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Original Article

EFFECT OF ISOTEMPORAL REPLACEMENT OF PHYSICAL ACTIVITY IN DIFFERENT CONTEXTS ON OBESITY IN BRAZILIAN ADULTS

EFEITO DA SUBSTITUIÇÃO ISOTEMPORAL ENTRE OS DOMÍNIOS DA ATIVIDADE FÍSICA SOB A OBESIDADE EM ADULTOS BRASILEIROS

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ABSTRACT
Overall physical activity (PA) contributes to reducing obesity. The objective of this study was to estimate the effect of reallocating time between the domains of PA on the obesity in adults in Brazilian capitals and the Federal District. This study comes from VIGITEL system carried out in 2019. The outcome was obesity, measured via body mass index (≥30 kg/m2). The time in the PA domains (leisure-time, occupational, domestic and commuting activities) analyzed using the isotemporal substitution method of 75, 150 and 300 minutes/week. Prevalence Ratios (PR) were used as a measure of association. Participated 52.1% women in the study. Among men, reallocating the minutes of PA constants in leisure-time to occupational and home activities corresponded with an increase in the prevalence of obesity. In women, the transfer of PA during commuting to leisure-time physical activities demonstrated a protective effect (decrease in the prevalence of obesity by 25.2% in relation to a constant of 150 minutes/week and 44% for a constant of 300 minutes/week). It is concluded that, when reallocating practice time in the areas of commuting, home and occupational activities to leisure-time, in Brazilian adults, there was an association with a reduction in the prevalence of obesity, especially in women.
Keywords: Nutritional status. Body mass index. Motor activity. Leisure activities. Commuting.

RESUMO
A atividade física (AF) global contribui para a redução da obesidade. O objetivo deste estudo foi estimar o efeito da realocação do tempo entre os domínios da AF sob a prevalência de obesidade em adultos das capitais brasileiras e do Distrito Federal. Este estudo derivado do VIGITEL realizado em 2019. O desfecho foi a obesidade, medida por meio do índice de massa corporal (≥30 kg/m^2). O tempo nos domínios de AF (atividades lazer, ocupacionais, domésticas e deslocamento) analisado pelo método de substituição isotemporal de 75, 150 e 300 minutos/semana. Razões de Prevalência (RP) foram utilizadas como medida de associação. Participaram 52,1% mulheres no estudo. Entre os homens, a realocação dos minutos constantes de AF no lazer para atividades ocupacionais e domésticas correspondeu a um aumento na prevalência de obesidade. Nas mulheres, a transferência da AF no deslocamento para AF de lazer demonstrou efeito protetor (diminuição da prevalência de obesidade em 25,2% em relação a constante de 150 minutos/semana e 44% para a constante de 300 minutos/semana). Conclui-se que, ao realocar o tempo de prática nas áreas de deslocamento, atividades domésticas e ocupacionais para o lazer, em adultos brasileiros, houve associação com redução da prevalência de obesidade, principalmente em mulheres.
Palavras-chave: Estado nutricional. Índice de massa corporal. Atividade motora. Atividades de lazer. Deslocamento.

Introduction

Obesity is a public health problem that, in addition to compromising quality of life, is associated with the development of numerous chronic diseases[1]. The World Health Organization estimates that the global prevalence of obesity has almost tripled since 1975, and in 2016 the frequency of obese adults was 13%, so that more than 650 million people aged 18 and over are obese[2]. In Brazil, according to a report from the Risk Factor and Health Protection Surveillance system (VIGITEL), the average annual variation in the prevalence of obesity in the period from 2006 to 2019 in percentage points, among women was 0.66 and for men it was 0.59[3].

Among health-related behaviors, physical activity plays an important role against of the occurrence of obesity[2,4]. Physical activity in general is associated with a lower incidence of obesity[5], and the practice carried out specifically during leisure time is inversely related to this disease[6,7], especially when performed at moderate to vigorous intensity[7,8]. Furthermore, the practice of physical activity in the context of commuting can negatively influence the occurrence of overweight and obesity[9]. On the other hand, the practice of physical activities in occupational and domestic contexts does not demonstrate an impact on reducing obesity[10,11].

