Outcomes of a Personalised Nutrition Intervention in Adults with Obesity and Overweight Attending Outpatient Nutrition Consultations at a Private Hospital in Portugal

Resultados de uma Intervenção Nutricional Personalizada em Adultos com Excesso de Peso e Obesidade Seguidos em Consulta de Nutrição num Hospital Privado em Portugal

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ABSTRACT

INTRODUCTION: Given the rising rates of overweight and obesity, a growing number of individuals are seeking guidance from nutrition practitioners. This study aimed to assess adherence to nutrition intervention (Mediterranean Diet, MD) and its association with adiposity.

METHODS: We conducted this observational study at Hospital CUF Tejo with a sample of 53 patients with overweight and obesity regularly attending nutrition appointments. Participants completed a structured online questionnaire, and adherence to the MD was assessed through the PREDIMED questionnaire (low ≤ 5; moderate 6–9; high ≥10). The number of appointments attended, follow-up duration, anthropometric and body composition data were extracted from clinical records.

RESULTS: Participants attended, on average, 3 nutrition consultations and had a moderate adherence to the MD. Weight, BMI and waist circumference significantly decreased after nutritional counselling, with a maintenance of weight and BMI 1 year and 10 months post-treatment. Age was positively and significantly associated with MD adherence (β = 0.047; 95% CI: 0.001;0.094). Male sex was associated with higher weight (β = 13.105; 95%

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CI: 7.663;18.547) and waist circumference (β = 6.695; 95% CI: 2.106;11.284) at the last nutrition appointment. Physical activity was negatively associated with waist circumference at the last appointment (β = -4.342; 95% CI: -8.648;-0.037). No association was observed between MD adherence and adiposity-related markers at the last nutrition consultation.

CONCLUSION: Tailored nutritional counselling provided by a nutrition professional in patients with overweight and obesity results in moderate adherence to the intervention and a reduction of adiposity-related markers.

KEYWORDS: Diet, Mediterranean; Obesity/diet therapy; Overweight; Weight Loss.

RESUMO

INTRODUÇÃO: A prevalência de excesso de peso reflete-se num aumento da procura de terapêutica nutricional junto de nutricionistas. O objetivo deste estudo foi avaliar a adesão à intervenção nutricional (dieta mediterrânica, DM) e a sua relação com a adiposidade.

MÉTODOS: Este estudo observacional foi realizado no Hospital CUF Tejo com 53 doentes com pré-obesidade ou obesidade que frequentaram consultas de nutrição. Os participantes preencheram um questionário *online* estruturado, e a adesão à DM foi avaliada através do questionário PREDIMED (adesão baixa ≤5; moderada 6–9; elevada ≥10). Dos registos clínicos, recolheram-se o número de consultas, o tempo de seguimento e dados antropométricos e de composição corporal.

RESULTADOS: Os participantes frequentaram, em média, 3 consultas de nutrição e apresentaram adesão moderada à DM. Verificou-se uma redução no peso, IMC e perímetro da cintura, com manutenção do peso e IMC após 1 ano e 10 meses. A idade mostrou-se positiva e significativamente associada à adesão à DM (β = 0,047; 95% IC: 0,001; 0,094). No sexo masculino observaram-se indicadores antropométricos superiores na última consulta (peso: β = 13,105; 95% IC: 7,663; 18,547; perímetro da cintura: β = 6,695; 95% IC: 2,106; 11,284). A atividade física mostrou-se negativa e significativamente associada ao perímetro da cintura (β = -4,342; 95% IC: -8,648; -0,037). Nesta amostra, não observámos uma associação entre a adesão à DM e adiposidade na última consulta.

CONCLUSÃO: O aconselhamento nutricional personalizado por um nutricionista promove adesão moderada à DM e redução da adiposidade em indivíduos com excesso de peso e obesidade.

PALAVRAS-CHAVE: Dieta Mediterrânica; Excesso de Peso; Obesidade/dieta terapêutica; Redução de Peso.

