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ORIGINAL RESEARCH

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Physical activity levels affect mental health and behavior in men

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Abstract

Psychological, nutritional, oral health, and physical activity habits are behavioral factors previously linked to depression. The objective of this study was to analyze differences in behavioral patterns, in terms of psychological, nutritional, oral health, and physical activity habits, in a sample of men. Six hundred and five men (36.7 ± 15 years, 25.7 ± 4.3 kg/m^2) were interviewed through an online questionnaire due to the pandemic. A compendium of factors related to psychological parameters, oral health, nutritional habits, and physical activity was analyzed through a set of online questionnaires. We found that participants with higher levels of both aerobic and self-loading physical activity generally demonstrated better nutritional habits, including higher water intake ($p < 0.001$; Effect Size (ES) = 0.62 and $p < 0.001$; ES = 0.69, respectively), higher weekly consumption of meat ($p = 0.007$; ES = 3.10 and $p < 0.001$; ES = 0.40, respectively), fish ($p < 0.001$; ES = 3.13 and $p = 0.023$; ES = 0.22, respectively), eggs ($p = 0.002$; ES = 2.80 and $p = 0.002$; ES = 0.30, respectively), greater vitality ($p < 0.001$; ES = 0.50 and $p = 0.006$; ES = 0.21, respectively), and lower alcohol consumption, including beer ($p = 0.007$; ES = 0.25 and $p < 0.001$; ES = 0.36, respectively) and wine ($p = 0.001$; ES = 0.30 and $p < 0.001$; ES = 0.50), among other healthy habits compared to participants with lower levels of physical activity. We also found that participants with higher self-loading physical activity reported higher perceived stress ($p = 0.003$; ES = 0.02) and conscientiousness ($p < 0.001$; ES = 1.86).

Keywords

Depression; Anxiety; Nutritional habits; Exercise; Oral health; Questionnaire

1. Introduction

The World Health Organization (WHO) defines health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or diseases" [1]. According to this definition, mental health is a fundamental component of health. Good mental health means that people can cope with the natural stresses of life, be productive at work, and fulfill their potential by contributing to their communities. There are WHO guidelines on physical activity and sedentary behavior that highlight the importance of regular exercise, including aerobic exercise on the one hand, and muscle-strengthening exercise on the other. Specific recommendations are also included for the different types of groups in the population, such as pregnant women or people with disabilities or chronic illnesses, among others [2]. In relation to these population groups, there is a manual that explains the different procedures and recommendations for the type of exercise in both healthy and sick patients [3]. The WHO recommends vigorous-intensity aerobic activities in adults and activities that strengthen muscles and bones at least three days a week. In addition, physical activity reduces symptoms of depression and anxiety, and improve concentration, learning and general well-being. On the other hand, it must be considered that the way of exercising is different in each part of the planet [4]. In Europe, mainly the practice of physical exercise is aimed at health and special populations [5].

Depression and anxiety are common illnesses worldwide; approximately 280 million people in the world suffer from depression, which is 3.8% of the population [6]. Since 2020, the prevalence of anxiety and depression has increased by 25% [7] and, compared with previous years even double in some countries [8]. In the Lancet magazine, an international study estimated that cases of major depression and anxiety disorder in the world had increased during the pandemic by 28% and 26%, respectively. There were 53 million more depressive disorders and 76 million more anxiety diagnoses than expected in 2020 [9]. More than 75% of affected people in low- and middle-income countries do not receive any treatment [10], despite the existence of known and effective treatments for mental disorders. In this line, at present, stress is an important health problem, which can be the origin of many pathologies in the patient and even aggravate the state of those that already exist [11]. In Spain, depressive and anxiety disorders appear in 4.1% of the population, affecting 2.3% of men, with frequency

increasing progressively with age until it reaches 5% of men aged 75 to 84 years [12].

Depression and anxiety can cause distress among those who suffer from them, affecting their lifestyle and ability to carry out even the simplest everyday tasks. They can also significantly damage relationships with family and friends, as well as participation in the world of work, resulting in economic and social impacts [13]. Depression and anxiety are multifactorial diseases, and recent research has shown that social relationships, psychological profiles, physical activity, and nutritional behaviors could directly affect depressive symptoms [14]. In this regard, regular physical activity can increase self-esteem [15] by reducing stress and anxiety [16].

Regular physical activity plays an important role in preventing the development of mental health problems [17] and improving the quality of life of people who suffer from those disorders [18]. Scientific evidence shows a direct relationship between a sedentary lifestyle and depressive disorders, making it biologically possible for exercise to have antidepressant effects [19]. In a recent study, it was also found that performing a combination of aerobic and anaerobic exercise has more beneficial effects on health than doing them separately [20]. For adults, exercising in natural environments has been shown to increase energy, positive engagement, and greater feelings of revitalization compared to exercising indoors [21].