Despite evidence on the importance of physical activity in controlling body weight[12], the practice of physical activities in Brazil, at an insufficient level (less than 150 minutes per week), is recurrent (44.8%) in the adult population, with a higher prevalence among women[3]. In order to protect people from the advancement of obesity, moving more appears to be a key lifestyle strategy to adopt[13], therefore, reducing the time exposed to sedentary behavior and reallocating it to the practice of physical activities at moderate to vigorous intensity is essential to minimize the impact of excess central or global adiposity in adults[14].

Otherwise, it is essential to consider that physical activity in Brazil, in most situations, is not a choice, but a necessity[15]. In different situations, this practice can be carried out in unhealthy places and without the minimum quality, even in the context of leisure. Little is known about the effects of practice in each domain of physical activity (leisure, commuting, occupational and domestic activities) in relation to the occurrence of obesity in the Brazilian adult population, as well as the impact of transferring practice time in a context to the other, for example, when you can choose to walk to work instead of playing sports in your free time. In this way, this understanding may favor the implementation of public policies to guide the adoption of this behavior in domains of practice that can effectively minimize the occurrence of obesity. Based on the above, the objective of this study was to estimate the effect of reallocating time between the domains of physical activity on the prevalence of obesity in adults in Brazil.

Methods

Study characterization

This secondary data analysis study comes from public domain information from the Risk Factor and Health Protection Surveillance system (VIGITEL), carried out in 2019. The Vigitel research was approved by the National Research Ethics Commission of the Brazilian Ministry of Health (CAAE: 65610017.1.0000.0008) and is based on the guidelines of the Declaration of Helsinki. All participants reported verbal consent.

Participants

The VIGITEL system, implemented in 2006, corresponds to one of the biggest actions of the Brazilian Ministry of Health, which seeks to monitor, through cross-sectional studies, on an annual basis, by telephone contact, the adult population (18 years or older) of the 26 capitals of the Brazilian states plus the Federal District (capital of Brazil), information about chronic non-communicable diseases and their risk/protective factors. The sample is made up of the population of each city participating in VIGITEL, selected through fixed telephone lines, totaling a minimum of 2,000 lines. Details on the sampling procedures and data collection instrument are available in a previous report[3].

Procedures

In this study, the dependent variable was body mass index (BMI) and the outcome was obesity (BMI: $\geq$30 kg/m^2)[2]. To obtain the BMI, the measures reported of height in meters and body mass in kilos were analyzed by standard equation (body mass divided by height squared)

The measurements of body mass and height have satisfactory validity for use in epidemiological telephone surveys with adults[16].

The independent variables were the times in minutes, referring to physical activities, according to the domains: leisure-time, commuting, occupational and home activities. The validity of the physical activity measures of the VIGITEL questionnaire were previously presented[17]. The physical activity variables in time format in minutes in intensity moderate to vigorous are made available in the microdata of the VIGITEL survey, as they are precursors for classifying the practice of physical activity at a sufficient level[3]. Chart 1 describes the questions from the VIGITEL questionnaire relating to each domain investigated in this study.

Variable (domains of physical activity)	Survey questions
Leisure-time physical activity	In the last three months, have you practiced any type of physical exercise or sport?
	What is the main type of physical exercise or sport that you practiced?
	Do you exercise at least once a week?
	How many days a week do you usually practice physical exercise or sport?
	On the day you practice exercise or sport, how long does this activity last?
Occupational physical activity	In the last three months, did you work?
	At work, do you walk a lot?
	At work, do you carry weight or do other heavy activities?
	In a normal week, how many days do you do these activities at work?
	When you carry out these activities, how long does it usually last?
Physical activity while commuting	To get to or from work, do you walk or cycle some distance?
	How much time do you spend going back and forth on this route (on foot or by bike)?
	Are you currently attending a course/school or taking someone to a course/school?
	To get to or from this course or school, do you travel on foot or by bike?
	How much time do you spend going back and forth on this route (on foot or by bike)?
Physical activity at home	Who usually cleans your house?
	The heaviest part of the cleaning is:
	In a normal week, how many days do you clean your house?
	And how long does cleaning usually take?