INTRODUCTION

Given the worldwide prevalence of overweight and obesity,[1] an increasing number of patients seek advice for weight management through individual nutrition counselling. In Portugal, more than 50% of the population is overweight, with an obesity prevalence of 22.3%.[2] Both obesity and overweight are associated with increased morbidity and mortality, including increased risk of developing type 2 diabetes, cardiovascular diseases, some types of cancer, osteoarthritis among other health issues.[3] According to The National Food, Nutrition and Physical Activity Survey[2] conducted in 2015-2016, only 18% of the Portuguese population adheres strongly to the Mediterranean diet (MD), a dietary pattern frequently linked to a reduced risk of non-communicable diseases and mortality.[4] Studies have shown an inverse association between the MD diet and adiposity.[5] Therefore, a dietary intervention conducted by qualified nutrition professionals is warranted to improve the health and quality of life of these patients. However, given the complexity of obesity, it is common for patients to have experienced multiple unsuccessful attempts to lose weight, which, in turn, have been associated with an increased risk for comorbidities such as hypertension or dyslipidaemia.[4] Thus, a dietary intervention can only be successful if it is tailored to the individual and focused on long-term behaviour change.[6] Due to the challenges of sustaining lifestyle modifications, it is essential to evaluate not only structured programs but also individual dietary interventions, to enhance patient care for individuals with overweight and obesity.

It has been described that physicians, particularly general practitioners, show reluctance to treat overweight and obesity for several reasons, such as low confidence in their nutrition intervention skills, time restraints, and low patient compliance.[7-10] Therefore, referrals to nutrition consultations are on the rise. In

Portugal, due to an overload of the national health service,[11] private practice is increasingly sought after by physicians seeking to refer their patients, as well as by patients themselves.

Most studies on the effectiveness of various dietary interventions in weight management primarily focus on structured programs and often prioritize efficacy, including only those patients who have adhered to the program.[12] Relatively few studies report on losses to follow-up, although it is well- known that dropouts are common in both clinical trials and clinical practice.[13] Considering that a single nutrition consultation is insufficient for achieving long-term improvements, and given the limited research on longer-term outcomes after one-to-one consultation with nutrition practitioners,[12] studies that describe adherence to nutrition consultations and assess the effectiveness of these interventions in terms of weight management outcomes as well as related comorbidity outcomes, are warranted.

This study aimed to assess the adherence to nutrition intervention (Mediterranean diet, MD), factors associated with adherence to this dietary pattern, changes in adiposity-related markers and the association between adherence to the MD and adiposity.

MATERIAL AND METHODS

STUDY DESIGN AND POPULATION

This study had a cross-sectional design with a retrospective component of data collection from clinical records. It received approval from the Ethics Committee of Hospital CUF Tejo. The research was conducted in accordance with the Declaration of Helsinki of 1964[14] and its later amendments and adhered to the standards established by the Portuguese Data Protection Authority. An online informed consent was collected from each individual participant.

Patients who had attended nutrition appointments at Hospital CUF Tejo were invited to participate in this study via email. A total of 116 adult patients met the inclusion criteria (≥ 18 years old, with a body mass index (BMI) ≥25 kg/m^2 and had attended one-to-one nutrition appointments at Hospital CUF Tejo), of which 53 accepted to participate. Exclusion criteria comprised patients with an inability to complete online surveys, those who had attended only a single nutrition appointment, patients who had undergone bariatric surgery, and patients seeking advice for other conditions, such as digestive surgery, inflammatory bowel disease or oncology.

DATA COLLECTION

Data collection for this study took place between April and June 2023. Sociodemographic data (sex, age and education) were collected through an online survey specifically developed for this study. Additionally, this questionnaire gathered information on the patient's medical history (presence or absence of prediabetes, diabetes, dyslipidaemia, hypertension and hyperuricemia), adherence to the Mediterranean diet (using the PREDIMED score[5]), reported weight, physical activity and the use of dietary supplements. This survey was self-administered and consisted of 29 items.