Physical exercise acts as a natural anxiolytic against depression. Regularly practicing physical exercise helps to improve mood and increase the feeling of well-being. In recent years, studies linking physical exercise with anxiety and depression have appeared, suggesting that it could be an appropriate natural procedure to contribute to preventing and treating these problems [22]. On the other hand, nutritional habits, physical activity habits, and oral health habits can also modulate depression and anxiety. There is growing evidence linking diet with the psychological health of the adult population. It has been found that the prevalence of anxiety and depression is significantly related to poor nutrition [23]. Previous studies found that patients with depression also presented higher rates of gastritis [24], dry mouth, tooth sensitivity, poor dental health, and more sick days per year [25]. These studies also found higher consumption of soft drinks per week, poor digestion, and migraine in the depressed group. Previous studies found that there was a direct association between mental disorders and migraine [26], as a high percentage of people who suffer from mental disorders had migraine at some point in their lives [27].

Previous studies have analyzed the difference between high and low levels of physical activity, but there is limited literature that has analyzed differences based on the type of exercise performed (strength versus aerobic) [28, 29]. Previous evidence has shown that multifactorial factors such as nutritional habits, physical activity, social relationships, and psychological profile are controlling factors in the development of depression and anxiety. Considering that depression and anxiety are diseases with an important behavioral basis, understanding descriptive behavior would allow for better prevention and treatment. The present research intends to analyze the effect of different types of physical activities (aerobic and strength), on the psychological, nutritional, odontological, and behavioral profile of male participants. The initial hypothesis was that participants with higher levels of both aerobic and strength physical activities would present different psychological, nutritional, odontological, and behavioral profiles.

2. Materials and methods

2.1 Participants

In the current study, 605 men participants (36.7 ± 15 years, 177.0 ± 6.4 centimeters, 79.8 ± 14.5 kilograms, 25.7 ± 4.3 kg/m^2) were interviewed *via* an online questionnaire. The participants were recruited by a public call due to the limitation that existed at that time due to the COVID-19 (Coronavirus Disease-19) pandemic. Participants were divided by percentile 50 of the level of aerobic physical activity in a high aerobic activity group (n = 193) and a low aerobic activity group (n = 412). In this line, a similar division by percentile 50 was made by the level of self-loading activity, dividing the group into a high self-loading activity group (n = 195) and low self-loading activity group (n = 410). Then, differences in psychological, nutritional, odontological and behavioral profile were analyzed.

2.2 Design and procedure

Multifactorial items related to anthropometric and sociodemographic variables, psychological measures, physical activity, nutritional habits, and oral health habits were analyzed using a compendium of questionnaires following previous research [30, 31].

2.2.1 Anthropometric and sociodemographic questionnaires

The present study analyzes age (years), height (cm), and weight (kg) variables, which were included in the analysis of body mass index (kg/m^2). In addition, the following questions were asked: "How many hours per day do you watch Television (TV)?" and "How many hours per day do you spend on social media?". These items were measured on a scale where participants could freely select the number of hours per day.

2.2.2 Psychological questionnaires

The study employed questionnaires to measure various factors: a short version of the Spanish Big Five Inventory [32], which analyzes five personality factors - neuroticism, extraversion, open-mindedness, kindness, and responsibility. The short version comprises ten items, rated on a 5-point Likert scale, where one means completely disagree and five means completely agree. The Spanish version of the short form of the State-Trait Anxiety Inventory (STAI) [33] was used to measure anxiety, consisting of six items rated on a 4-point Likert scale where one means not at all and four means very much. The Acceptance and Action Questionnaire (AAQ-II) [34] was used to analyze psychological inflexibility or experiential avoidance, and it comprises seven items, each corresponding to a 7-point Likert scale, where zero means never true and seven means always true. An example item is: "Emotions are causing problems in my life". High scores on this scale could indicate

current clinical distress. The UCLA Loneliness Scale [35], a short version composed of three items, was used to evaluate loneliness, with each item answered by a 3-point Likert scale, where one is never and three is frequently. An example item is: "My ideas and interests are not shared by those around me". The short Spanish version of the Perceived Stress Scale (PSS) [36], composed of fourteen items answered on a 5-point Likert scale ranging from 0 (never) to 4 (very often), was used to analyze participants' perceived stress levels. An example item is: "In the last month, how often have you heard that you could not control the important things in your life"? The Zung Depression Scale [37], a self-applied scale used to measure depression, was used in its Spanish version, with a sensitivity and specificity greater than 80%. The scale comprises twenty items formulated in positive and negative terms, with eight items for each of the somatic and cognitive symptom groups. The scale also includes two mood items and two psychomotor symptoms. The scale consists of four items, from the shortest to the longest time.

2.2.3 Physical activity questionnaires

The measurement was carried out using a questionnaire that was consistent with previous research [38, 39]. The questionnaire included the following items: "How many average steps have you taken per day in the last week?", "Did you engage in any physical activity in the last seven days?", "If so, how many minutes of cyclic and/or aerobic activity (*e.g.*, cycling, treadmill, Zumba) did you engage in, adding up all the sessions of the seven days?", and "If so, how many minutes of activity with self-loads (*e.g.*, sit-ups, push-ups, squats) or weights (*e.g.*, gym machines, weights) did you engage in, adding up all the sessions of the seven days"? The average minutes of self-loads per session in the last week were measured using a self-perception scale that indicated the average minutes of self-loads the participant had engaged in during the last week.

