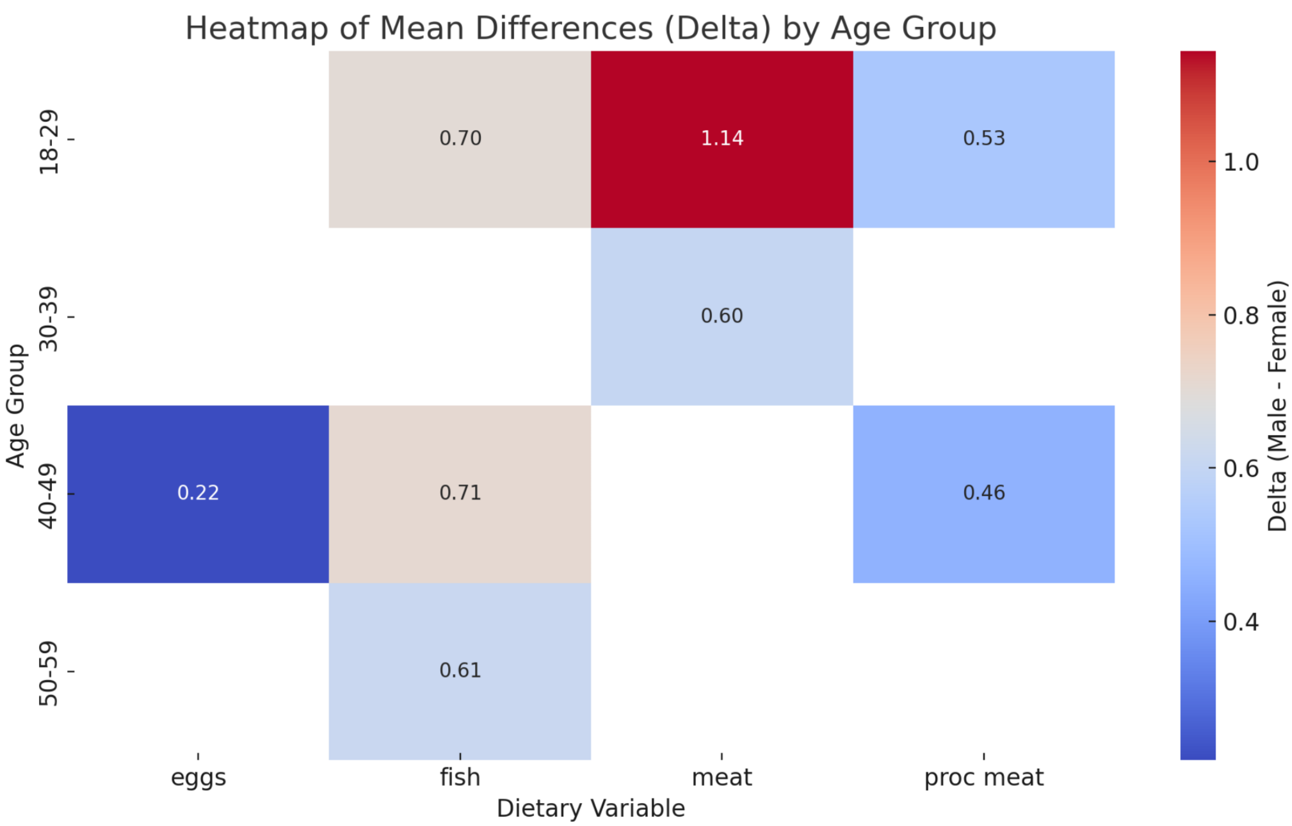

Fig. 1 Gender differences in weekly food consumption across age groups. Heatmap of mean differences (delta: males - females) in weekly food consumption by dietary variable and age group. Delta values were calculated only for variables with significant differences ($p < 0.05$), using Student's t-test for independent samples. The total number of patients analysed is 1,429 (592 males, 837 females). Significant p-values are: meat (18-29, $p = 0.0000$); proc meat (18-29, $p = 0.0000$); fish (40-49, $p = 0.0001$); meat (30-39, $p = 0.0009$); proc meat (40-49, $p = 0.0013$); fish (50-59, $p = 0.0063$); eggs (40-49, $p = 0.0252$)

to diets of higher nutritional quality than men [24]. Conversely, men, especially in the 18–29 age group, are more likely to skip meals, a tendency associated with irregular lifestyles and work outside the home, as noted by Grzymisławska et al. [27]. Furthermore, in terms of alertness and eating speed, men tend to consume meals more quickly and distractedly than women, with significant differences in the 40–49 and 50–59 age groups. This behavior, known to be associated with a higher risk of obesity and metabolic syndrome, has been widely documented in recent literature [28, 29]. We previously observed that work and family factors, influencing time spent eating, could exacerbate these differences [30]. As far as social habits are concerned, women, especially in the 60–69 age group, show a greater tendency to eat alone than men. This behavior may reflect social and family changes, such as widowhood, which affect older women more frequently [31]. Similar data were reported by Amagasa and coworkers, who highlighted how social isolation can negatively affect diet quality, especially among Japanese women [29]. Moreover, in terms of food preferences, men prefer salty foods in all age groups, while women