The PREDIMED score is a 14-item questionnaire that assesses adherence to the MD,[5] and was validated for the Portuguese population.[15] The MD is characterized by higher consumption of fruits and vegetables, legumes, whole grains, dietary fibre, fish, vegetable protein and vegetable fat from olive oil, in contrast to adverse dietary factors related to obesity (fast food, sugar-sweetened beverages, refined grain products, energy density foods, and partially hydrogenated or trans-fat). According to the PREDIMED trial, each item is scored with 1 or 0, and a final score ≤ 5 means "low adherence" to the MD, while a score between 6 and 9 is considered "moderate adherence" and a "high adherence" to this dietary pattern is considered with a final score ≥10.[5]

Information on attendance to nutrition appointments (e.g., number of appointments attended and follow-up duration), body composition and anthropometric measurements (e.g., weight, height, BMI, skeletal muscle mass, body fat and waist circumference at the first and last appointments) were extracted from patients' clinical records. Height was measured with a wall stadiometer (SECA®, Hamburg, Germany), weight, skeletal muscle mass and body fat were measured with the InBody 770 (InBody®Co. Ltd., Seoul, Korea). Waist circumference was measured using an unextendible tape measure. Participants' BMI was calculated as body weight divided by height squared.

STATISTICAL ANALYSIS

Descriptive statistics are presented as percentages for categorical variables and as the mean and standard deviation (SD) or median and interquartile range (IQR) for continuous variables. Means were compared using paired t-test, Wilcoxon tests or sign test as appropriate.

We calculated the amount of time that had elapsed between the end of the follow-up and the completion of the questionnaire for each patient.

We assessed the association of participants' characteristics and MD adherence to check for potential confounding factors. To assess the association of participants' characteristics and the primary exposure of interest (Mediterranean diet adherence) and the outcome (adiposity), linear regression models, both crude and adjusted, were fitted to estimate regression coefficients and respective 95% confidence intervals (B, 95% CI).

The models were adjusted for sex (male versus female as reference category), age, education (completed schooling years), physical activity (yes versus no as reference category), duration of nutritional therapy (in months) and baseline BMI. Research has shown an association between MD adherence and age, education and physical activity engagement.[16,17]

Statistical analyses were conducted using SPSS statistical software package version 29.0 (SPSS Inc., Chicago, IL, USA). In all analyses, a *p* value <0.05 was considered statistically significant.

RESULTS

A total of 53 participants, with complete information on weight and BMI, agreed to take part in this study. Due to incomplete clinical records, a total of 44 participants had complete information on waist circumference. In a subsample of 13 participants, data on body composition were available (skeletal muscle mass, n = 13; body fat mass, n = 12).

Participants' characteristics are presented in Table 1. Age ranged from 25 to 74, and 73.6% were women. Regarding one-to-one nutrition appointments, 27 (50.9%) patients attended two to three nutrition appointments, while 26 (49.1%) had more than three appointments. Participants attended consultations for an average of 8 months and the survey was filled out, on average, 1 year and 10 months after the last appointment.

Participants reporting the presence of comorbidities (prediabetes, diabetes, dyslipidaemia, hypertension or hyperuricemia) accounted for 45% of the sample. Hypertension was the most common condition, with a prevalence of 24.5%, followed by dyslipidaemia with 20.8%. Diabetes was reported by 11.3% of participants, while 9.4% reported having prediabetes. Only 5.7% of participants suffered from hyperuricemia.

The mean PREDIMED score was 7.2 ± 2,0, indicating moderate adherence to the MD. Low adherence to the MD was observed in 18.9% of participants, while 71.7% and 9.4% of participants had a moderate and high adherence to the MD, respectively (Table 1).

From the first to the last one-to-one nutrition appointment, participants' weight, BMI and waist circumference significantly decreased (Table 2).

Since the end of the nutritional follow-up, there were no statistically significant differences between the self-reported present weight and BMI and the weight and BMI measured by the Nutritionist at the last appointment (Table 3).