2.2.4 Nutrition habits questionnaires

The following adapted questionnaire, previously used in research [40], was used to analyze eating and nutritional behaviors. It included variables such as the weekly consumption of: Fruit juices and nectars (250 mL); Alcohol (whiskey, rum, gin…) (50 mL approx.); Beer (250 mL approx.); Wine (50 mL approx.); Soft drinks (coke, soda…) (250 mL approx.); Energy drinks (250 mL approx.); Coffee (250 mL approx.); Tea (250 mL approx.); Milk (250 mL approx.); Fermented products (125 gr); Pastries (1 portion); Cookies-sweet cereals (30 g–250 mL); Cheese (50 g); Eggs (1 piece); Meat (150 gr); Fish (150 gr); Sausage/cold meat (150 gr); Legumes (200 gr); Rice (150 gr); Pasta (150 gr); Fruit (1 portion); Raw vegetables (salad) (200 gr approx.); Cooked vegetables (200 gr approx.); Bread (50 gr approx.); Whole-grain cereal (bread, rice, oat…); Fast food (1 serving); Protein shakes (300 mL); Vitamin supplements (1 capsule).

Each item was rated on a scale of one to six per week, where one means "No consumption", two means "less than three times", three means "three times or more", four means "seven or more times", five means "ten or more times", and six means "more than thirteen times".

It was also analyzed through different questions as follows: vitality during the week and at the end of the week with two questions that could be answered using a 10-point Likert scale, where 0 means very low and 10 means very high. The question "Do you have migraines?" was answered using a 10-point Likert scale, where 0 means rarely and 10 means very often [41]. The question "Are you satisfied with your weight?" had the following answers: "completely satisfied", "I want to increase weight". and "I want to lose weight". For the question "How many glasses of water (250 mL) do you drink per day?" the responses ranged from "0" to "more than 10". For the question "How many tablespoons do you take per day?" the answers ranged from "0" to "more than 5". For the question "How is your digestion after eating?" the responses were: "I usually feel good", "I feel heavy digestion sometimes", and "I often feel heavy digestion". To the question "What kind of bowel movement did you have during the last week?" the responses ranged from 1 to 7 based on the Bristol Scale [42]: 1 means "hard, lumpy stools", 2 means "sausage-shaped, but lumpy", 3 means "like a sausage but with cracks on the surface", 4 means "smooth and soft", 5 means "soft blobs with clear-cut edges", 6 means "fluffy pieces with ragged edges, a mushy stool", and 7 means "watery, no solid pieces".

2.2.5 Oral health questionnaires

Oral health habits were assessed using a previously employed questionnaire [38] consisting of six items related to oral health. The first question asked was, "How many times per day do you brush your teeth?", with responses ranging from "none" to "more than four times per day". The question "Do you smoke?" was answered with options ranging from "no" to "more than five cigarettes per day" [43]. The other three questions were: "Do you have gastritis or heartburn?", "Is your mouth often dry as if there is no saliva?", and "Do you have tooth sensitivity?", with responses of "yes", "sometimes", or "no". For the last question, participants were asked, "How many days have you been ill in the last year (flu, cold, *etc.*)?" and were able to provide their answer on a free-choice scale indicating the number of sick days they experienced in the past year.

2.3 Statistical analysis

The statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) Version 22.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics (mean and standard deviation) were calculated for each variable. An independent *t*-test with confidence intervals was used to analyze group differences between the low and high aerobic activity groups. Another independent *t*-test with confidence intervals was used to analyze group differences between the low and high self-loading activity groups. Additionally, a Multivariate analysis of variance (MANOVA) with Bonferroni post hoc test was used to analyze differences between the low and high aerobic activity groups, and the low and high self-loading activity groups in nutritional parameters. Effect Size (ES) was tested by Cohen's D. The significance level was set at $p \leq 0.05$.

TABLE 1. Anthropometric and sociodemographic variables of the low (n = 412) and high aerobic activity group (n = 193).

						Confidence Interval	
Variable	Low aerobic activity group	High aerobic activity group	*t*	*p*	Cohen's D	Lower	Upper
Age (yr)	38.3 ± 15.3	33.3 ± 13.5	3.925	<0.001	0.33	2.53	7.59
Height (cm)	176.7 ± 6.4	177.5 ± 6.5	−1.302	0.193	0.13	−1.83	0.37
Weight (kg)	80.1 ± 13.8	78.8 ± 15.8	1.018	0.309	0.09	−1.19	3.76
Body mass index (kg/m^2)	25.6 ± 4.2	25.1 ± 4.7	1.473	0.141	0.12	−0.19	1.31
TV hours per day (h)	1.4 ± 2.5	2.3 ± 7.1	−2.097	0.036	0.36	−1.60	−0.05
Social media hours per day (h)	2.0 ± 3.7	1.3 ± 3.0	0.004	0.997	0.19	−1.28	1.28

3. Results

Based on anthropometric and sociodemographic variables, the low aerobic activity group demonstrated significantly higher age levels. Additionally, lower levels of daily TV viewing time (measured in minutes) were found in the low aerobic activity group (Table 1).