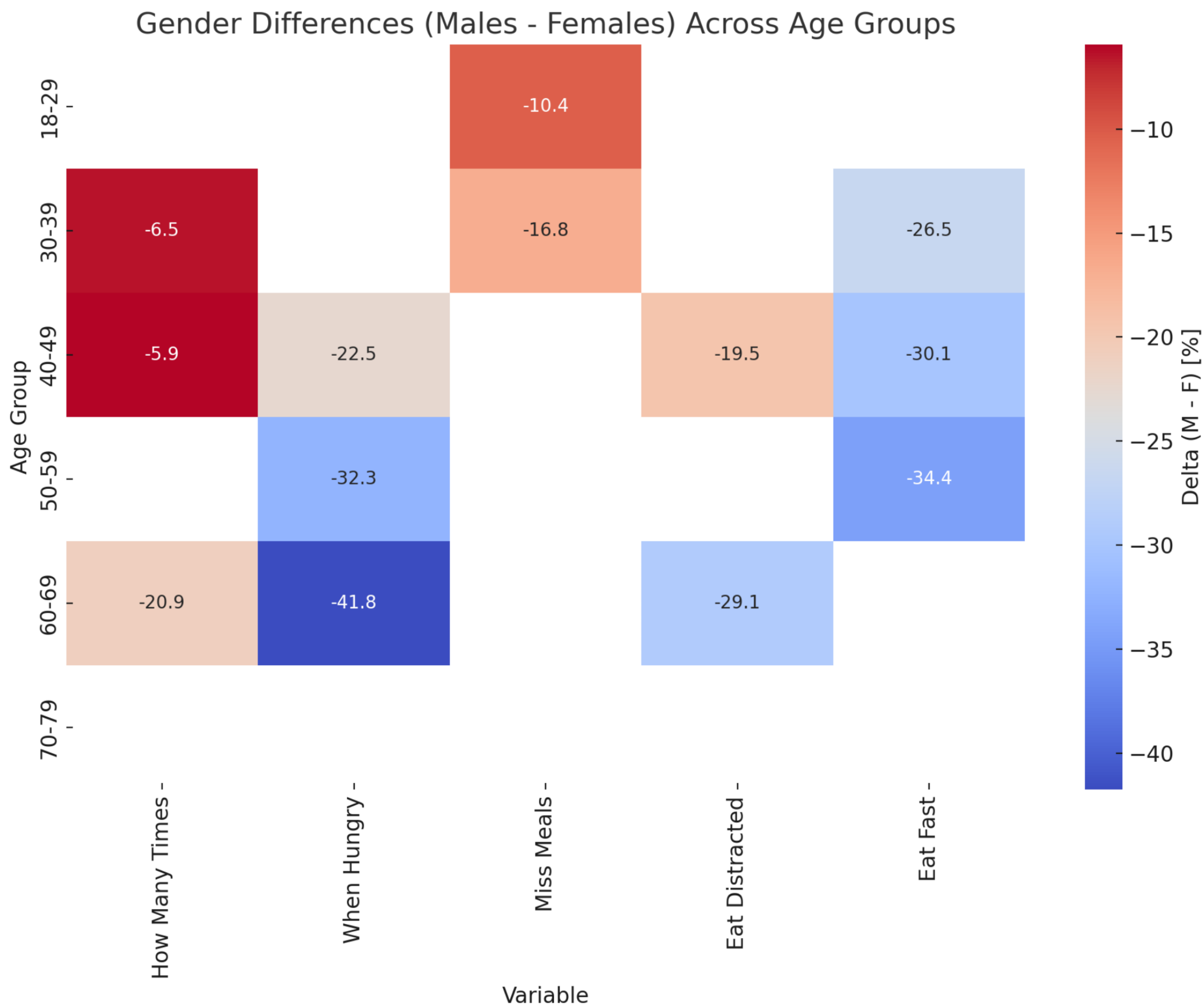

Fig. 2 Gender differences in eating habits: Delta (M - F) by age group. Mean delta (M - F) of relative frequencies for significant variables in the age groups. Significant differences were determined using the chi-square test (p < 0.05). The p-values calculated with the chi-square test for the significant variables are: How Many Times: 30-39 (p = 0.025), 40-49 (p = 0.0003), 60-69 (p = 0.045). When Hungry: 40-49 (p = 0.0036), 50-59 (p = 0.020), 60-69 (p = 0.011). Miss Meals: 18-29 (p = 0.0031), 30-39 (p = 0.0038). Eat Distracted: 40-49 (p = 0.027), 60-69 (p = 0.011). Eat Fast: 30-39 (p < 0.0001), 40-49 (p = 0.0018), 50-59 (p = 0.0007)

tend to prefer sweet flavors and healthier food options. This trend is consistent with other studies [30, 32] which highlighted how women are more inclined to choose low-calorie foods, driven by health-related motivations. Regarding beverages, alcohol consumption is significantly higher in men, consistent with the observations of Masella and Malorni [33]. Instead, sugary beverage consumption is higher among young men, but surprisingly increases in middle-aged women, a finding that could be explained by a more frenetic lifestyle and a greater use of these beverages as a source of quick energy [34]. Our above described findings, align with many recent observations, though some differences emerge. While studies by Amagasa et al. [35] and Gherasim et al. [36] primarily attribute dietary habit differences to cultural factors, our data emphasize the influence of age groups and social changes, particularly within the European context. Additionally, compared to previous research, our results provide detailed insights into gender-specific food preferences and their variation across age.

