



Associations between motivation and different aspects of physical exercise in individuals who maintained weight loss

Associações entre a motivação e diferentes aspectos do exercício físico em indivíduos que mantiveram a perda de massa corporal

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ABSTRACT

The objective of this study was to analyze the association between motivation and various aspects of physical exercise in individuals who maintained weight loss, and to explore the role of gender. The sample consisted of 253 participants, and their sociodemographic characteristics, body composition, physical exercise, and general and specific motivation for exercise were assessed using validated instruments. The t-test was used to compare various variables between participants. Pearson's correlation coefficient was used to analyze the association between motivational variables and different aspects of physical exercise. Motivational variables were divided into tertiles, and the means of various aspects of physical exercise were compared between tertiles using one-way ANOVA. Differences between genders were observed in terms of intensity, duration, energy expenditure, and most motivational variables, favoring males. Positive associations were identified between motivational variables related to exercise, specifically intrinsic motivation and more autonomous regulations, and different aspects of physical exercise in the total sample and among females ($p < 0.05$). In individuals who successfully maintained weight loss, particularly women, more autonomous motivations for exercise were associated with greater physical exercise. These findings are significant for weight loss and health promotion programs, indicating that autonomous motivation may be a factor in successful weight maintenance.

Keywords: Physical activity; Motivation; Weight management.

RESUMO

O objetivo deste estudo foi analisar a associação entre a motivação e vários aspectos da prática de exercício físico (EF) em indivíduos que mantiveram a perda de massa corporal, e explorar o papel do gênero. A amostra foi constituída por 253 participantes, foram avaliadas as suas características sociodemográficas, a composição corporal, o EF, a motivação geral e específica para o exercício, com instrumentos validados. Utilizou-se o teste t-de student de independência para comparar as diversas variáveis entre os participantes. Para analisar a associação entre as variáveis motivacionais e os diferentes aspectos do EF, utilizou-se o coeficiente de correlação de Pearson. Foram ainda criados tercios para as variáveis motivacionais e posteriormente comparadas as médias dos vários aspectos do EF entre tercios, através do teste one-way ANOVA. Observaram-se diferenças entre gêneros no que respeita à intensidade, duração e dispêndio energético e na maioria das variáveis motivacionais, favorecendo o gênero masculino. Identificaram-se associações positivas entre as variáveis motivacionais relacionadas com o exercício, nomeadamente a motivação intrínseca e as regulações de ordem mais autónoma, e os diferentes aspectos do EF, na amostra total e no gênero feminino ($p < 0,05$). Em indivíduos com sucesso na manutenção da perda de massa corporal, particularmente nas mulheres, motivações mais autónomas para o exercício associaram-se a maior prática de EF. Essas conclusões são significativas para programas de perda de massa corporal e promoção de saúde, indicando que a motivação autónoma pode ser um fator de sucesso na manutenção da massa corporal.

Palavras-chave: Atividade física; Motivação; Gestão da massa corporal.

Introduction

The maintenance of long-term weight loss is a major challenge for most people diagnosed with obesity¹⁻³. Although many individuals can lose weight, most fail to maintain the loss and eventually regain it over the

long term^{1,2,4,5}. Studies indicate that engaging in physical exercise (PE) is crucial for preventing body mass regain and that individuals who exercise more effectively maintain the weight lost in the long term⁶. Similar to weight control registries in other countries, the Nation-



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al Weight Control Registry (NWCR) of Portugal aims to study the success of long-term weight loss maintenance and has shown positive associations between PE practice and the maintenance of weight loss^{7,8}.

Furthermore, psychosocial factors, such as motivation, play an important role in the adoption and maintenance of health behaviors that contribute to long-term body mass management^{5,7,9}. The Self-Determination Theory (SDT) offers a theoretical explanation for sustaining health behaviors over the long term, promoting body mass management¹⁰⁻¹². According to SDT, motivation ranges from more controlled forms to more autonomous forms. It has been shown that more autonomous behavioral regulations, such as identified and integrated motivation, are associated with better weight control^{5,9}.