TABLE 1. Participants' characteristics

Characteristics	*n* = 53
Sex (% female)	39 (73.6%)
Age (years)	53.8 ± 11.6
Education (years)	16.0 (6.0)
Medical history (% yes)*	24 (45.3%)
Use of dietary supplements (% yes)	12 (22.6%)
Physical activity (% yes)	24 (45.3%)
Time since end of nutritional therapy (years)	1.8 ± 1.3
Nutritional therapy duration (months)	8.4 ± 10.4
Number of nutrition consultations attended	3.0 (4.0)
Adherence to the MD (PREDIMED score)	7.2 ± 2.0
Low **	10 (18.9%)
Moderate **	38 (71.7%)
High **	5 (9.4%)

Data is presented as mean ± standard deviation, median (interquartile range) ou frequence (%).
* Presence of, at least, one of the following conditions: prediabetes, diabetes, dyslipidaemia, hypertension and hyperuricemia.
**PREDIMED score: Low adherence (score ≤ 5); moderate adherence (score 6–9); high adherence (score ≥10)
MD: Mediterranean Diet

TABLE 2. Changes in body composition parameters during nutritional therapy

Variable	*n*	1st Consultation	Last Consultation	*p* value*
Weight (kg)	53	84.1 (26.2)	80.1 (23.8)	<0.001
BMI (kg/m²)	53	29.9 (7.2)	29.1 (6.2)	<0.001
Waist circumference (cm)	44	104.7 ± 11.9	98.0 ± 10.9	<0.001
Skeletal muscle mass (kg)	13	26.7 (7.4)	26.9 (6.8)	0,759
Percentage of body fat (%)	12	42.1 ± 8.3	41.1 ± 8.8	0,101
Body fat (kg)	12	39.3 ± 12.7	37.4 ± 12.8	0,388

Data is presented as mean ± standard deviation or median (interquartile range).
* Wilcoxon, sign or paired-t test.
BMI: Body mass index

TABLE 3. Changes in weight and BMI since the end of nutritional therapy (n = 53)

Variable	Last Consultation	Current	*p* value*
Weight (kg)	80.0 (23.8)	82.0 (27.0)	0,117
BMI (kg/m²)	29.1 (6.2)	29.0 (6.7)	0,108

Data is presented as median (interquartile range).
* Wilcoxon, sign or paired-t test.
BMI: Body mass index

TABLE 4. Association between patients' characteristics and adherence to the MD and adiposity

	Adherence to the MD (PREDIMED score)	Adiposity (BMI in the last consultation)	Adiposity (weight in the last consultation)	Adiposity (waist circumference in the last consultation)
	B (95% CI)	B (95% CI)	B (95% CI)	B (95% CI)
Sex (REF: female)				
Model 1 (crude)	-0.839 (-2.051; 0.373)	-1.116 (-3.949; 1.716)	**10.805 (1.180; 20.431)**	5.322 (-1.734; 12.398)
Model 2 (Adjusted) **	-0.660 (-1.852; 0.533)	-0.914 (-3.748; 1.921)	**12.177 (2.332; 22.022)**	6.337 (-0.840; 13.513)
Model 3 (Model 2 plus baseline adiposity) †	-0.657 (-1.850; 0.536)	-0.625 (-1.853; 0.604)	**13.105 (7.663; 18.547)**	**6.695 (2.106; 11.284)**
Age (years)				
Model 1 (crude)	**0.049 (0.003; 0.094)**	0.037 (-0.072; 0.146)	-0.092 (-0.478; 0.294)	0.175 (-0.114; 0.463)
Model 2 (Adjusted) **	**0.047 (0.001; 0.094)**	0.023 (-0.087; 0.132)	-0.070 (-0.451; 0.311)	0.249 (-0.051; 0.549)
Model 3 (Model 2 plus baseline adiposity) †	**0.047 (0.001; 0.094)**	0.017 (-0.030; 0.065)	-0.089 (-0.300; 0.121)	0.176 (-0.016; 0.369)
Education (years)				
Model 1 (crude)	0.110 (-0.034; 0.254)	0.293 (-0.038; 0.624)	0.621 (-0.568; 1.810)	0.093 (-0.757; 0.944)
Model 2 (Adjusted) **	0.102 (-0.041; 0.245)	0.255 (-0.083; 0.593)	0.917 (-0.260; 2.095)	0.403 (-0.444; 1.249)
Model 3 (Model 2 plus baseline adiposity) †	0.101 (-0.043; 0.244)	0.111 (-0.037; 0.259)	0.465 (-0.190; 1.120)	0.008 (-0.541; 0.558)
Physical activity (REF: no)				
Model 1 (crude)	0.645 (-0.433; 1.723)	2.065 (-0.396; 4.526)	4.022 (-4.818; 12.863)	0.285 (-6.218; 6.788)
Model 2 (Adjusted) **	0.309 (-0.794; 1.412)	1.808 (-0.813; 4.429)	2.549 (-6.555; 11.653)	-1.753 (-8.419; 4.912)
Model 3 (Model 2 plus baseline adiposity) †	0.300 (-0.811; 1.412)	0.692 (-0.453; 1.837)	-1.035 (-6.105; 4.036)	**-4.342 (-8.648; -0.037)**
Nutritional therapy duration (months)				
Model 1 (crude)	-0.205 (-0.838; 0.427)	-0.503 (-1.963; 0.957)	-0.749 (-5.921; 4.422)	2.297 (-2.716; 7.310)
Model 2 (Adjusted) **	-0.137 (-0.744; 0.469)	-0.168 (-1.609; 1.273)	0.430 (-4.575; 5.434)	3.202 (-1.755; 8.160)
Model 3 (Model 2 plus baseline adiposity) †	-0.140 (-0.747; 0.468)	-0.466 (-1.092; 0.160)	-0.528 (-3.299; 2.242)	-0.253 (-3.527; 3.021)
Baseline BMI				
Model 1 (crude)	0.025 (-0.075; 0.126)	**0.774 (0.670; 0.878)**	**2.389 (1.876; 2.902)**	**1.509 (1.110; 1.907)**
Model 2 (Adjusted) **	0.006 (-0.089; 0.101)	**0.752 (0.655; 0.850)**	**2.417 (1.986; 2.848)**	**1.566 (1.194; 1.939)**
Model 3 (Model 2 plus baseline adiposity) †	----	----	----	----