Considering sport preferences by gender, our analysis shows that in the 30–39 age group, men participate more in team sports, while women prefer skill sports and strength training. This result aligns with Craft et al. [37], who attributes these differences to personal goals: with men preferring competitive and social activities and women focusing on well-being and personal fitness. Recent findings suggest that the type of physical activity practiced is also linked to disordered eating behaviors, with variations observed between men and women

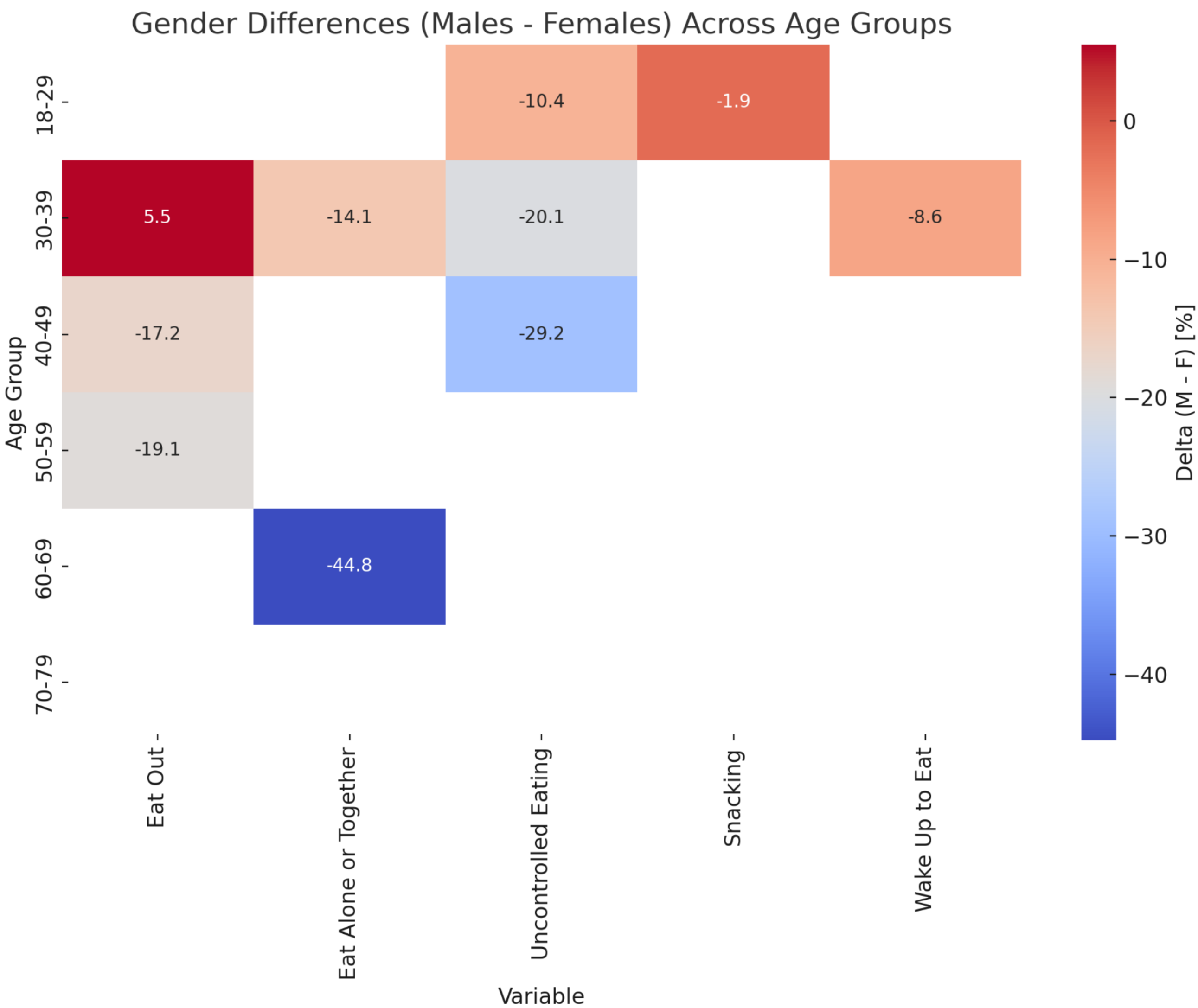

Fig. 3 Gender differences in eating behaviour: Delta (M - F) by age group. Gender differences in eating behaviour between age groups. The figure shows the average percentage difference (delta: M - F) for the main eating behaviour variables, stratified by gender and age group. Positive values indicate a higher prevalence in males, while negative values indicate a higher prevalence in females. Significant differences were determined using the chi-square test ($p < 0.05$). Major trends include: - Men are more likely to eat out (age 30-49 years), have higher rates of uncontrolled eating (age 18-49 years) and report more frequent snacking (age 18-29 years). - Women, especially in the older age groups, tend to eat alone more frequently (ages 30-39 and 60-69). The p-values for each variable and age group are: Eat Out: 30-39 ($p = 0.00003$), 40-49 ($p = 0.031$), 50-59 ($p = 0.00046$).Eat Alone or Together: 30-39 ($p = 0.0011$), 60-69 ($p = 0.022$). Uncontrolled Eating: 18-29 ($p < 0.0001$), 30-39 ($p = 0.030$), 40-49 ($p < 0.0001$). Snacking: 18-29 ($p = 0.013$). Wake Up to Eat: 30-39 ($p = 0.0053$)

depending on the sport modality chosen [38] Conversely, inactive participants are significantly more frequent among women in the same age group. This is in line with the observations of Sharkey et al. [39], who highlighted that barriers such as family roles and unpaid workloads restrict women's participation in sports. In other age groups, gender differences in sports preferences are less pronounced, likely due to more homogeneous lifestyles and declining overall sports participation with aging. However, physical activity levels remain consistently higher in men than women across all age groups [36]. Our data align with our previous observations [40, 41] highlighting a gender gap in team sports and competitive activities. Nevertheless, our study reveals greater female participation in skill sports and strength training within the 30–39 age group, a trend less prominent in previous research. This may be linked to increasing fitness awareness among women, influenced by recent cultural trends and the rise of personalized training programs [42]. The observed gender differences in eating habits and sports participation suggest the need for targeted interventions that address these specific patterns. Younger men, who tend to skip meals and eat uncontrollably, may benefit from structured meal planning programmes