This study applies SDT to analyze how motivation contributes to various aspects of PE practice in individuals who have successfully maintained weight loss^{1,4}. The main objective is to verify the associations between motivation and PE practice (weekly frequency, intensity, duration, and energy expenditure). The secondary objective is to identify gender differences in these associations. Evidence suggests that different forms of motivation may predict various aspects of PE practice distinctly and that there are gender differences in how motivation influences this practice.

Methods

The sample of the present study consists of 253 participants from the NWCR. The inclusion criteria for the NWCR included: having Portuguese nationality; being between 18 and 65 years old; having successfully lost at least 5 kg and maintained that weight loss for at least one year. The criterion of 5 kg weight loss was chosen because it represents more than 5% of weight loss for most overweight individuals in Portugal, aligning with the values that the literature indicates have significant health benefits¹⁴.

The exclusion criteria were weight loss that occurred more than 15 years ago or occurred in childhood/adolescence (<18 years). Participants were recruited through information on the NWCR website and social media (Facebook and Instagram), with instructions to register for the NWCR. People who expressed interest in participating in the NWCR, through message or email, are invited to contact the project team, and a screening is conducted via questionnaire. After verifying eligibility criteria, individuals were invited to participate in the study

and are asked to sign the informed consent document.

Participation in the NWCR involved two evaluation moments: one initial moment (at the start of the study) and another after one year of study entry. Both evaluation moments were conducted at the Exercise and Health Laboratory of the Faculty of Human Kinetics and involve completing a battery of psychometric questionnaires and history of weight, assessing diet and PE (subjectively and objectively), and anthropometric evaluation (weight, height, and waist circumference). The NWCR was approved by the Ethics Committee of the Faculty of Human Kinetics at the University of Lisbon.

In the present study, variables collected only at the initial evaluation moment (baseline) were used. Socio-demographic information collected through the main questionnaire (e.g., gender, age) and information related to body composition (weight and height) collected objectively was used. Current weight and previous maximum weight (obtained by self-report) were used to calculate the magnitude of weight lost, and current weight and height were used to calculate the Body Mass Index (BMI).

Regarding PE evaluation, the 7-day Physical Activity Recall (7-d PAR)^{15,16} was used, which consists of a self-reported assessment of physical activity in the last 7 days (or a typical week of the last month, if the last week was atypical), allowing assessment of the type of PE, its duration, intensity, and energy expenditure. In the present study, the following variables were analyzed: weekly frequency of PE, intensity (mean metabolic equivalent-METs per PE session), energy expenditure (Kcal/week), and duration (min/week of moderate and vigorous PE).

Regarding psychometric evaluation, the Self-Determination Scale¹⁷ was used to assess the degree of general self-determination. This scale encompasses 10 pairs of statements, such as “I always feel that I choose the things I do” vs. “sometimes I feel that it is not really me who chooses the things I do”; scores are obtained by summing the ratings of items for each subscale, with higher results indicating greater levels of self-determination. The Basic Need Satisfaction Scale¹⁸ was also used to assess the satisfaction of basic psychological needs. This scale is composed of 21 items, such as “I really like the people I relate to”, rated on a Likert scale of 1-7 points (1 = Not true at all, 7 = Very true).

To assess motivation for exercise, the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2)¹⁹

was used. This questionnaire consists of 19 items that evaluate five types of exercise regulation using five subscales (i.e., amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation). It uses a 5-point Likert scale (0 = definitely not, 4 = definitely yes), and for each subscale, the mean score of the items is calculated. Additionally, the Intrinsic Motivation Inventory (IMI)^{20,21} was used to assess intrinsic motivation for exercise, consisting of 16 items related to enjoyment, competence, involvement (or lack thereof), and pressure for exercise, rated on a 5-point scale ranging from “strongly disagree” to “strongly agree.” Scores are obtained by averaging the items for each dimension, where higher scores indicate greater levels of intrinsic motivation.