The low self-loading activity group demonstrated significantly higher age levels (years), weight (kg), and body mass index (kg/m^2) (Table 2).

Regarding the psychological profile, the low aerobic activity group demonstrated significantly higher levels of perceived stress compared to the high aerobic activity group. In addition, participants with high self-loading activity levels exhibited significantly higher levels of Perceived Stress Scale (PSS4) and Big Five conscientiousness than those with low self-loading activity levels (Tables 3 and 4).

In terms of nutritional variables, the low aerobic activity group demonstrated significantly lower levels of daily water intake, weekly vitality, vitality at the end of the week, and weekly consumption of soft drinks, energy drinks, milk, fermented milk products, eggs, meat, fish, legumes, rice, pasta, fruits, whole grains (such as rice and oats), protein shakes, and vitaminic supplements. Additionally, the low aerobic activity group showed significantly higher levels of weekly consumption of distilled alcohol, beer, wine, and coffee compared to the high aerobic activity group (Table 5).

The low self-loading activity group demonstrated significantly lower levels of daily water intake, weekly vitality, and weekly consumption of energy drinks, milk, fermented milk products, eggs, meat, fish, rice, pasta, whole grains (such as rice and oats), protein shakes, and vitaminic supplements. Additionally, the low self-loading activity group showed significantly higher levels of weekly consumption of beer, wine, and coffee compared to high self-loading activity participants (Table 6).

The low self-loading activity group demonstrated significantly lower levels of daily steps taken last week and significantly higher levels of physical activity during the last 7 days (Table 7).

Regarding the oral health profile, the low aerobic activity group exhibited a significantly lower incidence of dry mouth and a significantly higher incidence of smoking compared to the high aerobic activity group (Table 8).

The low self-loading activity group exhibited a significantly lower incidence of daily toothbrushing and dry mouth, and a significantly higher incidence of smoking compared to the high self-loading activity group regarding the oral health profile (Table 9).

4. Discussion

The present study aimed to analyze the effect of different physical activities (aerobic and self-loading) on the psychological, nutritional, odontological, and behavioral profiles of male participants. The initial hypothesis was partially fulfilled since significant differences were found only in the psychological profile between the analyzed groups.

Participants with higher aerobic activity presented significantly lower levels of perceived stress (PSS). This result was in line with previous studies that found regular physical exercise decreases the degree of anxiety and stress, while providing a feeling of well-being and improving mood, self-esteem, and the quality of sleep [44]. The higher the level of physical activity practice, the greater the perceived control in a stressful situation [45]. Physical activity has proven to be a good ally of psychotherapy and medical treatments. There is strong evidence showing a 20–30% reduction in depression in adults who perform daily physical activity [46]. The activities that give the best results due to their anxiolytic effect are aerobics of moderate intensity. Normally, the first change made in our lifestyle for the prevention and management of chronic diseases is to include physical exercise. Exercise is often the first step in lifestyle modification for the prevention and management of chronic diseases such as anxiety and depression [47]. The practice of exercise produces significant physiological changes in the immune system, including characteristic cytokine responses, so there is a direct relationship between exercise and the immune system. Cytokines induce inflammatory and anti-inflammatory responses that regulate each other to limit damage from prolonged inflammation. Previous studies indicate that diagnosed depressed patients show increased levels of circulating cytokines [48]. Likewise, it is important to highlight that physical activity has an anti-inflammatory effect on the body, as well as a positive mental effect it has on patients with depression [49]. Therefore, due to the anti-inflammatory effect caused by moderate physical exercise, a new door is opened for the treatment of chronic

TABLE 2. Anthropometric and sociodemographic variables of low (n = 410) and high self-loading activity group (n = 195).

						Confidence Interval	
Variable	Low self-loading activity group	High self-loading activity group	*t*	*p*	Cohen's D	Lower	Upper
Age (yr)	40.5 ± 15.3	28.7 ± 10.4	9.722	<0.001	0.77	9.39	14.15
Height (cm)	176.7 ± 6.6	177.6 ± 6.0	−1.679	0.094	0.14	−2.04	0.12
Weight (kg)	80.5 ± 14.3	78.0 ± 14.8	1.979	0.048	0.17	0.02	4.95
Body mass index (kg/m2)	25.8 ± 4.3	24.7 ± 4.4	2.792	0.005	0.26	0.31	1.80
TV hours per day (h)	1.8 ± 5.0	1.6 ± 3.1	0.580	0.562	0.04	−0.55	1.00
Social networks hours per day (h)	2.0 ± 8.8	2.0 ± 3.1	−0.048	0.962	0.00	−1.31	1.25

TABLE 3. Results of psychological variables of the low (n = 412) and high aerobic activity group (n = 193).