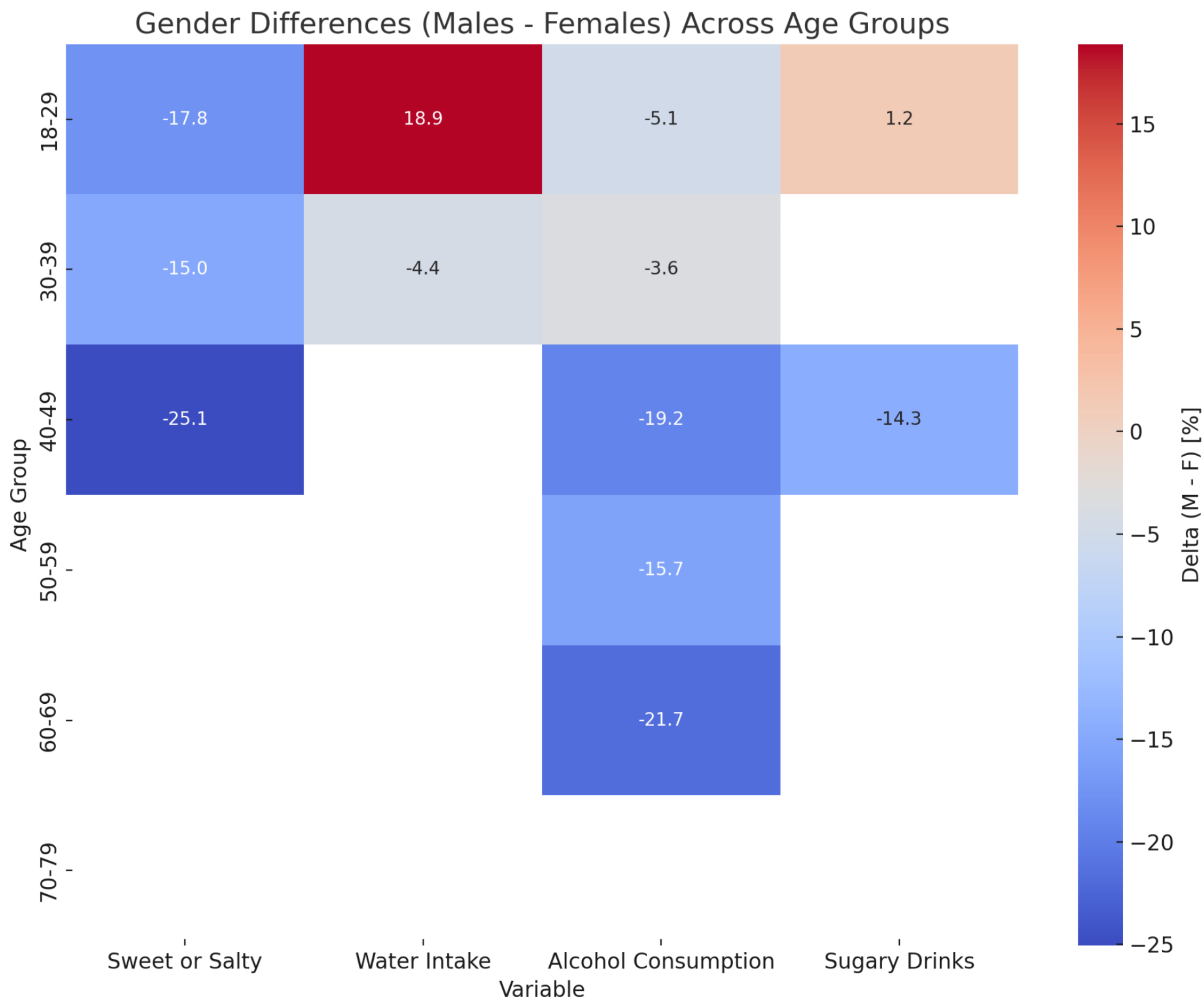

Fig. 4 Gender differences in food preferences and consumption: Delta (M - F) by age group. Mean delta (M - F) of relative frequencies for significant variables across age groups. Significant differences were determined using the chi-square test. The p-values for each variable and age group are: Sweet or Salty: 18-29 ($p = 0.00008$), 30-39 ($p = 0.0020$), 40-49 ($p = 0.0012$). Water Intake: 18-29 ($p < 0.0001$), 30-39 ($p = 0.0001$). Alcohol Consumption: 18-29 ($p = 0.020$), 30-39 ($p = 0.0002$), 40-49 ($p = 0.0004$), 50-59 ($p = 0.0013$), 60-69 ($p = 0.034$). Sugary Drinks: 18-29 ($p = 0.013$), 40-49 ($p = 0.029$)

that emphasise regularity of timing and balanced intake of macronutrients. Conversely, older women, who are more likely to eat alone, could be supported by community-based nutrition programmes that encourage social meals to improve diet quality. With regard to physical activity, interventions should take gender-specific preferences into account. Women in the 30–39 age group, who participate less in team sports, may be encouraged to participate in structured group activities to promote adherence to regular exercise. Conversely, men, who tend to prefer endurance and competitive sports, can be guided towards incorporating strength training and flexibility-based activities to improve overall musculoskeletal health.