Statistical analysis was performed using IBM SPSS software (version 28). For descriptive statistics, the mean and standard deviation were calculated for quantitative variables and absolute and relative frequencies for qualitative variables. Variables were tested for normality of distribution using the Kolmogorov-Smirnov test. To compare various variables between participants of different genders, the independent t-test was used for variables with a normal distribution, and the non-parametric alternative was used for variables with a non-normal distribution. To test the association between motivational variables and different aspects of PE, Pearson's correlation coefficient was used for normally distributed variables and Spearman's correlation coefficient for non-normally distributed variables. Since parametric tests are robust to deviations from normality in relatively large samples²², and considering that differences between parametric and non-parametric comparison and association tests were minimal, only the results of the parametric tests are reported.

Tertiles were also created for the motivational variables, and subsequently, the means of the various aspects of PE were compared between tertiles using one-way ANOVA with Bonferroni post-hoc tests. A significance level of 5% ($p < 0.05$) was assumed.

Results

Table 1 presents the characteristics of the participants, divided by gender. The sample included 59% women ($n = 148$) and 41% men ($n = 101$). Most were married or living in a common-law relationship (54.2%) and had completed higher education (71.5%). It was observed that men were, on average, older than women (40.6 ± 10.4 vs. 37.8 ± 11.1 years, $p = 0.049$). Additionally, men

showed greater weight, height, and BMI ($p < 0.05$).

Significant differences between genders were observed in the intensity, duration, and energy expenditure of PE, with men showing higher values ($p < 0.05$). Significant differences were found between genders in the variables of self-determination, intrinsic motivation, amotivation, identified motivation, and autonomous motivation. Men had higher scores ($p < 0.05$), except in amotivation, where women showed higher values (0.4 ± 1.2 vs. 1.0 ± 2.4 , $p = 0.009$).

Table 2 presents the correlation coefficients between aspects of PE and motivational variables. BMI showed a negative correlation with the intensity of PE in both the total sample ($r = -0.21$, $p = 0.005$) and in women ($r = -0.24$, $p = 0.012$). Regarding general motivation, the perception of positive relationships was positively correlated with the weekly frequency of PE in the total sample ($r = 0.19$, $p = 0.009$) and in females ($r = 0.25$, $p = 0.006$), and negatively with the intensity of PE ($r = -0.2$, $p = 0.039$). Concerning motivation for exercise, consistent positive correlations were observed between various dimensions of intrinsic motivation and more autonomous behavioral regulations (identified and autonomous motivation) with several aspects of PE in the total sample and females ($p < 0.05$), except for intensity. In males, positive correlations were identified between specific dimensions of intrinsic motivation and the duration and energy expenditure of PE.

The various aspects of PE based on total intrinsic motivation and autonomous motivation are shown in Figures 1 and 2. Regarding intrinsic motivation, individuals in the third tertile expended more kcal per week in PE ($p < 0.001$), engaged in more frequent and longer PE sessions ($p = 0.009$ and $p < 0.001$, respectively), and with greater intensity ($p = 0.001$) compared to the first tertile. Individuals in the second tertile expended fewer kcal per week in PE ($p = 0.002$), engaged in fewer minutes ($p = 0.006$), and with lower intensity ($p = 0.007$) compared to the third tertile. In females, women in the third tertile expended more kcal per week in PE ($p < 0.001$) and engaged in more frequent and longer PE sessions ($p = 0.009$ and $p < 0.001$) compared to the first tertile. Women in the second tertile expended fewer kcal per week ($p < 0.001$) and engaged in less frequent PE ($p = 0.009$) compared to the third tertile.