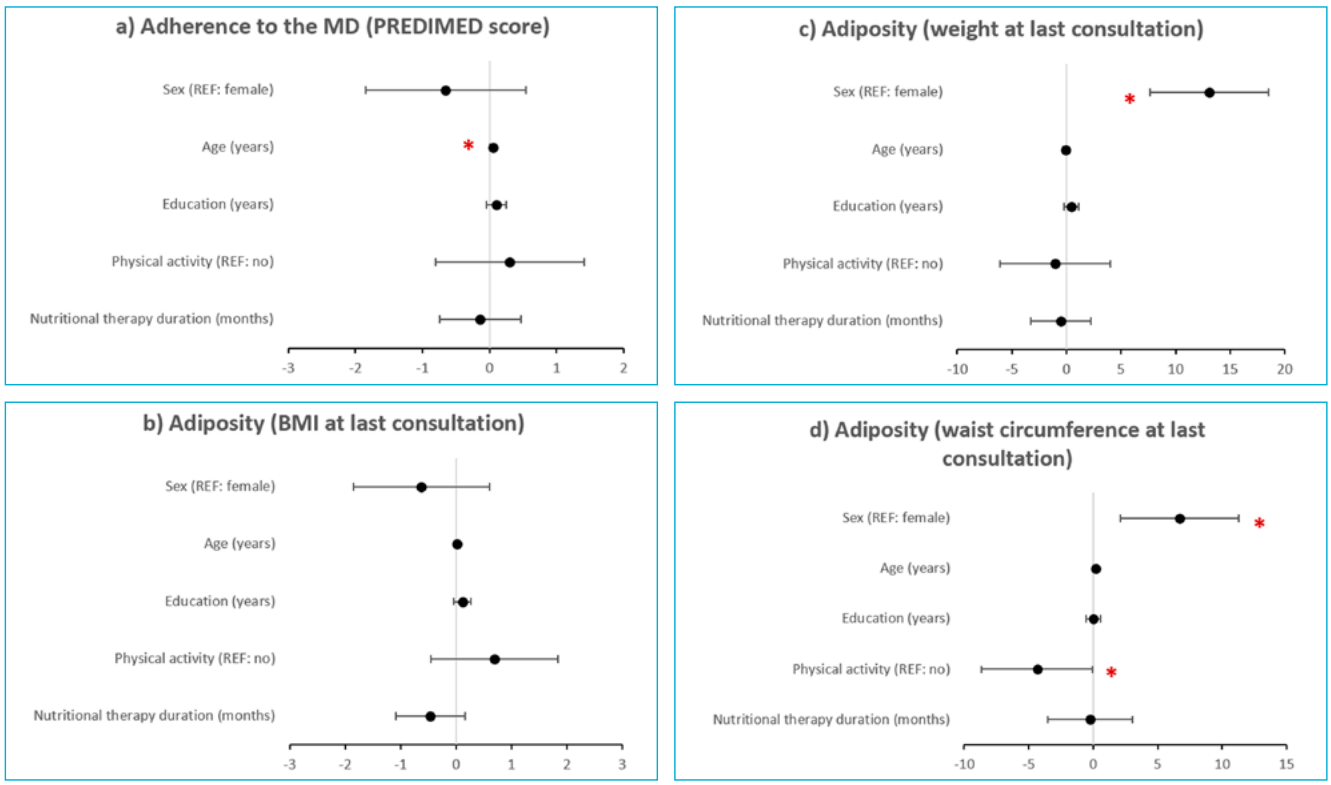
REF: reference class; BMI: body mass index; MD: Mediterranean diet; CI: confidence interval
* Significant associations are highlighted in bold (α level = 0.05)
** Model 2 was adjusted for sex, age, education, physical activity and nutritional therapy duration.
† Model 3 was adjusted for sex, age, education, physical activity, nutritional therapy duration and baseline BMI.