Chart 1. Description of physical activity variables from the VIGITEL survey, Brazil, 2019.
Source: The authors.

In calculating the minutes of leisure-time physical activity, moderate and vigorous intensities are considered, based on the relative energy expenditure associated with the type of activity practiced[18], with the time in minutes of vigorous-intensity activities weighted by two[19]. For the other domains, it is not possible to consider the specificities of the activities performed; however, the minimum intensity is estimated as moderate through the questions used. The exception occurs only in the context of physical activities at home, which may not accurately represent the practice at moderate intensity.

In this study, the minutes of physical activity per week in the different domains were standardized based on the constants of 75, 150 and 300 minutes per week, in moderate to

vigorous intensities. The time in minutes in each domain was divided by the value of each constant. This value represents the standardized time in minutes.

These constants were adopted to characterize a possible relationship with the recommendations for the practice of global physical activities presented by the Physical Activity Guide for the Brazilian population[20] and WHO[21]. Both guidelines indicate the minimum for acquiring health benefits, at 150 minutes per week in physical activities at moderate[20,21], and the WHO[21] points out the possibility of practicing 300 minutes or more at moderate intensity to obtain additional benefits to health. health.

The variables analyzed in this study as descriptive variables of the sample and control variable in the adjusted analyzes were: regions of Brazil, based on the capitals and the Federal District (north, northeast, center west, southeast and south); age (18-24, 25-34, 35-44, 45-54, 55-64, and 65 or more); marital status (with partner and without partner); years of schooling, classified as 0 to 8 years, 9 to 11 years and 12 years or more; screen time (television or computer, tablet or cell phone, in free time per day) for 3 hours or more (no and yes); consumption of recommended fruits and vegetables, referring to the consumption of fruits (maximum of three servings per day) or fruit juices (maximum of 1 juice per day) and raw vegetables (salads) or cooked at lunch and/or dinner (maximum of four servings) on five or more days of the week (no and yes); and quantity of ultra-processed foods consumed, with a value of 1 being computed for each positive answer for the products consumed (soft drink; fruit juice in box or can; powdered drink; chocolate drink; flavored yogurt; packaged snacks [or chips] or savory, sweet or stuffed biscuits, or packaged cupcakes; chocolate, ice cream, gelatin, or other industrialized dessert; sausage, mortadella or ham; sliced bread, hot dog or hamburger; mayonnaise, ketchup or mustard; margarine; instant noodles, packaged soup, frozen lasagna or other ready-made dish purchased frozen).

Statistical analysis

Data were analyzed using post-stratification weight assignment, called the rake method. Descriptive analyzes of absolute and relative frequencies, mean, standard deviation (SD), median and interquartile range were carried out. The measure of association was the Prevalence Ratios (PR), complemented by the 95% confidence interval (95%CI), with the values presented in four decimal places, aiming to observe with quality the effect estimates.

Isotemporal analysis was performed, which represents a model implemented in the epidemiology of physical activity, which focuses on investigating the effect of transferring time spent on a certain activity to another. In this proposition, when removing one of the activities, the coefficients of the activities that remain present the effect of this replacement[22]. It is possible to identify this effect because the total time is included in the analysis, that is, the sum of the standardized minutes of the four domains. Thus, the increase or decrease in the prevalence of obesity is due to the increase in minutes per week of physical activities standardized according to the constant, which were not removed. For example, the increase or decrease in the PR of the occurrence of obesity is due to the increase of 75, 150 or 300 minutes per week in the behaviors that were not removed.

In these analyzes there was an adjustment for the control variables, in analyzes separated by gender. The Omnibus test was considered for the purpose of analyzing the quality of adjustment of the models, as it compares the current model in relation to the null model (intercept), with the occurrence of a p-value <0.05 being considered to be of satisfactory quality. Statistical analysis was performed using IBM SPSS software, version 25.0. The association was considered based on 95%CI values that do not cross 1.