Regarding autonomous motivation, individuals in the third tertile expended more kcal per week in PE ($p < 0.001$), engaged in more frequent and longer PE sessions ($p = 0.007$ and $p < 0.001$) compared to the

Table 1 – Sociodemographic Characteristics, Physical Exercise Aspects, and Motivation of Participants in the National Weight Control Registry

	Women (n = 148)	Men (n = 101)	p-value *
	n (%)	n (%)	
Sociodemographic Characteristics			
Educational Level			
Higher education	107 (72.8)	69 (69.7)	0.583**
Secondary education	34 (23.1)	23 (23.2)	
Less than secondary education	6 (4.1)	7 (7.1)	
Marital Status			
Married	44 (29.7)	47 (47.5)	0.025**
Living together (common law)	27 (18.2)	16 (16.2)	
Single	59 (39.9)	22 (22.2)	
Divorced	16 (10.8)	13 (13.1)	
Widowed	2 (1.4)	1 (0.4)	
	Mean ± SD (n)	Mean ± SD (n)	
Age (yy)	37.8 ± 11.1 (146)	40.6 ± 10.4 (100)	0.049***
Weight and Body Composition			
BMI (kg/m ²)	26.21 ± 4.48 (133)	27.48 ± 3.59 (89)	0.026***
Weight (kg)	69.13 ± 11.85 (133)	82.71 ± 11.6 (89)	<0.001***
Height (m)	1.63 ± 0.07 (134)	1.73 ± 0.06 (89)	<0.001***
Aspects of Physical Exercise			
Intensity (METs/session)	7.63 ± 5.02 (109)	9.48 ± 4.43 (74)	0.009***
Frequency (weekly)	4.30 ± 2.05 (118)	4.62 ± 1.98 (78)	0.283
Duration (min/week)	304.69 ± 224.97 (118)	374.69 ± 256.58 (77)	0.046***
Energy Expenditure (Kcal/week)	1754.98 ± 1430.90 (114)	3421.75 ± 2834.16 (74)	<0.001***
General Motivation			
Perception of Autonomy (score)	37.7 ± 6.0 (146)	37.5 ± 5.8 (101)	0.777
Perception of Competence (score)	32.0 ± 5.6 (146)	32.7 ± 5.2 (101)	0.341
Perception of Positive Relationships (score)	45.4 ± 6.5 (146)	44.5 ± 6.9 (101)	0.317
SD Self-Awareness (score)	20.0 ± 4.1 (144)	21.2 ± 3.2 (99)	0.012***
SD Perceived Choice (score)	18.7 ± 3.9 (144)	18.9 ± 4.2 (99)	0.697
SD Total Autonomy (score)	38.7 ± 6.5 (144)	40.1 ± 6.1 (99)	0.086
Motivation Related to Exercise			
IM: Pleasure/Interest (score)	16.4 ± 3.0 (145)	17.1 ± 2.8 (99)	0.067
IM: Perceived Competence (score)	14.9 ± 3.1 (145)	15.5 ± 2.4 (99)	0.087
IM: Tension/Pressure (score)	16.6 ± 2.7 (145)	17.0 ± 2.3 (99)	0.227
IM: Effort/Importance (score)	15.6 ± 3.2 (145)	16.4 ± 2.5 (99)	0.017***
IM: Total Score (score)	63.5 ± 9.9 (145)	66.1 ± 7.9 (99)	0.033***
SR-E: Amotivation (score)	1.0 ± 2.4 (148)	0.4 ± 1.2 (101)	0.009***
SR-E: External (score)	1.5 ± 2.4 (148)	1.3 ± 2.5 (101)	0.420
SR-E: Introjected (score)	4.8 ± 3.2 (148)	5.1 ± 3.1 (101)	0.463
SR-E: Identified (score)	12.0 ± 2.9 (148)	13.3 ± 2.1 (101)	<0.001***
SR-E: Intrinsic (score)	12.2 ± 3.9 (148)	13.4 ± 2.9 (101)	0.007***
Autonomous Motivation (Identified + Intrinsic) (score)	24.2 ± 6.1 (148)	26.7 ± 4.3 (101)	<0.001***
Controlled Motivation (External + Introjected) (score)	6.3 ± 4.5 (148)	6.3 ± 4.4 (101)	0.936

