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Trabajo Original

Epidemiología y dietética

Change in leisure-time physical activity and perception of weight gain during the COVID-19 pandemic: results from the ELSA-Brasil Cohort

Cambio en la actividad física de tiempo libre y percepción de aumento de peso durante la pandemia de COVID-19: resultados de la cohorte ELSA-Brasil

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Abstract

Objective: this study aimed to identify the association between changes in Leisure-Time Physical Activity (LTPA) and Perceived Weight Gain (PWG) during the COVID-19 pandemic among participants enrolled in the Longitudinal Study of Adult Health (ELSA-Brasil).

Methods: an observational longitudinal study utilizing data from the ELSA-Brasil, Wave 3 – W3 (2017-2019), and Wave-COVID – WC (July/2020 to February/2021). LTPA was assessed using the International Physical Activity Questionnaire, collected at both time points, while PWG was evaluated through a questionnaire in WC. Statistical analyses were performed using the SPSS 21.0, with significance set at $p < 0.05$.

Results: among 4402 adults (57.8 % women), after adjusting for potential confounding variables, individuals who reduced their LTPA levels to the extent of changing their classification were more likely to experience PWG — specifically, those who were moderately active in W3 and became sedentary in WC (OR = 1.5 [95 % CI, 1.2-1.9]) or had low LTPA in WC (OR = 1.6 [95 % CI, 1.2-2.1]), and those who were highly active in W3 and presented a low level of LTPA in WC (OR = 2.3 [95 % CI, 1.05-5.4]).

Conclusion: our findings suggest that individuals who engaged in LTPA (moderately and highly levels) during W3 but transitioned to insufficiently active or sedentary lifestyles during the WC, were more likely to experience PWG.

Keywords:

Physical activity. Body weight. Nutrition. Epidemiology.

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Resumen

Objetivo: este estudio tuvo como objetivo evaluar la asociación entre los cambios de actividad física en el tiempo libre (AFTL) y la percepción de aumento de peso (PAP) durante la pandemia de COVID-19 entre los participantes del Estudio Longitudinal de Salud del Adulto (ELSA-Brasil).

Métodos: estudio longitudinal observacional con datos del ELSA-Brasil, ola 3 (O3) (2017-2019) y ola COVID (OC) (julio/2020 a febrero/2021). La AFTL se evaluó mediante el *International Physical Activity Questionnaire* en ambos momentos y la PAP se obtuvo mediante un cuestionario en el OC. Los análisis se realizaron en el SPSS 21.0, con significancia en $p < 0,05$.

Resultados: entre 4402 adultos (57,8 % mujeres), después de ajustar las posibles variables de confusión, aquellos que redujeron sus niveles de AFTL hasta el punto de cambiar su clasificación tenían más probabilidades de experimentar PAP; específicamente, aquellos que eran moderadamente activos en O3 y se volvieron sedentarios en OC (OR = 1,5 [IC 95 %: 1,2-1,9]) o tenían un AFTL bajo (OR = 1,6 [IC 95 %: 1,2-2,1]) y aquellos que eran muy activos en O3 y tenían un nivel bajo de AFTL en OC (OR = 2,3 [IC 95 %: 1,05-5,4]).

Conclusión: nuestros resultados sugieren que los individuos que practicaron AFTL (niveles moderados y altos) durante O3, pero que hicieron la transición a estilos de vida insuficientemente activos o sedentarios durante OC, tenían más probabilidades de experimentar PAP.

Palabras clave:

Actividad física. Peso corporal. Nutrición. Epidemiología.

INTRODUCTION

The COVID-19 pandemic caused by the SARS-CoV-2 virus (COVID-19) was officially declared by the World Health Organization (WHO) on March 11, 2020 (1). Owing to the high transmissibility of the virus and the lack of preventive or therapeutic measures, the number of cases increased exponentially, resulting in a global health emergency. To mitigate this situation, public health measures of individual, environmental, and community scope were recommended, with social distancing emerging as a prominent non-pharmacological intervention (2).

While social distancing proves effective in curbing disease transmission and preventing healthcare system overload, evidence suggests negative repercussions on lifestyle habits across diverse populations (3,4). Notably, a significant decline in physical activity has been observed, largely attributed to the closure of recreational facilities (5,6). Di Renzo *et al.* (7) documented a slight increase in physical activity in Europe, echoing the well-documented behavioral shifts induced by social distancing measures (8,9).

Studies conducted with Brazilian adults have reported increased sedentary behavior and decreased physical activity levels during pandemic-related social restrictions (4,10). Molina *et al.* (11), utilizing data from the Longitudinal Study of Adult Health (ELSA-Brasil), similarly observed reduced physical activity levels, with women and men experiencing declines of 195.5 (standard deviation – SD ± 1,146.4) and 240.5 (SD ± 1,474.2) metabolic equivalents/week, respectively, during the COVID-19 pandemic. While some studies have suggested associations between changes in physical activity and weight gain (12,13), such investigations have yet to be conducted within the ELSA-Brasil cohort.