						Confidence	Interval
Variable	Low aerobic activity group	High aerobic activity group	*t*	*p*	Cohen's D	Lower	Upper
ZUNG	46.0 ± 4.2	45.9 ± 4.4	0.321	0.748	0.02	−0.61	0.85
PSS4	4.9 ± 2.7	4.2 ± 3.0	2.955	0.003	0.26	0.24	1.21
STAI	12.0 ± 3.5	11.4 ± 3.7	1.413	0.158	0.17	−0.17	1.04
UCLA	4.1 ± 1.4	4.0 ± 1.3	0.607	0.544	0.07	−0.17	0.31
AAQII	19.8 ± 9.3	18.4 ± 8.2	0.184	0.854	0.15	−1.40	1.68
Extraversion	6.0 ± 1.7	6.2 ± 1.5	−1.417	0.157	0.12	−0.48	0.08
Agreeableness	6.4 ± 1.5	6.3 ± 1.5	0.816	0.415	0.07	−0.14	0.35
Conscientiousness	6.9 ± 1.6	7.6 ± 1.5	−0.380	0.704	0.44	−0.33	0.23
Neuroticism	5.4 ± 1.8	5.2 ± 1.7	0.668	0.504	0.11	−0.20	0.41
Open to experience	7.1 ± 1.6	7.1 ± 1.6	1.103	0.270	0.00	−0.12	0.44

ZUNG—Zung Depression Scale; PSS4—Perceives Stress Scale; STAI—Spielberger State-Trait Anxiety Inventory; UCLA—UCLA Loneliness Scale; AAQII—Acceptance and Action Questionnaire II; Big Five Factors (Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness to experience).

TABLE 4. Table 4. Results of psychological variables of the low (n = 410) and high self-loading activity group (n = 195).

						Confidence	Interval
Variable	Low self-loading activity group	High self-loading activity group	*t*	*p*	Cohen's D	Lower	Upper
ZUNG	46.0 ± 4.4	45.9 ± 4.0	0.321	0.748	0.02	−0.61	0.85
PSS4	4.5 ± 2.8	4.9 ± 2.9	2.955	0.003	0.14	0.24	1.21
STAI	11.9 ± 3.7	11.3 ± 3.2	1.413	0.158	0.16	−0.17	1.04
UCLA	4.1 ± 1.4	4.1 ± 1.4	0.607	0.544	0.00	−0.16	0.31
AAQII	19.4 ± 9.3	19.3 ± 8.3	1.837	0.067	0.01	−0.10	2.98
Extraversion	5.9 ± 1.7	6.1 ± 1.4	−1.897	0.580	0.12	−0.55	0.01
Agreeableness	6.4 ± 1.5	6.3 ± 1.4	0.413	0.680	0.07	−0.20	0.30
Conscientiousness	7.1 ± 1.6	7.2 ± 1.6	−4.967	<0.001	0.06	−0.97	−0.42
Neuroticism	5.4 ± 1.8	5.3 ± 1.7	1.468	0.143	0.06	−0.07	0.53
Open to experience	7.1 ± 1.7	7.0 ± 1.7	0.082	0.934	0.06	−0.27	0.29

ZUNG—Zung Depression Scale; PSS4—Perceives Stress Scale; STAI—Spielberger State-Trait Anxiety Inventory; UCLA—UCLA Loneliness Scale; AAQII—Acceptance and Action Questionnaire II; Big Five Factors (Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness to experience).

TABLE 5. Nutritional variables of the low (n = 412) and high aerobic activity group (n = 193).