Note: BMI = Body Mass Index; Kcal = Kilocalorie; SD = Self-Determination; IM = Intrinsic Motivation; SR-E = Self-Regulation for Exercise; *Independent Student's t-test; **Pearson's Chi-Square Test; ***With Statistical Significance.

first tertile. Individuals in the second tertile expended fewer kcal per week ($p < 0.001$) and engaged in fewer minutes ($p = 0.030$) compared to the third tertile. In females, the pattern followed the total sample. However,

Table 2 – Bivariate Correlations Between Physical Exercise Aspects and Motivational Variables in the Total Sample and by Gender

	Intensity (METs/session)			Frequency (weekly)			Duration (min/week)			Energy Expenditure (Kcal/ week)		
	Total	Women (n = 109)	Men (n = 74)	Total	Women (n = 118)	Men (n = 78)	Total	Women (n = 118)	Men (n = 78)	Total	Women (n = 118)	Men (n = 78)
Weight and Body Composition												
BMI	-0.21**	-0.24*	-0.22	-0.02	0.01	-0.12	0.02	-0.02	0.04	0.05	0.04	-0.03
General Motivation												
Perception of Autonomy	0.04	-0.12	0.4	0.14	0.15	0.13	0.09	0.11	0.06	0.07	0.03	0.12
Perception of Competence	-0.14	-0.14	0.14	-0.01	-0.02	-0.007	0.04	0.05	-0.001	-0.01	-0.03	-0.05
Perception of Positive Relationships	-0.1	-0.2*	0.48	0.19**	0.25**	0.09	0.1	0.15	0.1	0.08	0.06	0.13
Self-Awareness (SD)	0.03	-0.01	0.78	-0.02	-0.04	-0.05	0.02	0.03	-0.1	0.05	-0.004	-0.03
Perceived Choice (SD)	0.03	-0.01	0.53	-0.07	-0.14	0.01	0.06	0.02	0.1	0.09	0.02	0.13
Total Autonomy (SD)	0.04	-0.02	0.57	-0.06	-0.11	-0.02	0.04	0.03	0.04	0.08	0.01	0.08
Motivation Related to Exercise												
IM: Pleasure/Interest	0.03	0.6	0.03	0.3**	0.39**	0.12	0.35**	0.39**	0.28*	0.33**	0.39**	0.3**
IM: Perceived Competence	0.21**	0.23*	0.14	0.23**	0.31**	0.07	0.24**	0.36**	0.02	0.26**	0.35**	0.19
IM: Tension/Pressure	0.06	0.03	0.11	0.22**	0.25**	0.15	0.27**	0.3**	0.22	0.23**	0.21*	0.25*
IM: Effort/Importance	0.23**	0.26**	0.15	0.28**	0.38**	0.07	0.35**	0.43**	0.18	0.34**	0.46**	0.27*
IM: Total Score	0.16*	0.18	0.11	0.31**	0.41**	0.13	0.37**	0.45**	0.22	0.36**	0.43**	0.32**
SR-E: Amotivation	0.01	0.003	0.1	-0.21**	-0.27**	-0.03	-0.25**	-0.29**	-0.15	-0.2**	-0.25**	-0.15
SR-E: External	-0.01	-0.002	-0.002	-0.12	-0.1	-0.13	-0.18*	-0.21**	-0.13	-0.13	-0.12	-0.15
SR-E: Introjected	0.003	-0.03	0.03	0.02	0.03	0.007	-0.02	-0.01	-0.04	0.05	0.1	-0.01
SR-E: Identified	0.19**	0.16	0.16	0.25**	0.34**	0.04	0.28**	0.32**	0.16	0.34**	0.36**	0.26*
SR-E: Intrinsic	0.07	0.08	0.03	0.30**	0.43**	0.04	0.31**	0.37**	0.19	0.29**	0.38**	0.22
Autonomous Motivation	0.14	0.13	0.1	0.32**	0.43**	0.05	0.34**	0.39**	0.21	0.35**	0.41**	0.28*
Controlled Motivation	-0.003	-0.02	0.02	-0.05	-0.04	-0.07	-0.11	-0.12	-0.1	-0.04	0.007	-0.09