Given this context, understanding the pandemic's effects on lifestyle habits and their relationship with Perceived Weight Gain (PWG) is crucial for disease prevention and health management. Thus, this study aims to elucidate changes in Leisure-Time Physical Activity (LTPA) between the period before and during the COVID-19 pandemic and assess its association with PWG among ELSA-Brasil participants amidst the COVID-19 pandemic.

METHODS

STUDY POPULATION

This longitudinal study utilized data from the Longitudinal Study of Adult Health in Brazil (ELSA-Brasil) (baseline range: 2008-2010, and first follow-up 2012-2014), encompassing Wave 3 (W3) conducted between 2017 and 2019, and the supplementary Wave-COVID (WC) conducted from 2020 to 2021 (14). ELSA-Brasil is a multicenter cohort study initiated with 15,105 active or retired civil servants, aged 35 and 74 years, from six research and higher education institutions: Federal Universities of Bahia (UFBA), Espírito Santo (UFES), Minas Gerais (UFMG), and Rio Grande do Sul (UFRGS); University of São Paulo (USP); and the Oswaldo Cruz Foundation (FIOCRUZ/Rio de Janeiro). The primary objective of ELSA-Brasil is to investigate the incidence of chronic diseases and their socio-biological determinants, particularly diabetes and cardiovascular diseases (15,16).

During the COVID-19 pandemic, a survey was conducted with cohort participants to monitor them throughout the period of social distancing (WC), involving five Research Centers (RC) (UFMG, UFBA, UFRGS, UFES, and FIOCRUZ/RJ) (14). The São Paulo research center did not participate because it had initiated a separate survey at the time that considered similar questions (11). Consequently, individuals from the USP-SP RC and/or those who declined participation in the study and/or had definitive refusals and/or were deceased were excluded. The W3 comprised 12,636 individuals, while the WC comprised 5,544 participants. Those who did not participate in both data collection moments were excluded (n = 128). Furthermore, participants with missing data on exposure and/or outcome variables were considered losses (n = 1,104) (Fig. 1).

Data collection respected the ethical precepts established in Resolution 466/2012 of the National Health Council. The ELSA-Brasil were approved by the research ethics committees of the five participating RCs, namely: Certificate of Presentation of Ethical Review - CPER: 32778620.1.0000.5030/4.067.18 (UFBA); CPER: 56021516.0.1001.5240/4.063.982 (FIOCRUZ); CPER: 32061620.5.0000.5060/4.090.940 (UFES); CPER: 48608515.5.1001.5327/ 4.023.601 (UFRGS); CPER: 47125015.4.1001.5149/4.082.055 (UFMG). All participants provided a signed term of informed consent. Participant data

confidentiality was guaranteed, and each individual's identity was concealed for analysis procedures.

DATA COLLECTION

Throughout all stages of the ELSA-Brasil study, participants received detailed instructions for conducting examinations at each RC on pre-scheduled dates. During the WC, which occurred between July 2020 and February 2021, following exclusions before data collection (including definitive refusals to participate and/or deaths), the remaining participants were contacted via email or telephone to introduce the study through an invitation letter. Data collection was conducted online via a dedicated platform, where participants accessed a virtual environment to complete four questionnaire modules covering various aspects including adherence to social distancing, COVID-19 exposure, symptoms, lifestyle habits, nutrition, mental health, and occupational history, among others. For participants facing difficulties accessing the online platform, the option of a telephone interview with a trained researcher was provided.

Study variables

Independent variable — Assessment of Change in Leisure-Time Physical Activity

LTPA was assessed during W3 and WC using the International Physical Activity Questionnaire (IPAQ), validated for the Brazilian population (17). At both times, participants reported the weekly frequency and duration of various activities performed during leisure time, including walking, moderate, and vigorous activities, excluding domestic and commuting activities. Subsequently, the data were converted into multiples of metabolic equivalents (METs) for each LTPA intensity, considering the formulas (18):

- *Walking (METs/week) = 3.3 x frequency (days/week) x duration (minutes/day)*
- *Moderate (METs/week) = 4 x frequency (days/week) x duration (minutes/day)*
- *Vigorous (METs/week) = 8 x frequency (days/week) x duration (minutes/day)*

Values considered outliers were replaced by those in the 99th percentile. Individuals who did not practice LTPA received a score of zero and were classified as "sedentary". The remaining individuals had the total sum of METs/week classified as "Low" (> 0 and < 600 METs/week), "Moderate" (≥ 600 and < 3000 METs/week) and "High" (≥ 3000 METs/week) (18). Furthermore, with the total sum of METs/week of W3 e WC, the measurements were subtracted to obtain the total change in LTPA (Δ) in METs/week, being used continuously.