Some limitations of this study must be considered. The cross-sectional design does not allow causal relationships to be established between behavioural patterns and body composition metrics, limiting the ability to infer long-term effects of dietary habits and physical activity on health outcomes. Future longitudinal studies are essential to follow changes over time and determine whether the gender-specific differences observed in this study persist, evolve or lead to different health trajectories. Another limitation is the use of an unvalidated online questionnaire, which, while providing broad accessibility, may introduce biases due to the subjectivity of responses, particularly with regard to dietary behaviours and preferences. Furthermore, the focus on an Italian population affected by obesity may limit the generalisability of the results to other cultural or socioeconomic contexts. Finally, the use of bioimpedance analysis to assess body composition, although practical and widely

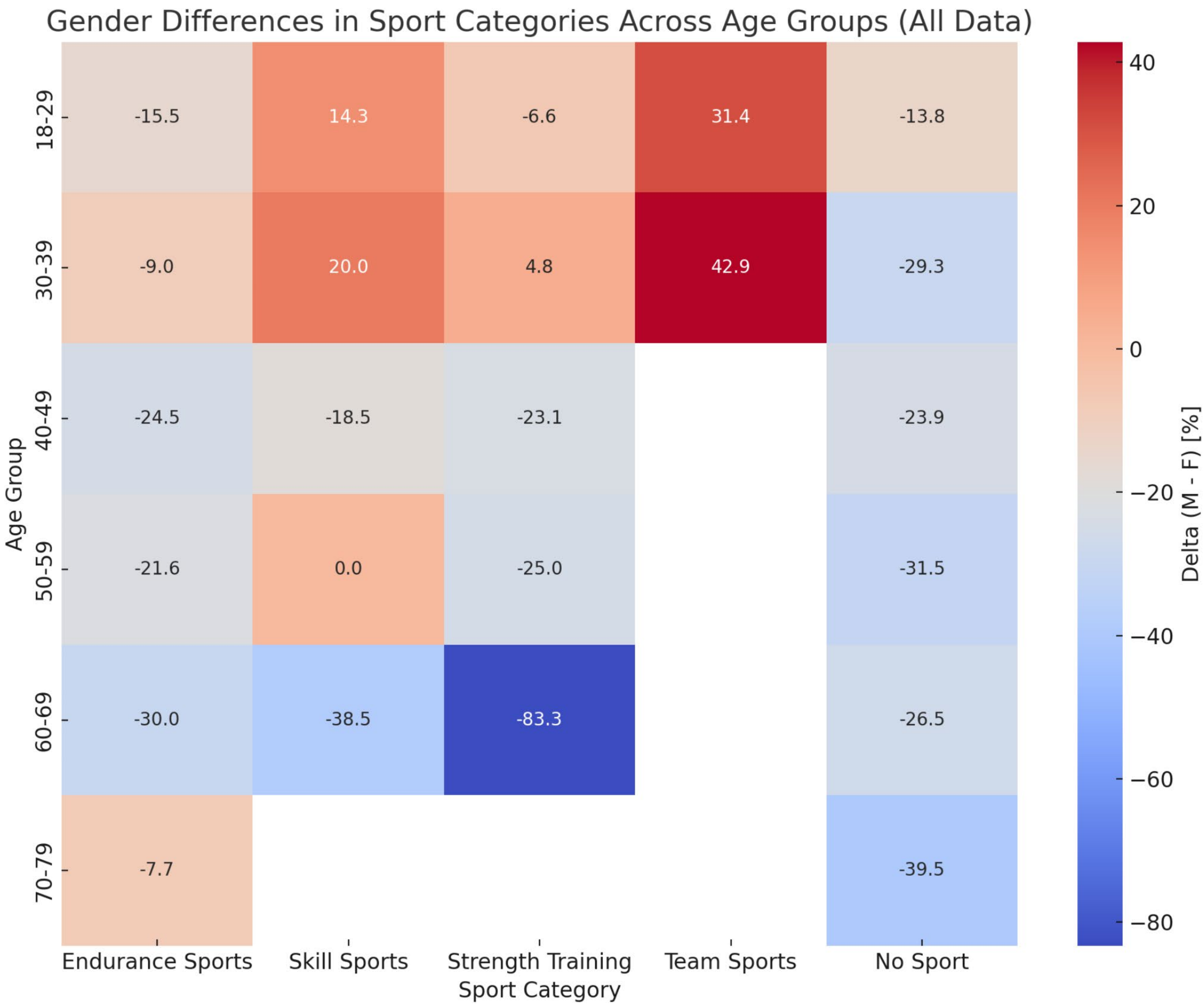

Fig. 5 Gender differences in sport preferences: Delta (M - F) by age group. Mean delta (M - F) of relative frequencies for sports categories across age groups. The p-values for statistically significant differences were calculated using the chi-square test. Only in the 30-39 age group were significant differences found: Endurance Sports: p = 0.032, delta = -8.96% Skill Sports: p = 0.014, delta = 20.0% Strength Training: p = 0.045, delta = 4.84% Team S ports: p = 0.012, delta = 42.86% No Sport: p = 0.003, delta = -29.28%. The other age groups show no statistically significant differences, but are included for completeness

available, lacks the precision of advanced techniques such as DEXA. Future research incorporating prospective designs and repeated measures will be invaluable in strengthening the evidence base and informing more effective and personalised health interventions.

Conclusions

Our study confirms significant gender differences in body composition, food preferences and sports habits, challenging the traditional one-size-fits-all approach to health promotion. These findings encourage reflection on how gender-specific knowledge can be harnessed to develop more effective and personalised health interventions. Science should go beyond simply describing gender differences, focusing instead on developing innovative strategies to close these gaps. For example, structured community-based programmes that encourage female participation in team sports could be implemented to address the lower engagement observed in women. Similarly, initiatives promoting strength training among men, who predominantly participate in endurance and competitive sports, may provide additional long-term health benefits. Nutrition education should also be tailored to address cultural and social factors that influence food choices between genders. Interventions that focus on regularity of meals and reducing uncontrolled consumption in young men or social catering programmes for older women, who are more likely to eat alone, could be helpful in promoting healthier eating habits. Recognising gender differences is crucial for effective public health interventions. Accommodating these distinctions allows for more inclusive and personalised strategies, improving both physical health outcomes and overall quality of life for all genders. Advancing innovation in this field is not only a practical necessity, but also an ethical imperative. As society becomes increasingly diverse, our understanding of gender dynamics must continually evolve to address its complexities.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12967-025-06311-x.