BMI = body mass index; MET = metabolic equivalent; Kcal = kilocalorie; Total = Total sample; SD = Self-determination; IM = Intrinsic motivation; SR-E = Self-regulation for exercise; * $p < 0.05$, ** $p < 0.01$.

er, women in the second tertile expended fewer kcal per week ($p = 0.020$) and engaged in less frequent PE ($p = 0.006$) compared to the third tertile. In males, significant differences were observed only in energy expenditure, with men in the third tertile expending more kcal per week ($p = 0.040$) compared to the second and first tertiles.

Discussion

This study is the first to analyze the association between different types of motivation and various aspects of PE weekly frequency, intensity, duration, and energy expenditure – in individuals who have successfully maintained long-term weight loss, revealing interesting results but should be interpreted in light of certain limitations and the available knowledge.

A significant limitation is the unbalanced sample composition, with 59% women and 41% men. This dis-

crepancy may influence the results, particularly the observed differences between genders in the associations between motivation and PE. Literature suggests that men and women may respond differently to different types of motivation, and a more balanced sample could provide a clearer view of these differences.

Furthermore, it would be interesting to have data from individuals who did not maintain weight loss to compare with those who succeeded. However, this study specifically focuses on the motivational associations in individuals who managed to maintain weight, not on the comparison between those who succeeded and those who did not. This approach limits the generalization of the results but offers a detailed view of the motivational characteristics associated with successful weight maintenance.

Another limitation is the study design. Being a cross-sectional study limits the ability to establish cau-