Dependent variable — Perceived Body Weight Gain

PWG during the pandemic was assessed through the WC questionnaire item: "*Did you notice any changes in weight or body measurements during the period of social distancing?*" Par-

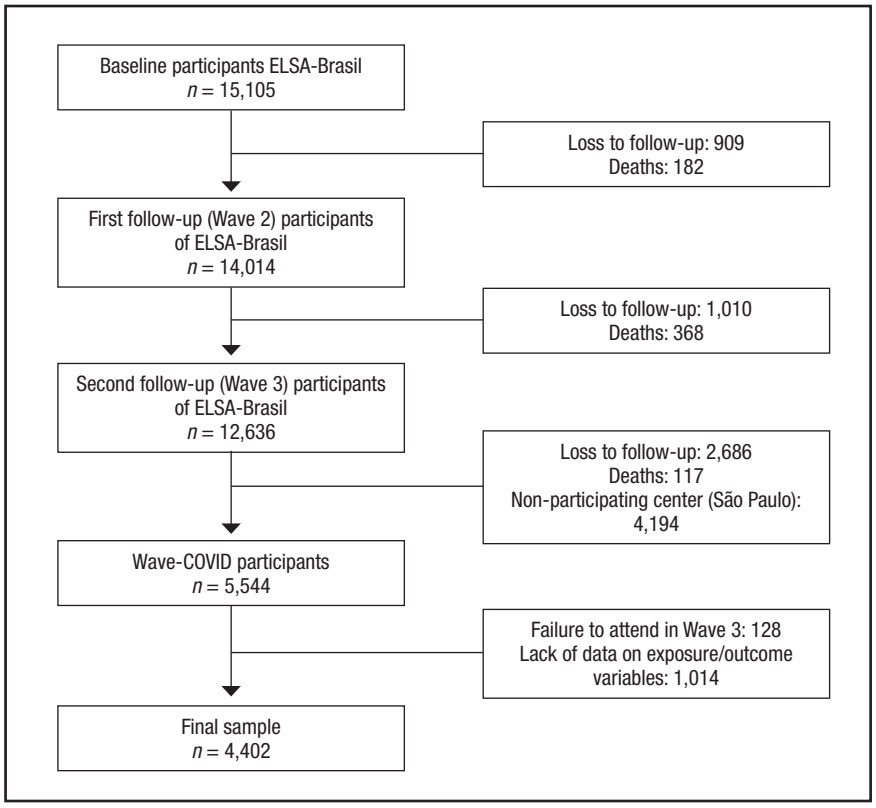

Figure 1.
Flowchart of the study sample (source: authors).

ticipants could respond "no," "yes, for less," or "yes, for more," with the latter considered affirmative for perceived weight gain. Responses "no" and "yes, for less" were grouped as they did not show statistical differences.

Covariates

Socioeconomic data: they were collected through structured questionnaires, and for the present study, information from W3 (2017-2019) was used: age (categorized as "< 58 years" and ≥ 58 years, considering the median), self-reported race/skin color (grouped into "White" and "Black, brown ['pardo'], Asian ['amarelo'] and indigenous"), sex and per capita income (US$). From WC (2020-2021), data on occupational status ("active worker" or "not an active worker [includes retirees and unemployed]") and marital status (grouped into "Single/ Separated/ Divorced/ Widowed" and "Married/ Stable Union") were used.

Nutritional status: the anthropometric assessment was carried out in W3 using techniques consolidated in the literature following standardized protocols (19,20). Body weight was measured using an electronic scale (Toledo™, model 2096PP), with a capacity of 300 kg and precision of 50 g. Height was measured with a wall stadiometer (Seca™, Hamburg, BRD) with an accuracy of 1 mm, affixed to a smooth wall without a baseboard. The body mass index (BMI) was used to classify the nutritional status of the participants, calculated by the formula BMI = weight(kg) / height(m)^2 and considered as "not overweight" (BMI < 25 kg/m²) and "overweight" (BMI ≥ 25 kg/m²) (21).

Food Quality Score (FQS): nutritional assessment utilized a semi-quantitative Food Frequency Questionnaire (FFQ) comprising 76 items in W3, capturing dietary exposure over the preceding year (22). In the WC, FFQ items from W3 were condensed to 22 items, focusing solely on current consumption frequency.

To facilitate the comparison of food consumption frequencies between W3 and WC, FFQs were standardized, aligning foods/food groups from W3 with WC. Subsequently, the Food Quality Score — ELSA-Brasil (FQS ELSA-Brasil) was devised, incorporating 22 items and the 5 consumption frequency response options from the WC FFQ (23). Briefly, each food/food group was assigned a score (positive or negative) based on consumption frequency, drawing from evidence in the literature and/or national dietary guidelines. Scores ranged from -15 to +15, with higher FQS scores indicative of greater consumption of healthy diet marker foods. The difference between W3 and WC FQS yielded the change in FQS (Δ), classified into tertiles for analysis.

Statistical analysis

The normality of continuous data was assessed using the Kolmogorov-Smirnov test. Data were presented as proportions and mean ± standard deviation. The chi-square or Fisher's exact tests were used to test statistical differences between socioeconomic, occupational, nutritional status and FQS according to PWG during the pandemic, and subsequently according to the change in LTPA classification between the two waves of follow-up exact tests.

The Wilcoxon's test was employed to compare LTPA averages (METs/week) before (W3) and during the COVID-19 pandemic (WC), considering the LTPA classification in W3. Additionally, the Kruskal-Wallis test, with post hoc pairwise comparisons, was utilized to assess differences in the mean change in LTPA (Δ LTPA) among different LTPA classifications in W3. Similarly, differences in Δ LTPA means between individuals reporting and not reporting PWG were examined using the same test. Intragroup analysis, conducted with the Mann-Whitney test, explored differences in Δ LTPA means based on PWG, stratified by LTPA classification in W3.