As displayed in Table 4, crude and adjusted linear regression models showed that age was significantly and positively associated with adherence to the MD (B = 0.047; 95% CI: 0.001;0.094). Male sex was associated with higher weight (B = 13.105; 95% CI: 7.663;18.547), as well as higher waist circumference (B = 6.695; 95% CI: 2.106;11.284) at the last nutrition appointment. Furthermore, structured physical activity was negatively and significantly associated with waist circumference at the last nutrition appointment (B = -4.342; 95% CI: -8.648;-0.037). These associations are visually summarized in Fig. 1.

As shown in Table 5, no association between current adherence to the MD and adiposity-related markers was observed.

DISCUSSION

The aim of this study was to evaluate adherence to a nutrition intervention (Mediterranean dietary pattern), as well as its association with adiposity. This study shows a moderate adherence to a healthy dietary pattern, the Mediterranean dietary pattern, and a reduction in adiposity-related parameters, including weight, BMI and waist circumference. Additionally, it highlights that patients' weight and BMI have not undergone sig-



REF: reference class; BMI: body mass index; MD: Mediterranean diet; CI: confidence interval *p value < 0.05

FIGURE 1. B (95% CI) of the associations between patients' characteristics and adherence to the MD and adiposity

nificant changes since the end of the treatment. Yet, no association was observed between adherence to the MD and adiposity (weight, BMI and waist circumference at the last nutrition consultation).

Consistent with these findings, a systematic review of randomized controlled trials conducted in 2017 indicated that dietetic consultations, provided by dietitians in primary health care, appear to be effective in improving diet quality, diabetes outcomes and weight loss outcomes.[18]

In the current study, participants attended on average a total of three consultations, and the mean duration of the follow-up was eight months. It has been documented that treatment duration is positively associated with weight loss.[19-21] In addition, future studies should explore potential factors associated with losses to follow-up in nutrition consultations as it has been documented that non-attendance rates in obesity treatment are high, and the determinants are complex.[22]

Results regarding changes in weight and BMI are consistent with findings from other observational studies, which have reported reductions in these markers following nutrition consultations.[12,20,21] A systematic review and meta-analysis of randomized controlled trials published in 2019 showed that individualized nutrition care provided by a dietitian, when compared to minimal or no intervention, appears to be more effective for weight loss.[23]

Despite the changes in anthropometric outcomes, significant differences in skeletal muscle mass and body fat were not observed. This may be due to the smaller sub-sample of participants for whom these parameters were recorded, namely, low statistical power to show an association between MD and accurate adiposity measures. Unfortunately, the instrument for assessing these outcomes was not always available, and the prerequisites for performing this analysis were not met in all consultations.