Variable	Low aerobic activity group	High aerobic activity group	*p*	Cohen's D
Water glasses per day (250 mL)	3.9 ± 1.3	4.7 ± 1.5	<0.001	0.62
Week vitality (0–10)	7.3 ± 1.4	8.0 ± 1.2	<0.001	0.50
Vitality end of the week (0–10)	6.3 ± 2.0	6.9 ± 1.9	0.001	0.30
Migraine occurrence (0–10)	1.7 ± 1.6	1.6 ± 2.2	0.667	0.06
Juice (250 mL) per week	1.9 ± 1.0	1.9 ± 1.0	0.507	0.00
Distilled alcohol (50 mL) per week	1.5 ± 0.5	1.3 ± 0.5	0.009	0.40
Beer (250 mL) per week	2.0 ± 0.8	1.8 ± 1.0	0.007	0.25
Wine (50 mL) per week	1.6 ± 1.0	1.3 ± 0.7	0.001	0.30
Soft drink (250 mL) per week	1.8 ± 1.1	2.0 ± 1.2	0.020	0.18
Energy drink (250 mL) per week	1.2 ± 0.6	1.4 ± 0.8	0.001	0.33
Coffee (250 mL) per week	2.9 ± 1.6	2.6 ± 1.6	0.034	0.19
Tea (250 mL) per week	1.5 ± 0.9	1.5 ± 0.9	0.680	0.00
Milk (250 mL) per week	2.7 ± 1.4	3.0 ± 1.4	0.029	0.21
Fermented milk products (125 g/mL) per week	2.5 ± 1.2	2.7 ± 1.3	0.034	0.17
Pastries (1 portion) per week	1.7 ± 0.8	1.7 ± 0.9	0.843	0.00
Cookies-sweet cereals (30 g/mL) per week	2.0 ± 1.1	2.1 ± 1.2	0.208	0.09
Cheese (50 g) per week	2.3 ± 1.0	2.6 ± 1.2	0.664	2.30
Eggs (1 piece) per week	2.8 ± 1.0	3.1 ± 1.2	0.002	2.80
Meat (150 g) per week	3.1 ± 1.0	3.3 ± 1.2	0.007	3.10
Fish (150 g) per week	2.5 ± 0.8	2.8 ± 1.1	<0.001	3.13
Sausages (50 g) per week	2.5 ± 1.1	2.3 ± 1.1	0.210	2.27
Legume (200 g) per week	2.4 ± 0.8	2.5 ± 0.9	0.046	3.00
Rice (150 g) per week	2.6 ± 1.0	2.9 ± 1.3	0.001	2.60
Pasta (150 g) per week	2.5 ± 1.0	2.7 ± 1.1	0.010	2.50
Fruits (1 portion) per week	3.2 ± 1.4	3.6 ± 1.4	0.001	2.29
Fresh Vegetables-Salad (200 g) per week	2.8 ± 1.1	3.0 ± 1.3	0.065	2.55
Cooked Vegetable (200 g) per week	2.8 ± 1.1	3.0 ± 1.2	0.267	2.55
Bread (50 g) per week	2.8 ± 1.3	3.0 ± 1.2	0.067	2.15
Whole grains-rice-oat (30 g) per week	2.2 ± 1.3	2.6 ± 1.3	0.001	1.69
Fast food-pizza-hamburger (1 serving) per week	1.8 ± 0.7	1.9 ± 0.8	0.123	2.57
Protein shakes (300 mL) per week	1.6 ± 1.1	1.8 ± 1.2	0.014	1.45
Vitaminic supplements (1 capsule) per week	1.3 ± 0.7	1.4 ± 1.0	0.031	1.86
Daily teaspoons of sugar	1.3 ± 0.5	1.4 ± 0.6	0.568	0.20
Post-meal digestion (1–5)	1.4 ± 0.6	1.3 ± 0.5	0.342	0.17
Bristol scale	3.6 ± 1.0	3.8 ± 1.0	0.107	0.20

TABLE 6. Nutritional variables of the low and high (n = 410) self-loading activity group (n = 195).

Variable	Low self-loading activity group	High self-loading activity group	*p*	Cohen's D
Water glasses per day (250 mL)	3.9 ± 1.3	4.8 ± 1.5	<0.001	0.69
Week vitality (0–10)	7.4 ± 1.4	7.7 ± 1.3	0.006	0.21
Vitality end of the week (0–10)	6.5 ± 2.1	6.6 ± 1.9	0.708	0.05
Migraine occurrence (0–10)	1.8 ± 2.7	1.3 ± 2.0	0.017	0.19
Juice (250 mL) per week	1.9 ± 1.0	2.0 ± 1.0	0.133	0.10
Distilled alcohol (50 mL) per week	1.4 ± 0.6	1.4 ± 0.5	0.126	0.00
Beer (250 mL) per week	2.1 ± 1.1	1.7 ± 0.9	<0.001	0.36
Wine (50 mL) per week	1.6 ± 0.8	1.2 ± 0.6	<0.001	0.50
Soft drink (250 mL) per week	1.8 ± 1.2	1.9 ± 1.0	0.789	0.08
Energy drink (250 mL) per week	1.2 ± 0.6	1.4 ± 0.8	0.002	0.33
Coffee (250 mL) per week	3.0 ± 1.7	2.4 ± 1.5	<0.001	0.35
Tea (250 mL) per week	1.5 ± 0.9	1.6 ± 1.0	0.177	0.11
Milk (250 mL) per week	2.6 ± 1.4	3.2 ± 1.3	<0.001	0.43
Fermented milk products (125 g/mL) per week	2.4 ± 1.2	2.8 ± 1.4	0.002	0.33
Pastries (1 portion) per week	1.7 ± 0.8	1.7 ± 0.9	0.343	0.00
Cookies-sweet cereals (30 g/mL) per week	2.0 ± 1.7	2.1 ± 1.1	0.306	0.06
Cheese (50 g) per week	2.6 ± 1.2	2.5 ± 1.2	0.423	0.08
Eggs (1 piece) per week	2.8 ± 1.0	3.1 ± 1.2	0.002	0.30
Meat (150 g) per week	3.0 ± 1.0	3.4 ± 1.2	<0.001	0.40
Fish (150 g) per week	2.5 ± 0.9	2.7 ± 1.1	0.023	0.22
Sausages (50 g) per week	2.4 ± 1.1	2.4 ± 1.1	0.802	0.00
Legume (200 g) per week	2.4 ± 0.8	2.5 ± 1.0	0.149	0.13
Rice (150 g) per week	2.6 ± 1.0	3.0 ± 1.1	<0.001	0.40
Pasta (150 g) per week	2.4 ± 1.0	2.8 ± 1.1	<0.001	0.40
Fruits (1 portion) per week	3.3 ± 1.4	3.4 ± 1.4	0.196	0.07
Fresh Vegetables-Salad (200 g) per week	2.8 ± 1.1	3.0 ± 1.3	0.704	0.18
Cooked (200 g) per week	2.8 ± 1.1	3.0 ± 1.3	0.188	0.18
Bread (50 g) per week	2.9 ± 1.3	2.9 ± 1.2	0.151	0.46
Whole grains-rice-oat (30 g) per week	2.1 ± 1.2	2.8 ± 1.3	<0.001	0.58
Fast food-pizza-hamburger (1 serving) per week	1.8 ± 0.8	1.8 ± 0.7	0.786	0.00
Protein shakes (300 mL) per week	1.3 ± 0.8	2.3 ± 1.4	<0.001	1.25
Vitaminic supplements (1 capsule) per week	1.2 ± 0.7	1.5 ± 1.0	0.001	0.43
Daily teaspoons of sugar	1.3 ± 0.5	1.3 ± 0.6	0.759	0.00
Post-meal digestion (1–5)	1.4 ± 0.6	1.3 ± 0.5	0.018	0.17
Bristol scale	3.7 ± 1.0	3.7 ± 1.0	0.893	0.00