The proportions of individuals reporting PWG according to changes in LTPA classification between W3 and WC were tested using the chi-square or Fisher's exact tests. Lastly, binary logistic regression was performed to assess the association between changes in LTPA classification and PWG during the pandemic. Potential confounding variables identified in bivariate analysis ($p < 0.20$). Adjustment models were established according to the LTPA classification in W3, namely: Sedentary – sex, race/color, per capita income, nutritional status and occupational status; Low – sex, race/color and per capita income; Moderate – sex, race/color, per capita income and nutritional status; High – sex.

Data processing and analysis were performed using SPSS IBM Statistics version 21.0 software (SPSS Inc., Chicago, IL), considering $p < 0.05$ as statistically significant.

RESULTS

The final sample consisted of 4,402 individuals, 57.8 % ($n = 2,546$) female, with a mean age at W3 of 59.0 ± 8.6 years. PWG in the WC was reported by 44.1 % ($n = 1,941$) of participants, with a significant difference for sex ($p < 0.001$), age ($p < 0.001$), per capita income ($p = 0.001$), nutritional status ($p < 0.001$) and occupational status ($p < 0.001$) (Table I).

Regarding the practice of LTPA, in W3 and in the WC, 41.9 % ($n = 1846$) and 34.8 % ($n = 1530$), respectively, were classified as moderately active (Table II). The socioeconomic, occupational, nutritional status and quality of diet variables were also considered, according to the change in LTPA classification between the two monitoring waves. For changes in LTPA level, among those who were sedentary in W3, differences were observed for sex ($p = 0.001$) and income ($p = 0.016$); for those who had a low level of LTPA in W3, differences were identified only for sex ($p < 0.001$); moderate level in W3 had differences regarding sex ($p < 0.001$), race/skin color ($p = 0.007$), income ($p < 0.001$), nutritional status ($p = 0.032$) and marital status ($p = 0.013$) (Table II). The change in LTPA among those who were active in W3 had no significant difference regarding the variables studied.

The LTPA classification in W3 was considered to compare the LTPA averages between W3 and WC and identify the change (Δ LTPA) (Table III). The Δ LTPA means were different between the

comparison groups, indicating a greater reduction in METs/week by highly active individuals ($p < 0.001$). Still in table III, a stratified analysis was carried out by LTPA classification in W3 to identify differences in the Δ LTPA averages according to PWG. A greater reduction in LTPA (more negative Δ LTPA) was observed in those who indicated PWG and in W3 were moderately and highly active ($p < 0.001$; $p = 0.006$, respectively) (Table III).

Table IV presents the PWG in the WC, according to the change in the LTPA classification between the monitoring periods. Among those who had a low level of LTPA in W3 and became sedentary in the WC, a higher percentage reported PWG (50.2 %; $p = 0.021$). Similarly, of those who were moderately active (W3) and became sedentary (WC), 52.0 % reported PWG ($p < 0.001$) (Table IV).

In the adjusted model of binary logistic regression, it was observed that those who presented a greater chance of PWG in the WC were those who reduced the practice of LTPA to the point of modifying its classification, namely: were moderately active and became sedentary (OR = 1.5 [95 % CI, 1.2-1.9]; $p < 0.001$) or low LTPA (OR = 1.6 [95 % CI, 1.2-2.1]; $p < 0.001$); they were highly active and presented a low level of LTPA in WC (OR = 2.3 [95 % CI, 1.05-5.4]; $p = 0.036$) (Table V).

Table I. Socioeconomic, occupational, nutritional status and quality of diet variables according to perception of body weight gain in the Wave-COVID. ELSA-Brasil (2020-2021)

Variables	Perception of body weight gain		*p*-value
	No 2461 (55.9)	Yes 1941 (44.1)	
Wave 3			
Sex			
Masculine	1158 (47.1)	698 (36.0)	*< 0.001**
Feminine	1303 (52.9)	1243 (64.0)	
Age			
≤ 58 years old	974 (39.6)	1071 (55.2)	*< 0.001**
> 58 years old	1487 (60.4)	870 (44.8)	
Race/skin color†			
White	1402 (57.8)	1066 (55.2)	0.086*
Black, Brown, Asian and Indigenous	1025 (42.2)	866 (44.8)	
Per capita income (US$)†			
1st tertile (24.8 to 433.7)	761 (31.0)	656 (33.8)	*0.001**
2nd tertile (433,7 to 867.5)	832 (33.9)	715 (36.9)	
3rd tertile (867.5 to 3,296,8)	860 (35.1)	569 (29.3)	
Nutritional status†			
Not overweight	972 (39.8)	538 (27.9)	*< 0.001**
Overweight	1471 (60.2)	1390 (72.1)	
Wave-COVID			
Marital status†			
Married/Stable union	1457 (61.8)	1106 (59.9)	*0.231**
Single/ Separated/ Divorced/ Widowed	902 (38.2)	739 (40.1)	
Occupational status†			
Not an active worker	1086 (44.3)	687 (35.6)	*< 0.001**
Active worker	1364 (55.7)	1241 (64.4)	
ΔFQS†			
1st tertile (-16 to -1)	832 (37.4)	690 (39.3)	*0.420**
2nd tertile (0 to 2)	749 (33.7)	563 (32.1)	
3rd tertile (3 to 15)	643 (28.9)	501 (28.6)	