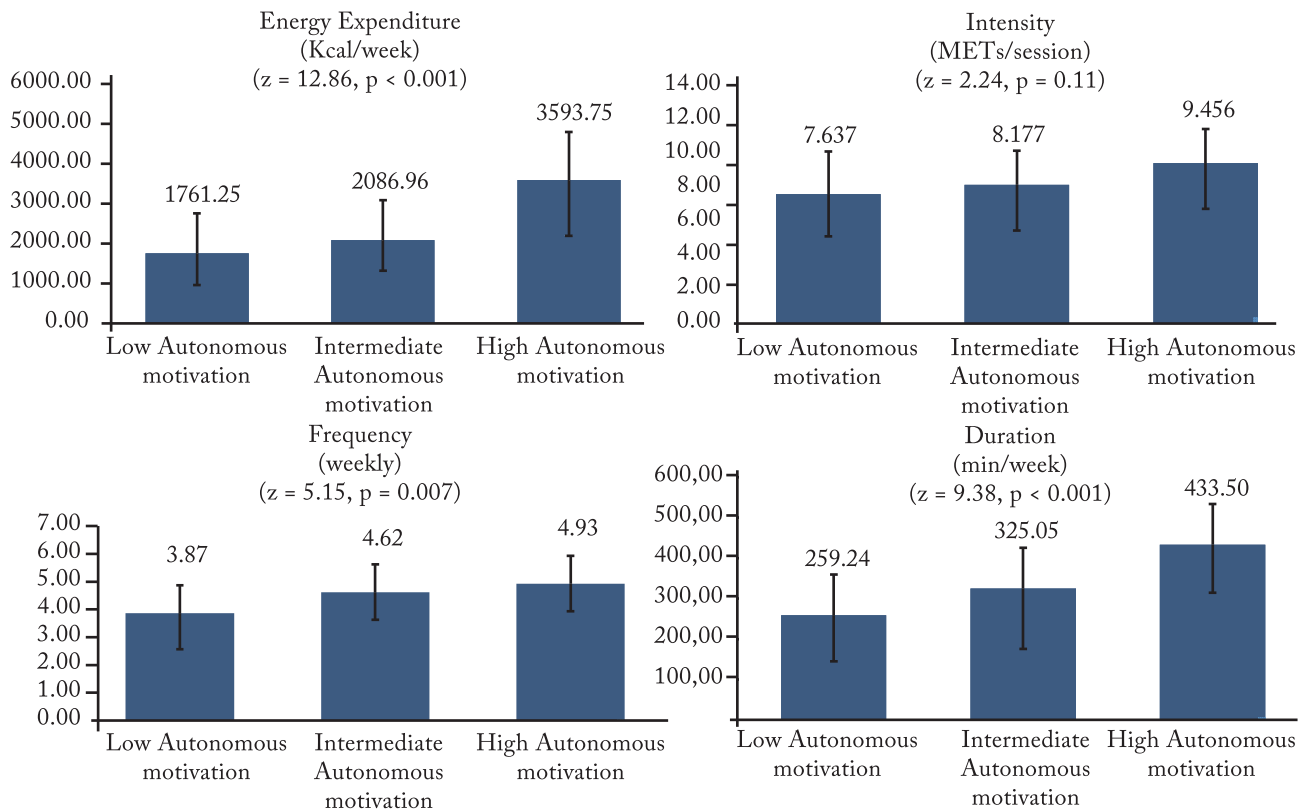


Figure 1 – Aspects of physical exercise according to total intrinsic motivation
 Kcal = kilocalorie; MET = metabolic equivalent; IMI = Intrinsic Motivation Inventory