TABLE 7. Physical Activity variable of low (n = 410) and high self-loading activity group (n = 195).

						Confidence	Interval
Variable	Low self-loading activity group	High self-loading activity group	*t*	*p*	Cohen's D	Lower	Upper
Daily Steps last week	11,520.3 ± 15,721.4	29,215.0 ± 106,633.4	−3.031	0.028	1.13	−29,162.61	−6226.65
Physical Activity last 7 days (h)	1.2 ± 0.4	1.0 ± 0.0	6.290	<0.001	0.50	0.12	0.22
Aerobic physical activity last 7 days (min)	240.0 ± 665.3	303.0 ± 287.2	−1.268	0.205	0.09	−160.74	34.58

TABLE 8. Oral health variables of the low (n = 412) and high aerobic activity group (n = 193).

			Confidence Interval				
Variable	Low aerobic activity group	High aerobic activity group	*t*	*p*	Cohen's D	Lower	Upper
Daily toothbrushing	2.5 ± 0.9	2.4 ± 0.9	0.845	0.398	0.11	−0.09	0.22
Smoker	1.4 ± 0.9	1.2 ± 0.6	2.860	0.004	0.22	0.06	0.35
Gastritis or heartburn	2.6 ± 0.6	2.7 ± 0.5	−1.919	0.056	0.17	−0.20	0.00
Dry mouth	2.6 ± 0.6	2.7 ± 0.5	−2.358	0.019	0.17	−0.23	−0.02
Dental sensibility	2.5 ± 0.6	2.5 ± 0.7	0.356	0.722	0.00	−0.10	0.13
Illness days per year	3.0 ± 6.3	3.3 ± 6.8	−0.519	0.604	0.05	−1.41	0.82

TABLE 9. Oral health variables of low (n = 410) and high self-loading activity group (n = 195).

						Confidence	Interval
Variable	Low self-loading activity group	High self-loading activity group	*t*	*p*	Cohen's D	Lower	Upper
Daily toothbrushing	2.4 ± 0.9	2.6 ± 0.8	−3.545	<0.001	0.22	−0.43	−0.12
Smoker	1.4 ± 0.9	1.2 ± 0.6	2.285	0.023	0.22	0.02	0.31
Gastritis or heartburn	2.6 ± 0.6	2.7 ± 0.6	−0.831	0.406	0.17	−0.14	0.06
Dry mouth	2.6 ± 0.6	2.7 ± 0.5	−3.307	0.001	0.17	−0.27	−0.01
Dental sensibility	2.5 ± 0.6	2.4 ± 0.6	1.714	0.087	0.17	−0.01	0.20
Illness days per year	3.3 ± 6.8	2.8 ± 5.7	1.016	0.310	0.07	−0.54	1.69

diseases such as depression [50], and if this treatment is also combined with changes in eating habits and psychological therapy, treatment can be significantly shortened compared to other conventional pharmacological treatments [51].

On the other hand, the groups with higher physical activity (aerobic and self-loading) presented a higher level of weekly vitality, better nutritional habits such as higher water consumption, weekly consumption of proteins (eggs, meat, fish, legumes, protein shakes), carbohydrates (rice, pasta, whole grains-rice-oat), fruits, and vitamin supplements. They also showed significantly lower consumption of distilled alcohol, beer, wine, and coffee. Higher scores in the mental component of quality of life are associated with better eating habits and greater adherence to a healthy diet. Likewise, positive scores in physical and mental function are related to the increase in aerobic physical activity [52].