*n = 4402. Data expressed in n (%). *Chi-square test. †n different due to lack of data. BMI: body mass index; ΔFQS: change in food quality score.*

Table II. Socioeconomic, occupational, nutritional status and food quality variables according to the LTPA classification in Wave-COVID, stratified by LTPA in Wave 3 (W3). ELSA-Brasil (2020-2021)

Variables	LTPA classification in Wave-COVID				*p*-value
	Sedentary 1394 (31.7)	Low 1306 (29.7)	Moderate 1530 (34.8)	High 172 (3.9)	
Sedentary (W3) (*n* = 1315)					
Sex					
Masculine	230 (31.7)	147 (39.7)	78 (38.2)	11 (68.8)	*0.001**
Feminine	495 (68.3)	223 (60.3)	126 (61.8)	5 (31.2)	
Age					
≤ 58 years old	344 (47.4)	166 (44.9)	109 (53.4)	7 (43.8)	0.262*
> 58 years old	381 (52.6)	204 (55.1)	95 (46.6)	9 (56.2)	
Race/skin color					
White	321 (45.0)	190 (51.8)	100 (49.3)	8 (50.0)	0.193*
Black, brown, Asian and indigenous	392 (55.0)	177 (48.2)	103 (50.7)	8 (50.0)	
Per capita income (US$)					
1st tertile (24.8 to 433.7)	350 (48.3)	148 (40.0)	73 (36.1)	6 (37.5)	*0.016†*
2nd tertile (433.7 to 867.5)	236 (32.6)	127 (34.3)	78 (38.6)	6 (37.5)	
3rd tertile (867.5 to 3,296.8)	139 (19.2)	95 (25.7)	51 (25.2)	4 (25.0)	
Nutritional status					
Not overweight	183 (25.4)	110 (30.0)	66 (33.0)	7 (43.8)	0.057*
Overweight	537 (74.6)	257 (70.0)	134 (67.0)	9 (56.2)	
Marital status					
Married/Stable union	376 (54.7)	196 (55.8)	115 (59.3)	8 (57.1)	0.734*
Single/Separated/Divorced/Widowed	311 (45.3)	155 (44.2)	79 (40.7)	6 (42.9)	
Occupational status					
Not an active worker	310 (42.9)	140 (37.9)	69 (34.3)	6 (37.5)	0.118*
Active worker	413 (57.1)	229 (62.1)	132 (65.7)	10 (62.5)	
ΔFQS					
1st tertile (-15 to -1)	268 (41.8)	121 (36.1)	61 (33.3)	7 (53.8)	0.271†
2nd tertile (0 to 2)	207 (32.3)	113 (33.7)	64 (35.0)	3 (23.1)	
3rd tertile (3 to 13)	166 (25.9)	101 (30.1)	58 (31.7)	3 (23.1)	
Low (W3) (*n* = 960)					
Sex					
Masculine	91 (29.3)	170 (43.9)	111 (43.5)	4 (57.1)	*< 0.001†*
Feminine	220 (70.7)	217 (56.1)	144 (56.5)	3 (42.9)	
Age					
≤ 58 years old	150 (48.2)	181 (46.8)	118 (46.3)	6 (85.7)	0.236†
> 58 years old	161 (51.8)	206 (53.2)	137 (53.7)	1 (14.3)	
Race/skin color					
White	166 (53.7)	232 (60.6)	154 (61.6)	4 (57.1)	0.197†
Black, brown, Asian and indigenous	143 (46.3)	151 (39.4)	96 (38.4)	3 (42.9)	
Per capita income (US$)					
1st tertile (28.8 to 433.7)	114 (36.9)	122 (31.5)	69 (27.1)	3 (42.9)	0.166†
2nd tertile (433.7 to 867.5)	114 (36.9)	151 (39.0)	97 (38.0)	3 (42.9)	
3rd tertile (867.5 to 3,296.8)	81 (26.2)	114 (29.5)	89 (34.9)	1 (14.3)	

(Continues on next page)

Table II (cont.). Socioeconomic, occupational, nutritional status and food quality variables according to the LTPA classification in Wave-COVID, stratified by LTPA in Wave 3 (W3). ELSA-Brasil (2020-2021)