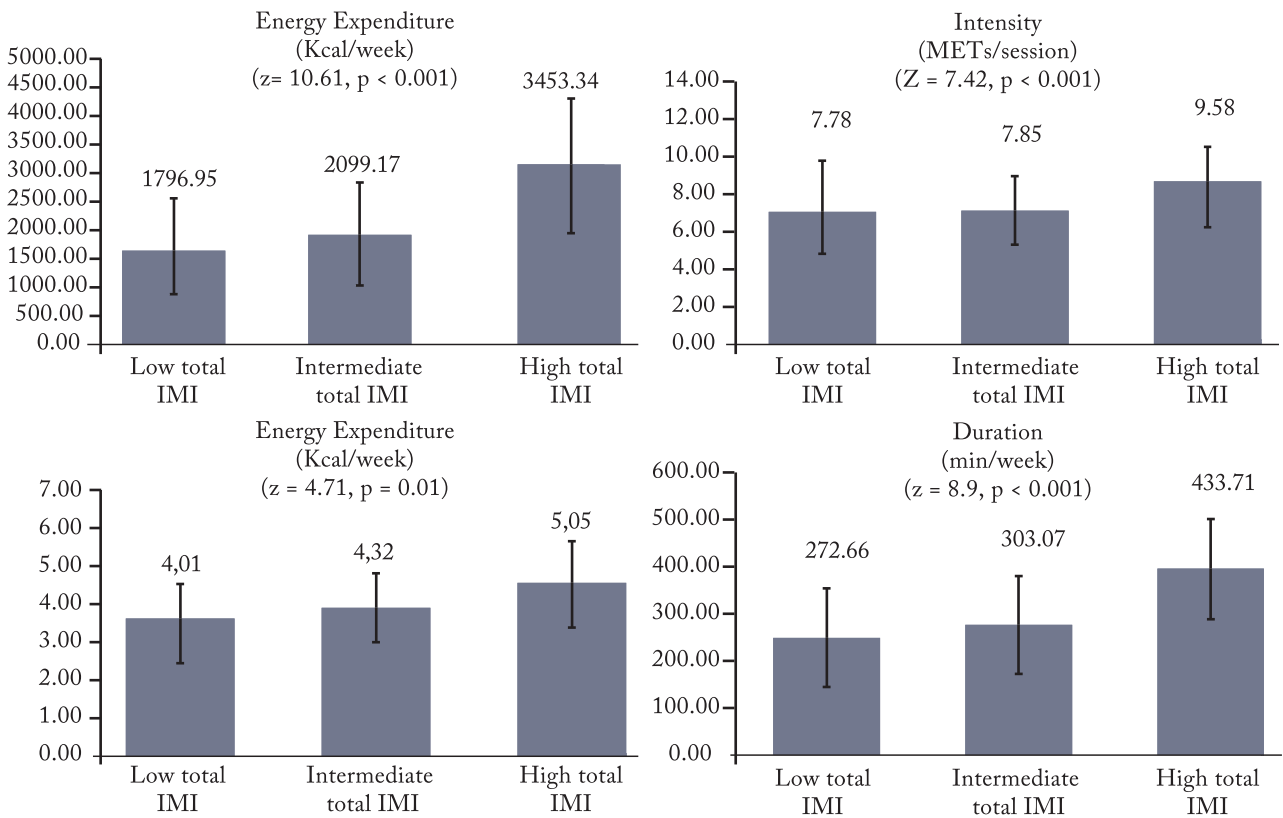


Figure 2 – Aspects of physical exercise according to autonomous motivation
 Kcal = kilocalorie; MET = metabolic equivalent; IMI = Intrinsic Motivation Inventory

sality between motivation and PE practice. Longitudinal studies would be needed to confirm if changes in motivation directly influence PE over time.

The results of this study are consistent with the SDT which highlights the importance of more autonomous motivations for sustainable and high-quality behaviors^{18,23,24}. Previous studies have also shown that intrinsic motivation is strongly associated with greater PE practice, while amotivation and external motivation are negatively associated with the amount of PE practiced in other populations²⁵⁻³¹.

In the present study, a consistent pattern of positive associations was observed between the dimensions of intrinsic motivation and PE, particularly among women. This association was not as strong among men, where only energy expenditure correlated positively with autonomous motivation. This result can be partially explained by differences in PE averages and motivation levels between genders, aligning with data from the World Health Organization, which shows that men tend to be more physically active than women^{3,4}.

Contrary to the findings of Duncan et al.¹³, who identified positive associations between more autonomous motivations and various aspects of PE regardless of gender, this study found that in women, an autonomous motivational profile is positively associated with all aspects of PE, while in men, this association was limited to energy expenditure.

The results reinforce the importance of fostering intrinsic and autonomous motivation in intervention programs for maintaining weight loss. Strategies that increase perceived enjoyment and challenge in PE and align activities with individuals' values and interests can be effective. For women, promoting a wide range of autonomous motivation aspects can be crucial, while for men, focusing on strategies that specifically increase energy expenditure may be more beneficial.

This study contributes to the understanding of the complex relationship between motivation and PE in individuals who have successfully maintained weight loss, highlighting the need for personalized approaches to promote PE. Future studies should consider more gender-balanced samples and utilize longitudinal designs to explore these associations more robustly. Additionally, integrating strategies that promote intrinsic and autonomous motivation in intervention programs may be key to increasing participation and maintenance of PE in this population.

Conflict of Interest

The authors declare no conflicts of interest.

Author Contributions

Pinto M: Conceptualization; Methodology; Development, implementation, and software testing; Data and experiment validation; Data analysis; Research; Tool provision; Data curation; Presentation design; Manuscript writing; Approval of the final manuscript version. Santos I: Conceptualization; Methodology; Tool provision; Supervision; Presentation design; Manuscript writing; Approval of the final manuscript version.

Declaration Regarding the Use of Artificial Intelligence Tools in Writing the Article

No artificial intelligence tools were used in the preparation of this manuscript.

Data Availability and Other Materials

The content underlying the research text is contained within the manuscript.

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