Supplementary Material 1

Acknowledgements

We would like to thank Miss Arianna Lombardo and Mr Tommaso Lombardo for their valuable help in compiling the participants' database.

Author contributions

Mauro Lombardo conceived and designed the study. Stefania Gorini and Elisabetta Camajani coordinated data collection and analysis. Edda Cava, Elvira Padua and Alessandra Feraco conducted body composition assessments and statistical analysis. Xinyan Wu and Isaac Amoah contributed to the interpretation of results and manuscript drafting. Andrea Armani and Tiziana Filardi and provided critical revision of the manuscript. Rocky Strollo and Massimiliano Caprio supervised the study. and Mauro Lombardo, Stefania Gorini and Elisabetta Camajani finalized the manuscript. All authors read and approved the final manuscript.

Funding

MIUR (Progetti di Ricerca di Interesse Nazionale 2022—Project code 202285HFZY —to MC, Work Package Leader), and by Institutional funding of the Italian Ministry of Health (Ricerca Corrente).

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request. All data will be shared in an anonymized format to ensure participant confidentiality.

Data availability

Data supporting the results of this study are accessible from the corresponding author upon reasonable request. All data will be shared in an anonymous format to ensure the confidentiality of participants is protected.

Declarations

Ethics approval and consent to participate

This study was approved by the Lazio Area 5 Territorial Ethics Committee (Approval Code: N.57/SR/23, Approval Date: 7 November 2023), in compliance with the Declaration of Helsinki and its amendments. Written informed consent was obtained from all participants prior to their enrollment.

Consent for publication

Participants provided consent for the anonymous use of their data for publication purposes.

Competing interests

The authors declare no competing interests.

Author details

[1]Department for the Promotion of Human Science and Quality of Life, San Raffaele Open University, Via di Val Cannuta, 247, Rome 00166, Italy
[2]Laboratory of Cardiovascular Endocrinology, San Raffaele Research Institute, IRCCS San Raffaele Roma, Via di Val Cannuta, 247, Rome 00166, Italy
[3]Clinical Nutrition and Dietetics, San Camillo Forlanini Hospital, Rome, circ.ne Gianicolense 87, Rome 00152, Italy
[4]Department of Biochemistry and Biotechnology, Kwame Nkrumah University of Science and Technology, Kumasi 0023351, Ghana
[5]College of Food Science and Nutritional Engineering, China Agricultural University, Beijing 100083, China

Received: 16 January 2025 / Accepted: 23 February 2025
Published online: 12 March 2025

References

1. Ivan S, Daniela O, Jaroslava BD. Sex differences matter: males and females are equal but not the same. Physiol Behav. 2023;259:114038. https://doi.org/10.1016/j.physbeh.2022.114038. Epub 2022 Nov 22. PMID: 36423797.
2. Owen KB, Corbett L, Ding D, Eime R, Bauman A. Gender differences in physical activity and sport participation in adults across 28 European countries between 2005 and 2022. Ann Epidemiol. 2025;101:52–7. Epub 2024 Dec 20. PMID: 39710014.
3. Bi X, Forde CG, Goh AT, Henry CJ. Basal metabolic rate and body composition predict habitual food and macronutrient intakes: gender differences. Nutrients. 2019;11(11):2653. https://doi.org/10.3390/nu11112653. PMID: 31689964; PMCID: PMC6893862.
4. Wang Y, Cao P, Liu F, Chen Y, Xie J, Bai B, Liu Q, Ma H. Gender differences in unhealthy lifestyle behaviors among adults with diabetes in the united States between 1999 and 2018. Int J Environ Res Public Health. 2022. https://doi.org/10.3390/ijerph192416412.
5. Briazu RA, Bell L, Dodd GF, Blackburn S, Massri C, Chang B, Fischaber S, Kehlbacher A, Williams CM, Methven L, McCloy R. The effectiveness of personalised food choice advice tailored to an individual's socio-demographic, cognitive characteristics, and sensory preferences. Appetite. 2024;201:107600. doi: 10.1016/j.appet.2024.107600. Epub 2024 Jul 11. PMID: 39002566.
6. Mariana Silva S, Rodrigues D, Correia D, Torres C, Lopes. Milton Severo– 6 Eating in or out of home in the Portuguese population: are there differences in dietary intake? Volume 5. BMJ Nutrition, Prevention & Health; 2022.
7. Garg S. Gender differences in pathways influencing leisure time physical activity: A structural equation analysis. Diabetes Metab Syndr. 2023;17(5):102761. https://doi.org/10.1016/j.dsx.2023.102761. Epub 2023 Apr 15. PMID: 37119796.
8. Strasser B, Pesta D, Rittweger J, Burtscher J, Burtscher M. Nutrition for older athletes: focus on sex differences. Nutrients. 2021. https://doi.org/10.3390/nu13051409.
9. Jimenez-Morcillo J, Clemente-Suárez V. Gender differences in body satisfaction perception: the role of nutritional habits, psychological traits, and physical activity in a strength-training population. Nutrients. 2023. https://doi.org/10.3390/nu16010104.
10. Mattioli A, Selleri V, Zanini G, Nasi M, Pinti M, Stefanelli C, Fedele F, Gallina S. Physical activity and diet in older women: A narrative review. J Clin Med. 2022. https://doi.org/10.3390/jcm12010081.
11. Carbonneau E, Bradette-Laplante M, Lamarche B, Provencher V, Bégin C, Robitaille J, Desroches S, Vohl MC, Corneau L, Lemieux S. (2017), Development and validation of the food liking questionnaire in a French-Canadian population, nutrients, 9 12, p. 1337.
12. Xu L, Cheng X-G, Wang J, Cao Q, Sato T, Wang M, Zhao X, Liang W. Comparisons of body-composition prediction accuracy: a study of 2 bioelectric impedance consumer devices in healthy Chinese persons using DXA and MRI as criteria methods. J Clin Densitometry: Official J Int Soc Clin Densitometry. 2011;14(4):458–64. https://doi.org/10.1016/j.jocd.2011.04.001.
13. Cheng M-F, Chen Y-Y, Jang T-R, Lin W-L, Chen J, Hsieh K. Total body composition estimated by standing-posture 8-electrode bioelectrical impedance analysis in male wrestlers. Biology Sport. 2015;33:399–405. https://doi.org/10.5604/20831862.1224097.
14. Martín-Rodríguez A, Belinchón-deMiguel P, Rubio-Zarapuz A, Tornero-Aguilera JF, Martínez-Guardado I, Villanueva-Tobaldo CV, Clemente-Suárez VJ. Advances in Understanding the interplay between dietary practices, body composition, and sports performance in athletes. Nutrients. 2024;16(4):571. https://doi.org/10.3390/nu16040571. PMID: 38398895; PMCID: PMC10892519.
15. Lombardo M, Feraco A, Armani A, Camajani E, Gorini S, Strollo R, Padua E, Caprio M, Bellia A. Gender differences in body composition, dietary patterns, and physical activity: insights from a cross-sectional study. Front Nutr. 2024;11. https://doi.org/10.3389/fnut.2024.1414217.