The 10,000 Steps Project classifies the sedentary lifestyle of people and physical activity according to the number of steps they take per day. Those who take less than 5000 steps a day have a sedentary lifestyle. Between 7500 and 10,000 steps a day have a moderate or little active level. Those who give more than 12,500 a day are considered very active. This result with self-loading training produces an effective modality for improving muscle function, performance, and health. Among the many expected outcomes, increases in muscle size and strength are considered important outcomes [53]. In this study, it is important to note that the sample's body mass index is 25.7 kg/m^2. Recent evidence suggests that various types of exercise can have positive effects on cardiometabolic parameters in overweight adults. To obtain healthy muscle, selected load

is an important variable in muscular endurance training to successfully increase muscle size and strength [54]. Therefore, healthcare professionals should promote the prescription of multi-component exercises to maximize clinical results and reduce rates of overweight in the population, which is a serious public health problem [55]. Regarding oral health habits, participants with higher levels of aerobic and self-loading activity have less dry mouth and smoke less. Multiple studies have investigated the negative consequences of tobacco on oral health [56], such as a decrease in salivary flow and an increase in the sensation of "dry mouth" [57]. Saliva helps maintain a balance of bacteria in the mouth, and reducing the amount of saliva can reduce protection against these bacteria [58]. Previous studies have shown that males are at a higher risk for tobacco consumption in terms of frequency and/or quantity [59]. Physical activity is inversely related to the consumption of tobacco in high frequencies and quantities; the less time spent on physical activity, the greater the consumption of tobacco [60]. Individuals with a sedentary lifestyle tend to smoke more, and the present study's results are consistent with this finding since participants who engage in less aerobic activity and self-loading are more likely to smoke. Furthermore, some studies have shown that individuals who drink alcohol are more likely to smoke [61], and the present study's results are consistent with this finding since participants who smoke and drink alcohol are the least physically active [62]. In the present study, it should be noted that the body mass index of the sample is 25.7 kg/m^2. There is recent evidence of the effectiveness of different types of exercise on cardiometabolic parameters related to health in overweight adults. The prescription of multi-component exercises in overweight adults should be promoted to maximize clinical…

Due to COVID-19 restrictions, the study analyzed a smaller number of participants. Access to the survey questionnaire was limited due to its online format, preventing many potential participants from completing it. This was the main limitation of this research. The pandemic led to changes in behavior, such as increased rates of anxiety and depression [63] and altered physical activity habits due to confinement. The confinement implied a change or a decrease in the recommended healthy values of the practice of physical activity [64–66]. No data collection has been carried out with biochemical parameters such as cortisol or alpha-amylase. The cross-sectional design was a limitation that prevented drawing causal implications. Measuring steps directly with an objective device was not possible due to the pandemic, which limited the study's ability to collect data on physical activity levels.

A new multidisciplinary approach to treating depression is emerging that considers physical activity, eating habits, and oral health. This approach has the potential to benefit future generations by reducing the risk of depression. Further investigation and prospective observational studies are needed to better understand the causal role of physical activity, nutritional habits, and oral health in the development and progression of depression and other mental illnesses. Currently, the mechanisms by which these disciplines may reduce depression in the population are not well understood. More scientific evidence is needed to answer questions about the risks associated with poor and sedentary diets. Further studies should assess whether combined therapy with physical exercise, anti-inflammatory foods, and antidepressants could produce beneficial clinical effects. The economic status of participants was not considered in the questionnaires. Future research should consider the potential impact of socioeconomic factors on mental health, as highlighted by previous authors [67, 68].

Due to the restrictions during the pandemic, it was not possible to have access to our largest population, this was the main limitation of the present investigation, the low number of participants analyzed. Future research should consider the differences between sexes, ages, cultures, and socioeconomic factors as previous authors showed a possible effect on mental health [69–77]. One additional limitation was that participants self-reported their measurements and results in questionnaires. The study was entirely based on self-reported answers.

5. Conclusions

The present study found that participants with higher levels of both aerobic and self-loading activity generally had better nutritional habits, higher intake of water, proteins, fiber, vitamins, and trace elements, lower alcohol consumption, higher daily step count, higher vitality, and dental health, and smoked less than participants with lower activity levels. The study also found that participants with higher self-loading activity had higher perceived stress and conscientiousness.

For practical applications, it is important for public institutions and competent bodies to be aware of the physical activity and dietary behavior patterns of the population. This knowledge can be used to implement multidisciplinary interventions in healthcare to reduce sedentary lifestyle and poor dietary habits in the population. Comprehensive interventions are necessary to reduce depression rates in the population. It is important to note that the success of these interventions relies on promoting healthy lifestyles and providing appropriate knowledge to the population to prevent the immediate and long-term risks of depression, as well as increase the quantity and quality of physical activity across all age groups.

AVAILABILITY OF DATA AND MATERIALS

The data are contained within this article.

AUTHOR CONTRIBUTIONS

VJCS—Conceptualization, methodology, supervision, project administration. VJCS and MCM—investigation; writing-original draft preparation, writing-review and editing, visualization. All authors have read and agreed to the published version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This research complied with the Helsinki declarations (revised in Brazil, 2013) on human research and was approved by the European University Ethics Committee (CIPI/20/219). Informed consent was obtained from all subjects involved

through an online written consent before the start of the study.

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CONFLICT OF INTEREST

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