Variables	LTPA classification in Wave-COVID				*p*-value
	Sedentary 1394 (31.7)	Low 1306 (29.7)	Moderate 1530 (34.8)	High 172 (3.9)	
Low (W3) (*n* = 960)					
Nutritional status					
Not overweight	92 (29.7)	129 (33.7)	91 (35.7)	2 (28.6)	0.465†
Overweight	218 (70.3)	254 (66.3)	164 (64.3)	5 (71.4)	
Marital status					
Married/Stable union	168 (56.0)	239 (64.6)	156 (64.7)	4 (80.0)	0.067†
Single/Separated/Divorced/Widowed	132 (44.0)	131 (35.4)	85 (35.3)	1 (20.0)	
Occupational status					
Not an active worker	133 (42.8)	156 (40.6)	102 (40.2)	1 (14.3)	0.509†
Active worker	178 (57.2)	228 (59.4)	152 (59.8)	6 (85.7)	
ΔFQS					
1st tertile (-11 to -1)	125 (43.6)	122 (35.6)	79 (34.5)	1 (20.0)	0.062†
2nd tertile (0 to 2)	94 (32.8)	117 (34.1)	71 (31.0)	1 (20.0)	
3rd tertile (3 to 15)	68 (23.7)	104 (30.3)	79 (34.5)	3 (60.0)	
Moderate (W3) (*n* = 1846)					
Sex					
Masculine	125 (37.8)	217(42.9)	444 (48.3)	61 (68.5)	*< 0.001**
Feminine	206 (62.2)	289 (57.1)	476 (51.7)	28 (31.5)	
Age					
≤ 58 years old	150 (45.3)	218 (43.1)	407 (44.2)	48 (53.9)	0.293*
> 58 years old	181 (54.7)	288 (56.9)	513 (55.8)	41 (46.1)	
Race/skin color					
White	178 (54.3)	320 (63.6)	593 (65.0)	53 (60.9)	*0.007**
Black, brown, Asian and indigenous	150 (45.7)	183 (36.4)	320 (35.0)	34 (39.1)	
Per capita Income (US$)					
1st tertile (24.8 to 433.7)	122 (36.9)	116 (23.1)	193 (21.0)	28 (31.5)	*< 0.001**
2nd tertile (433.7 to 867.5)	99 (29.9)	185 (36.9)	323 (35.1)	26 (29.2)	
3rd tertile (867.5 to 3,296.8)	110 (33.2)	201 (40.0)	403 (43.9)	35 (39.3)	
Nutritional status					
Not overweight	107 (32.6)	191 (38.0)	380 (41.5)	38 (42.7)	*0.032**
Overweight	221 (67.4)	312 (62.0)	535 (58.5)	51 (57.3)	
Marital status					
Married/Stable union	179 (57.4)	300 (61.5)	586 (66.1)	62 (71.3)	*0.013**
Single/Separated/Divorced/Widowed	133 (42.6)	188 (38.5)	301 (33.9)	25 (28.7)	
Occupational status					
Not an active worker	143 (43.6)	215 (42.7)	359 (39.2)	31 (35.2)	0.279*
Active worker	185 (56.4)	289 (57.3)	556 (60.8)	57 (64.8)	

(Continues on next page)

Table II (cont.). Socioeconomic, occupational, nutritional status and food quality variables according to the LTPA classification in Wave-COVID, stratified by LTPA in Wave 3 (W3). ELSA-Brasil (2020-2021)

Variables	LTPA classification in Wave-COVID				*p*-value
	Sedentary 1394 (31.7)	Low 1306 (29.7)	Moderate 1530 (34.8)	High 172 (3.9)	
Moderate (W3) (*n* = 1846)					
ΔFQS					
1st tertile (-16 to -1)	127 (42.1)	192 (41.4)	295 (34.9)	27 (4.2)	0.082*
2nd tertile (0 to 2)	98 (32.5)	143 (30.8)	290 (34.3)	33 (41.8)	
3rd tertile (3 to 12)	77 (25.5)	129 (27.8)	261 (30.9)	19 (24.1)	
High (W3) (*n* = 281)					
Sex					
Masculine	11 (40.7)	25 (58.1)	90 (59.6)	41 (68.3)	0.116*
Feminine	16 (59.3)	18 (41.9)	61 (40.4)	19 (31.7)	
Age					
≤ 58 years old	12 (44.4)	22 (51.2)	78 (51.7)	29 (48.3)	0.900*
> 58 years old	15 (55.6)	21 (48.8)	73 (48.3)	31 (51.7)	
Race/skin color					
White	13 (48.1)	21 (48.8)	84 (56.0)	31 (51.7)	0.769*
Black, brown, Asian and indigenous	14 (51.9)	22 (51.2)	66 (44.0)	29 (48.3)	
Per capita Income (US$)					
1st tertile (104 to 433.7)	9 (33.3)	9 (20.9)	38 (25.2)	17 (28.3)	0.929*
2nd tertile (433.7 to 867.5)	9 (33.3)	18 (41.9)	55 (36.4)	20 (33.3)	
3rd tertile (867.5 to 3,296.8)	9 (33.3)	16 (37.2)	58 (38.4)	23 (38.3)	
Nutritional status					
Not overweight	8 (29.6)	14 (32.6)	67 (44.7)	25 (43.1)	0.302*
Overweight	19 (70.4)	29 (67.4)	83 (55.3)	33 (56.9)	
Marital status					
Married/Stable union	16 (64.0)	25 (61.0)	84 (66.2)	39 (65.0)	0.942*
Single/Separated/Divorced/Widowed	9 (36.0)	16 (39.0)	48 (33.8)	21 (35.0)	
Occupational status					
Not an active worker	15 (55.6)	15 (36.6)	58 (38.7)	20 (33.3)	0.258*
Active worker	12 (44.4)	26 (63.4)	92 (61.3)	40 (66.7)	
ΔFQS					
1st tertile (-11 to -1)	9 (39.1)	17 (45.9)	52 (38.5)	19 (33.9)	0.941*
2nd tertile (0 to 2)	6 (26.1)	10 (27.0)	43 (31.9)	19 (33.9)	
3rd tertile (3 to 11)	8 (34.8)	10 (27.0)	40 (26.6)	18 (32.1)	