Results

Participated in the study 52,443 adults aged 18 or over. However, 10.2% did not report information to estimate obesity. Therefore, the sample for this study was 47,119 adults, with a predominance of participants from the southeast region of Brazil (44%). Among women, which corresponded to 52.1% of the sample, there were 55.1% without a partner, age range from 25 to 34 years (24.3%), 24.6% with up to 8 years of education, 71.9% who did not consume fruits and vegetables, an average of 2.60 (SD: 1.87) consumed ultra-processed foods and 61.7% who did not spend more than 3 hours on screen time. In relation to men, there were 50.3% without a partner, aged between 25 and 34 years (27.4%), 28.3% with up to 8 years of education, 81.5% who did not consume fruits and vegetables, an average of 3.04 (SD: 2.06) consumed ultra-processed foods and 61.3% who did not spend more than 3 hours on screen time. The time in minutes of physical activity during leisure, commuting, occupational and home activities in relation to sex are presented in Table 1.

Table 1. Description of time in minutes of physical activities in different domains in Brazilian adults, according to gender. VIGITEL, Brazil, 2019.

Variables	Gender			
	Male		Female	
	Mean (SD)	Med. (IQ)	Mean (SD)	Med. (IQ)
Minutes of leisure-time physical activity	152.90 (173.27)	101.50 (210)	107.20 (140.35)	0 (210)
Minutes of physical activity while commuting	44.13 (92.53)	0 (0)	41.67 (90.91)	0 (0)
Minutes of occupational physical activity	294.55 (746.51)	0 (0)	97.88 (417.95)	0 (0)
Minutes of physical activity at home	91.02 (209.93)	0 (100)	248.57 (380.08)	120 (360)

Note: SD: Standard Deviation; Med.: Median; IQ: interquartil range.
Source: The authors.

The prevalence of obesity observed in men and women was 19.6% and 20.8%, respectively. Table 2 presents the reallocation analysis of the time of 75 minutes per week of practice between the domains of physical activities in relation to gender. Among men, when reallocating minutes of leisure-time physical activity to commuting, there was a lower occurrence of obesity (PR: 0.9940; 95%CI: 0.9929 – 0.9951), however, for the other domains there was an increase in the prevalence of obesity by approximately 5%. The prevalence of obesity has decreased by reallocating physical activity time from work and home to the domains of commuting and leisure. In relation to women, the lowest occurrence of obesity was observed when reallocating time in physical activities from commuting to leisure activities (RP: 0.8649; 95%CI: 0.8640 – 0.8657).

Table 3 presents the reallocation analysis of the time of 150 minutes per week of practice between the domains of physical activities in relation to gender. Among men, when reallocating minutes of leisure-time physical activity to commuting, there was a lower occurrence of obesity (PR: 0.9881; 95%CI: 0.9859 – 0.9903), however, for the other domains there was an increase in the prevalence of obesity. On the other hand, the prevalence of obesity decreased by 11% when reallocating occupational physical activity time to commuting. For Brazilian women, reallocating time in leisure-time physical activities to other domains of physical activity favored an increase in the prevalence of obesity of more than 23%. By reallocating time from physical

activities during commuting to leisure time, there was a reduction in the prevalence of obesity by 25.2%.

Table 2. Analysis of reallocation between times of physical activity in different domains, based on a constant of 75 minutes per week[+], under obesity in Brazilian adults, according to gender. VIGITEL, Brazil, 2019.