16. Després JP. Body fat distribution and risk of cardiovascular disease: an update. Circulation. 2012;126(10):1301-13. https://doi.org/10.1161/CIRCULATIONAHA.111.067264. PMID: 22949540.
17. Kodete CS, Thuraka B, Pasupuleti V, Malisetty S. Hormonal influences on skeletal muscle function in women across life stages: A systematic review. Muscles. 2024;3:271–86. https://doi.org/10.3390/muscles3030024.
18. Lombardo M, Boaria A, Aulisa G, Padua E, Annino G, Pratesi A, Caprio M, Iellamo F, Bellia A. (2019). Sarcopenic Obesity: Etiology And Lifestyle Therapy. European Review For Medical And Pharmacological Sciences, Vol. 23, P. 7152–7162, Issn: 1128–3602. https://doi.org/10.26355/Eurrev_201908_18761
19. Liu D, Wang S, Liu S, Wang Q, Che X, Wu G. Frontiers in sarcopenia: advancements in diagnostics, molecular mechanisms, and therapeutic strategies. Mol Aspects Med. 2024;97:101270. https://doi.org/10.1016/j.mam.2024.101270. Epub 2024 Apr 6. PMID: 38583268.
20. Westerterp KR, Yamada Y, Sagayama H, Ainslie PN, Andersen LF, Anderson LJ, Arab L, Baddou I, Bedu-Addo K, Blaak EE, Blanc S, Bonomi AG, Bouten CVC, Bovet P, Buchowski MS, Butte NF, Camps SGJA, Close GL, Cooper JA, Das SK, Cooper R, Dugas LR, Ekelund U, Entringer S, Forrester T, Fudge BW, Goris AH, Gurven M, Hambly C, El Hamdouchi A, Hoos MB, Hu S, Joonas N, Joosen AM, Katzmarzyk P, Kempen KP, Kimura M, Kraus WE, Kushner RF, Lambert EV, Leonard WR, Lessan N, Martin CK, Medin AC, Meijer EP, Morehen JC, Morton JP, Neuhouser ML, Nicklas TA, Ojiambo RM, Pietiläinen KH, Pitsiladis YP, Plange-Rhule J, Plasqui G, Prentice RL, Rabinovich RA, Racette SB, Raichlen DA, Ravussin E, Reynolds RM, Roberts SB, Schuit AJ, Sjödin AM, Stice E, Urlacher SS, Valenti G, Van Etten LM, Van Mil EA, Wells JCK, Wilson G, Wood BM, Yanovski J, Yoshida T, Zhang X, Murphy-Alford AJ, Loechl CU, Luke AH, Pontzer H, Rood J, Schoeller DA, Wong WW, Speakman JR. International atomic energy agency doubly labeled water database group. Physical activity and fat-free mass during growth and in later life. Am J Clin Nutr. 2021;114(5):1583–9. https://doi.org/10.1093/ajcn/nqab260. PMID: 34477824; PMCID: PMC8574623.
21. Martins C, Gower BA, Hunter GR. Association between Fat-Free mass loss after diet and exercise interventions and weight regain in women with overweight. Med Sci Sports Exerc. 2022;54(12):2031–6. doi: 10.1249/MSS.0000000000002992. Epub 2022 Jul 8. PMID: 35797356; PMCID: PMC9669159.
22. Sinisterra Loaiza LI, Vázquez Belda B, Miranda López JM, Cepeda A, Cardelle Cobas A. Hábitos alimentarios en la poblacion gallega durante el confinamiento por la COVID-19 [Food habits in the Galician population during confinement byCOVID-19]. Nutr Hosp. 2020;37(6):1190–1196. Spanish. https://doi.org/10.20960/nh.03213. PMID: 33155474.
23. Alkazemi D. Gender differences in weight status, dietary habits, and health attitudes among college students in Kuwait: A cross-sectional study. Nutr Health. 2019;25(2):75–84. https://doi.org/10.1177/0260106018817410.
24. Fenton S, Ashton LM, Lee DCW, Collins CE. Gender differences in diet quality and the association between diet quality and BMI: an analysis in young Australian adults who completed the healthy eating quiz. J Hum Nutr Diet. 2024;37(4):943–51. https://doi.org/10.1111/jhn.13309. Epub 2024 Apr 25. PMID: 38664922.
25. Rolls BJ, Fedoroff IC, Guthrie JF. Gender differences in eating behavior and body weight regulation. Health Psychol. 2022;41(2):133–42. https://doi.org/10.1037/0278-6133.10.2.133.
26. Storz MA, Beckschulte K, Brommer M, Lombardo M. Current sex distribution of cooking and food shopping responsibilities in the united States: A Cross-Sectional study. Foods. 2022;11:2840. https://doi.org/10.3390/foods11182840.
27. Grzymisławska M, Puch EA, Zawada A, Grzymisławski M. Do nutritional behaviors depend on biological sex and cultural gender? Adv Clin Exp Med. 2020;29(1):165–172. https://doi.org/10.17219/acem/111817. PMID: 32017478.