*n = 4402. Data presented in n (%). *Chi-square test; †Fisher's exact test. LTPA: leisure-time physical activity.*

Table III. Leisure-time physical activity (LTA) in Wave 3 and Wave-COVID and the change in LTPA (Δ) according to perceived body weight gain, in the total sample and stratified by the LTPA classification in Wave 3. ELSA-Brasil study (2020- 2021)

LTPA classification in Wave 3†	LTPA (METs/week)		*p*-value*	Δ LTPA (METs/week)†	Perception of body weight gain		*p*-value‡
					No 2461 (55.9)	Yes 1941 (44.1)	
	Wave 3	Wave-COVID			Δ LTPA (METs/week)	Δ LTPA (METs/week)	
Sedentary	-	321.5 ± 659.8	*< 0.001*	321.5 ± 659.8[a]	340 ± 701.2	299.8 ± 607.3	0.295
Low	353.4 ± 152.7	469.6 ± 634.2	0.289	116.1 ± 637.9[b]	152.9 ± 657.3	68.4 ± 609.4	*0.026*
Moderate	1410.8 ± 631.6	961.2 ± 1002.8	*< 0.001*	-449.5 ± 1032.4[c]	- 323.3 ± 1063.6	- 616.4 ± 965.3	*< 0.001*
High	4214.6 ± 910.6	1860.5 ± 1475.5	*< 0.001*	-2354.1 ± 1674.2[d]	- 2102 ± 1691.9	- 2673.3 ± 1601.9	*0.006*

*n = 4402. Data expressed as mean ± standard deviation. *Wilcoxon's test; †p < 0.001 by the Kruskal-Wallis test followed by the post-hoc pairwise test; ‡Mann-Whitney test.*

Table IV. Perceived body weight gain according to change in LTPA classification between Wave 3 (W3) and Wave-COVID (WC)

LTPA classification	Perception of body weight gain		*p*-value
	No 2461 (55.9)	Yes 1941 (44.1)	
Sedentary (W3)			
Sedentary (WC)	383 (52.8)	342 (47.2)	
Low (WC)	204 (55.1)	166 (44.9)	*0.718**
Moderate (WC)	114 (55.9)	90 (44.1)	
High (WC)	10 (62.5)	6 (37.5)	
Low (W3)			
Sedentary (WC)	155 (49.8)	156 (50.2)	
Low (WC)	224 (57.9)	163 (42.1)	*0.021†*
Moderate (WC)	159 (62.4)	96 (37.6)	
High (WC)	4 (57.1)	3 (42.9)	
Moderate (W3)			
Sedentary (WC)	159 (48.0)	172 (52.0)	
Low (WC)	256 (50.6)	250 (49.4)	*< 0.001**
Moderate (WC)	569 (61.8)	351 (38.2)	
High (WC)	67 (75.3)	22 (24.7)	
High (W3)			
Sedentary (WC)	12 (44.4)	15 (55.6)	
Low (WC)	20 (46.5)	23 (53.5)	*0.081**
Moderate (WC)	84 (55.6)	67 (44.4)	
High (WC)	41 (68.3)	19 (31.7)	

*n = 4402. Data presented in n (%). *Chi-square test; †Fisher's exact test; LTPA: leisure-time physical activity.*

Table V. Crude and adjusted binary logistic regression for perceived body weight gain and change in Leisure-time Physical Activity (LTPA) classification between Wave 3 (W3) and Wave-COVID (WC)

LTPA classification	Perception of body weight gain*			*p*-value
	Crude model OR (95 % IC)	*p*-value	Adjusted model OR (95 % IC)	
Sedentary (W3)				
Sedentary (WC)	1		1	
Low (WC)	0.9 (0.7-1.1)	0.469	0.9 (0.7-1.2)	0.932
Moderate (WC)	0.8 (0.6-1.2)	0.440	0.9 (0.6-1.2)	0.915
High (WC)	0.6 (0.2-1.8)	0.446	0.8 (0.3-2.4)	0.861
Low (W3)				
Sedentary (WC)	*1.3 (1.02-1.8)*	*0.034*	1.2 (0.9-1.7)	0.113
Low (WC)	1		1	
Moderate (WC)	1.0 (0.2-4.6)	0.969	0.9 (0.2-4.4)	0.985
High (WC)	0.8 (0.6-1.1)	0.259	0.8 (0.6-1.1)	0.361
Moderate (W3)				
Sedentary (WC)	*1.5 (1.2-1.9)*	*< 0.001*	*1.5 (1.2-1.9)*	*< 0.001*
Low (WC)	*1.7 (1.3-2.2)*	*< 0.001*	*1.6 (1.2-2.1)*	*< 0.001*
Moderate (WC)	*1*		1	
High (WC)	*0.5 (0.3-0.8)*	*0.013*	0.6 (0.3-1.0)	0.052
High (W3)				
Sedentary (WC)	*2.6 (1.06-6.8)*	*0.037*	2.4 (0.9-6.1)	0.070
Low (WC)	*2.4 (1.1-5.5)*	*0.028*	*2.3 (1.05-5.4)*	*0.036*
Moderate (WC)	1.7 (0.9-3.2)	0.092	1.6 (0.8-3.1)	0.117
High (WC)	1		1	