Since the conclusion of the nutrition follow-up, weight and BMI regain were not observed, suggesting that participants have maintained their weight. However, the current weight was self-reported, which could have been underestimated by some participants. It has been documented that, after a weight loss diet, only 25% of patients manage to maintain the weight loss.[24] However, it has been reported that weight loss maintenance may get easier over time, after 2 to 5 years of maintenance.[25] Successful weight loss maintenance has been associated with high levels of physical activity, consuming a low-calorie and low-fat diet, eating breakfast, monitoring weight regularly, low levels of depression, reduced disinhibition, result satisfaction and long-term group help.[24,25] A recent systematic re-

TABLE 5. Association between adherence to the MD (PREDIMED score) and adiposity

	Adiposity (BMI in the last consultation)	Adiposity (weight in the last consultation)	Adiposity (waist circumference in the last consultation)
	B (95% CI)	B (95% CI)	B (95% CI)
PREDIMED score			
Model 1 (crude)	0.218 (-0.401; 0.838)	0.325 (-1.868; 2.519)	0.113 (-1.517; 1.743)
Model 2 (Adjusted) *	-0.029 (-0.669: 0.611)	0.592 (-1.625; 2.808)	-0.048 (-1.74; 1.645)
Model 3 (Model 2 plus baseline adiposity) **	-0.065 (-0.342; 0.212)	0.475 (-0.746; 1.696)	0.290 (-0.792; 1.372)
PREDIMED score			
Model 1 (crude)			
Low adherence (score ≤ 5)	REF	REF	REF
Moderate adherence (score 6-9)	0.184 (-3.029; 3.396)	1.146 (-10.267; 12.560)	-2.337 (-11.464; 6.790)
High adherence (score ≥10)	2.529 (-2.422; 7.480)	6.330 (-11.259; 23.919)	0.823 (-12.085; 13.731)
Model 2 (Adjusted)			
Low adherence (score ≤ 5)	REF	REF	REF
Moderate adherence (score 6-9)	-0.387 (-3.537; 2.763)	-1.314 (-12.205; 9.577)	-4.371 (-13.181; 4.439)
High adherence (score ≥10)	1.103 (-3.769; 5.976)	6.062 (-10.784; 22.907)	0.853 (-11.846; 13.552)
Model 3 (Model 2 plus baseline adiposity)			
Low adherence (score ≤ 5)	REF	REF	REF
Moderate adherence (score 6-9)	-0.719 (-2.045; 0.608)	-2.379 (-8.241; 3.483)	-3.359 (-8.821; 2.102)
High adherence (score ≥10)	0.877 (-1.174; 2.928)	5.335 (-3.729; 14.398)	3.018 (-4.862; 10.899)
PREDIMED score			
Model 1 (crude)			
1st tercile (score ≤ 6)	REF	REF	REF
2nd tercile (score 7 - 8)	-0.789 (-3.854; 2.276)	-5.144 (-15.979; 5.691)	-4.204 (-12.028; 3.620)
3rd tercile (score ≥ 9)	1.029 (-1.915; 3.972)	0.069 (-10.336; 10.475)	1.331 (-6.177; 8.839)
Model 2 (Adjusted)			
1st tercile (score ≤ 6)	REF	REF	REF
2nd tercile (score 7 - 8)	-1.016 (-4.080; 2.047)	-2.505 (-13.119; 8.109)	-4.736 (-12.304; 2.832)
3rd tercile (score ≥ 9)	-0.219 (-3.371; 2.933)	2.411 (-8.509; 13.332)	1.440 (-6.363; 9.243)
Model 3 (Model 2 plus baseline adiposity)			
1st tercile (score ≤ 6)	REF	REF	REF
2nd tercile (score 7 - 8)	-1.057 (-2.358; 0.244)	-2.635 (-8.413; 3.143)	-3.477 (-8.199; 1.244)
3rd tercile (score ≥ 9)	-0.284 (-1.623; 1.055)	2.203 (-3.742; 8.147)	2.275 (-2.588; 7.137)

REF: reference class; BMI: body mass index; MD: Mediterranean diet
* Model 2 was adjusted for sex, age, education, physical activity and nutritional therapy duration.
** Model 3 was adjusted for sex, age, education, physical activity, nutritional therapy duration and baseline BMI.

view of prospective cohort studies found that adhering to the MD was significantly associated with less weight gain during a 5-year follow-up period.[26]

Given that there were no statistically significant differences between weight at the last consultation and current self-reported weight, and given the higher accuracy of measurements done by a nutrition professional, we evaluated the association between adherence to the MD and adiposity-related markers at the last consultation.