28. Skoczek-Rubińska A, Bajerska J. The consumption of energy dense snacks and some contextual factors of snacking May contribute to higher energy intake and body weight in adults. Nutr Res. 2021;96:20–36. Epub 2021 Nov 20. PMID: 34890856.
29. Peters B, Vahlhaus J, Pivovarova-Ramich O. Meal timing and its role in obesity and associated diseases. Front Endocrinol. 2024;15:1359772. https://doi.org/10.3389/fendo.2024.1359772.
30. Feraco A, Armani A, Amoah I, Guseva E, Camajani E, Gorini S, Strollo R, Padua E, Caprio M, Lombardo M. Assessing gender differences in food preferences and physical activity: a population-based survey. Front Nutr. 2024;11:1348456. https://doi.org/10.3389/fnut.2024.1348456. PMID: 38445208; PMCID: PMC10912473.
31. DiGiacomo M, Lewis J, Nolan MT, et al. Health transitions in recently widowed older women: a mixed methods study. BMC Health Serv Res. 2013;13:143. https://doi.org/10.1186/1472-6963-13-143.
32. Culliford A, Bradbury J. A cross-sectional survey of the readiness of consumers to adopt an environmentally sustainable diet. Nutr J. 2020;19:138. https://doi.org/10.1186/s12937-020-00644-7.
33. Masella R, Malorni W. Lifestyle, nutrition, and gender. Clin Manage Issues. 2020;6(2):152–6. https://doi.org/10.7175/CMI.V11I2.1313.
34. Gil M, Rudy M, Stanisławczyk R, Duma-Kocan P, Żurek J. Gender differences in eating habits of Polish young adults aged 20–26. Int J Environ Res Public Health. 2022;19(22):15280. https://doi.org/10.3390/ijerph192215280.
35. Amagasa S, Inoue S, Shibata A, Ishii K, Kurosawa S, Owen N, Oka K. Differences in accelerometer-measured physical activity and sedentary behavior between middle-aged men and women in Japan: A compositional data analysis. J Phys Act Health. 2022;19(4):242–8. https://doi.org/10.1123/jpah.2022-0098.
36. Gherasim A, Arhire LI, Niță O, Popa AD, Graur M, Mihalache L. The relationship between lifestyle components and dietary patterns. Proc Nutr Soc. 2020;79(3):311–23. Epub 2020 Apr 1. PMID: 32234085; PMCID: PMC7663317.
37. Craft BB, Carroll HA, Lustyk MK. Gender differences in exercise habits and quality of life reports: assessing the moderating effects of reasons for exercise. Int J Lib Arts Soc Sci. 2014;2(5):65–76. PMID: 27668243; PMCID: PMC5033515.
38. Beaulieu DA, Best LA. The intersection of physical activity type and gender in patterns of disordered eating. Sci Rep. 2024;14:18127. https://doi.org/10.1038/s41598-024-68657-4.
39. Sharkey T, Whatnall M, Hutchesson M, Haslam RL, Bezzina A, Collins C, Ashton L. Effectiveness of gender-targeted versus gender-neutral interventions aimed at improving dietary intake, physical activity, and/or overweight/obesity in young adults. Nutr J. 2020;19(1):94. https://doi.org/10.1186/s12937-020-00594-0.
40. Molanorouzi K, Khoo S, Morris T. Motives for adult participation in physical activity: type of activity, age, and gender. BMC Public Health. 2015;15:66. https://doi.org/10.1186/s12889-015-1429-7. PMID: 25637384; PMCID: PMC4314738.
41. Hunter SK, Angadi S, Bhargava S, Harper A, Hirschberg J, D Levine AL, L Moreau B, Nokoff KJ, Stachenfeld N, Bermon NS. The biological basis of sex differences in athletic performance: consensus statement for the American college of sports medicine. Med Sci Sports Exerc. 2023;55(12):2328–60. Epub 2023 Sep 28. PMID: 37772882.
42. Batrakoulis A, Veiga OL, Franco S, Thomas E, Alexopoulos A, Valcarce-Torrente M, Santos-Rocha R, Ramalho F, Di Credico A, Vitucci D, Ramos L, Simões V, Romero-Caballero A, Vieira I, Mancini A, Bianco A. Health and fitness trends in Southern Europe for 2023: A cross-sectional survey. AIMS Public Health. 2023;10(2):378–408. https://doi.org/10.3934/publichealth.2023028. PMID: 37304589; PMCID: PMC10251056.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.