*OR: odds ratio; 95 % CI: 95 % confidence interval; *Reference category "no perception of body weight gain"; 1 = reference category "did not change LTPA classification". Variables with p < 0.20 in the bivariate analysis were inserted into the model adjusted using the Enter method, namely: Sedentary (W3) – sex, race/color, per capita income, nutritional status and occupational status; Low (W3) – sex, race/color and per capita income; Moderate (W3) – sex, race/color, per capita income and nutritional status; High (W3) – sex.*

DISCUSSION

In a sample of active and retired public servants, those who were moderately and highly active in W3, but reduced the practice of LTPA in the WC (became classified as insufficiently active or sedentary), had a higher chance of PWG.

Several studies have highlighted the relationship between physical activity and body weight (24,25). However, the self-reported nature of our data introduces subjectivity, potentially influenced by heightened awareness of body weight and health among previously physically active individuals during COVID-19 restrictions. Meta-analysis by Buja and collaborators (26) observed that, compared to those with a more sedentary lifestyle, active individuals tend to have higher levels of health literacy, understood, among other things, as the ability to make appropriate decisions related to health and having greater control over it, with practical consequences in everyday life.

Self-perception of body weight is understood as the degree of agreement between real and self-reported weight (27). Therefore, it is considered an important dimension of body image awareness, which is linked to how the person sees themselves and how they relate to society (27,28). From this perspective, the higher percentage of PWG among women and younger people is justified. These carry a social stigma that sometimes makes them pay more attention to aesthetic issues, and, therefore, to body weight (29). Furthermore, there are studies that considered female gender as a predictor of weight gain during COVID-19 (7,30).

Among both in-person and remote workers, the prevalence of PWG was notably higher compared to retirees. This trend may be attributed to the widespread adoption of remote work during the pandemic people (in our study 77.2 % were working from home), which likely fostered a more sedentary lifestyle among individuals, consequently impacting body weight (31). Furthermore, individuals already classified as overweight in W3 constituted a higher percentage of those reporting PWG in WC. Seal and collaborators (12), in a survey conducted with North American adults, observed that 26% of individuals with obesity gained

more than 2 kg during the COVID-19 pandemic, compared to 14.8 % of individuals with normal weight ($p < 0.001$).

Moreover, individuals in the lowest per capita income tertile comprised the smallest proportion of those reporting PWG. While the relationship between body weight gain during the pandemic and socioeconomic status remains debated (12,32), evidence suggests that a better socioeconomic condition enables the adoption of healthier eating habits even amidst social distancing measures (33,34), thereby serving as a protective factor against weight gain.

Although our study did not reveal a significant association between changes in food quality and PWG, several studies have indicated a deterioration in food consumption due to COVID-19-related restrictions (35,36). Consequently, it is plausible that such dietary changes may have contributed to PWG.

Regarding of changes in LTPA during COVID-19, we observed that those who were previously active were those who showed the most changes in their sports practice during the period of social distancing. A similar result was evidenced in a study conducted with adults in Qatar, in which the greatest propensity for changes in the time dedicated to physical activity was in those who were active before the pandemic and went to the gym regularly, when compared to those who were less active (37). Although we did not evaluate the motivation for reducing the practice of physical activity, Constandt and collaborators (38) point out that the lack of time and the closure of spaces intended for such activities were some of the main reasons.

Furthermore, we identified that those who were sedentary started to practice some type of physical activity during the period of social restriction, corroborating what was presented by other studies carried out in Austria (39) and Belgium (38). Such findings are possibly justified by the perception of threatened health due to the presence of the virus, leading the individual to seek the benefits of physical exercise (40).

The use of self-reported data can be understood as a limitation, as they can contribute to the occurrence of information bias. Furthermore, the use of online questionnaires was subject to selection bias. However, during the period of social distancing, the use of these tools became necessary and important in several studies. In our research, we used the telephone call feature for those who indicated difficulties in using technology, seeking to mitigate possible effects of this last bias. Monitoring participants from a relevant cohort in Brazil during COVID-19, and the use of longitudinal data to evaluate the exposure studied, were understood as potentialities of the present study.

It is concluded, therefore, that among active and retired public servants of the ELSA-Brasil cohort, those who practiced LTPA (moderately and highly) in W3, and who became insufficiently active and sedentary in WC, were those who had higher odds of PWG after adjustments for potentially confounding variables.

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