The PREDIMED trial documented strong inverse linear associations between the PREDIMED questionnaire and adiposity indexes in 7447 adults at high cardiovascular risk.[5] Furthermore, in a longitudinal analysis that followed a sub-sample (n=7009) of the PREDIMED trial participants for a median time of 4.8 years, the authors found that the consumption of some ultra-processed foods, refined carbohydrates, potatoes, red meat and alcohol was associated with a greater weight gain and waist circumference, while consumption of low-fat dairy products and plant-based foods was associated with lower weight and waist circumference regain.[27] However, our study did not find any association between adherence to the MD and adiposity-related markers (BMI, weight and waist circumference at the last nutrition consultation), neither with the continuous variable of the PREDIMED score nor

with the categorical variable of the original cut-offs reported in the PREDIMED trial.[5] Also, there was no association between the exposure and the outcome when using a categorical variable based on the terciles of our sample. Although adherence to the MD is recognized as an important determinant of adiposity, other factors, such as genetic predisposition, medication, stress and other environmental factors, can influence adiposity. We have adjusted models for sex, age, education, physical activity, nutritional therapy duration and baseline BMI. However, residual confounding is still possible. Another possibility for not observing an association between MD and adiposity is low statistical power that may have precluded observation of significant associations.

This study has limitations that must be discussed. Selection bias, social desirability bias and recall bias may have underestimated the magnitude of the association. Recruiting patients only in this private hospital could have led to a sample that is more health-conscious or motivated to make dietary changes, potentially not representing the broader population accurately, which could limit the external validity of our findings. Social desirability bias could also be a concern in this study, as participants may have been inclined to provide responses in the survey that align with socially acceptable dietary habits, potentially leading to over-reporting of healthy eating practices or under-reporting of less desirable dietary behaviours. Recall bias could also be present, considering participants may have had difficulty accurately recalling and reporting their dietary choices, leading to inaccuracies. Another limitation of the current study was the missing data regarding weight loss medication. Although medication use was assessed through both the online questionnaire and clinical records, we were not able to retrieve updated, detailed information on specific pharmacological treatments for weight loss. As such, confounding by pharmacological therapy cannot be excluded. The small sample size may have precluded enough statistical power to observe an association between adherence to the MD and adiposity. Still, we had enough statistical power to show significant associations between adherence to the MD and age, and between adiposity-related markers and sex, as well as physical activity.

Although we initially intended to include cardiometabolic parameters as another measure of patient outcomes, we were unable to incorporate this data into the analysis due to the incomplete information in clinical records. Biochemical data were only available if the blood-sample collection and analysis was conducted at the hospital or if the patient brought the results with them to the nutrition consultation. Therefore, the lack of biochemical data could be attributed to the fact that many patients were unaware of the importance of biochemical data in a nutritional care plan and, as a result, did not bring these reports with them during the initial consultation. Hospitals and clinics must raise awareness for the importance of blood results in nutritional care.

In conclusion, this study shows a moderate adherence to the MD and a reduction of adiposity-related markers after individualised nutritional treatment for patients with overweight and obesity. Additionally, it suggests that these changes are maintained after a year and 10 months, even with a relatively low average of follow-up consultations (8 months). Therefore, patients with overweight and obesity should be appropriately referred to a nutrition professional to receive an intervention tailored to their needs and preferences, facilitating dietary changes that are effective, safe and sustainable for long-term adherence.

CONTRIBUTORSHIP STATEMENT/ DECLARAÇÃO DE CONTRIBUIÇÃO

CP and CT - Study design, data analysis, drafted the initial manuscript, edited and revised the manuscript.

GR, IM AND CC - Edited and revised manuscript.

All authors and approved the final version to be published

CP e CT - Desenho do estudo, análise de dados, redação do manuscrito inicial, edição e revisão do manuscrito.

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