Outcome Variable	Variables	Physical activity not replaced			
		Minutes of leisure-time physical activity	Minutes of physical activity while commuting	Minutes of occupational physical activity	Minutes of physical activity at home
		PR (95%CI)*	PR (95%CI)*	PR (95%CI)*	PR (95%CI)*
Obesity	**Replacement physical activity**	Male[++]			
	Minutes of leisure-time physical activity	**Replaced**	0.9940 (0.9929 – 0.9951)	1.0568 (1.0562 – 1.0574)	1.0527 (1.0520 – 1.0534)
	Minutes of physical activity while commuting	1.0060 (1.0049 – 1.0071)	**Replaced**	1.0631 (1.0621 – 1.0642)	1.0590 (1.0579 – 1.0601)
	Minutes of occupational physical activity	0.9462 (0.9457 – 0.9467)	0.9406 (0.9397 – 0.9415)	**Replaced**	0.9961 (0.9957 – 0.9965)
	Minutes of physical activity at home	0.9499 (0.9493 – 0.9506)	0.9443 (0.9433 – 0.9452)	1.0039 (1.0035 – 1.0043)	**Replaced**
	Replacement physical activity	Female[++]			
	Minutes of leisure-time physical activity	**Replaced**	1.1562 (1.1551 – 1.1573)	1.1135 (1.1128 – 1.1142)	1.1157 (1.1150 – 1.1164)
	Minutes of physical activity while commuting	0.8649 (0.8640 – 0.8657)	**Replaced**	0.9630 (0.9623 – 0.9638)	0.9650 (0.9642 – 0.9657)
	Minutes of occupational physical activity	0.8981 (0.8975 – 0.8987)	1.0384 (1.0376 – 1.0392)	**Replaced**	1.0020 (1.0018 – 1.0022)
	Minutes of physical activity at home	0.8963 (0.8957 – 0.8969)	1.0363 (1.0355 – 1.0371)	0.9980 (0.9978 – 0.9982)	**Replaced**

Note: PR: Prevalence Ratios; 95%CI: 95% Confidence Interval; +The time in each variable was divided by 75 (constant), thus the increase or decrease in the PR of the occurrence of obesity is due to the increase of 75 minutes per week in the behavior; *Effect of physical activity due to the reallocation of time from one of the behaviors to the others under obesity; ++Adjusted for region of the country, age, years of schooling, marital status, screen time, consumption of fruits and vegetables, amount of ultra-processed foods consumed; Significant associations are represented by the 95%CI that does not cross the value 1. All models presented in this table showed satisfactory quality of adjustment (Omnibus test p-value <0.05).

Source: The authors.

Table 4 presents the analysis of the reallocation of time of 300 minutes per week of practice between the domains of physical activities in relation to gender. Among men, when reallocating minutes of leisure-time physical activity to commuting, there was a lower occurrence of obesity (PR: 0.9764; 95% CI: 0.9721 – 0.9807). The prevalence of obesity decreased by approximately 22% when reallocating time from occupational physical activities to commuting. In relation to women, reallocating time in leisure-time physical activities to other domains of physical activity was associated with increased prevalence. On the other hand, the greatest protective factor against obesity occurred when reallocating time from physical activities during commuting to physical activities during leisure time, with a decrease in the prevalence of obesity by 44%.

Table 3. Analysis of reallocation between times of physical activity in different domains, based on a constant of 150 minutes per week[+], under obesity in Brazilian adults according to gender. VIGITEL, Brazil, 2019.

Outcome Variable	**Variables**	**Physical activity not replaced**			
		Minutes of leisure-time physical activity	**Minutes of physical activity while commuting**	**Minutes of occupational physical activity**	**Minutes of physical activity at home**
		PR (CI95%)*	**PR (CI95%)***	**PR (CI95%)***	**PR (CI95%)***
Obesity	**Replacement physical activity**	Male[++]			
	Minutes of leisure-time physical activity	**Replaced**	0.9881 (0.9859 – 0.9903)	1.1168 (1.1156 – 1.1180)	1.1082 (1.1067 – 1.1096)
	Minutes of physical activity while commuting	1.0120 (1.0098 – 1.0143)	**Replaced**	1.1302 (1.1281 – 1.1324)	1.1215 (1.1192 – 1.1238)
	Minutes of occupational physical activity	0.8954 (0.8944 – 0.8963)	0.8847 (0.8830 – 0.8865)	**Replaced**	0.9922 (0.9915 – 0.9930)
	Minutes of physical activity at home	0.9024 (0.9012 – 0.9036)	0.8917 (0.8898 – 0.8935)	1.0078 (1.0070 – 1.0086)	**Replaced**
	Replacement physical activity	Female[++]			
	Minutes of leisure-time physical activity	**Replaced**	1.3368 (1.3342 – 1.3394)	1.2398 (1.2382 – 1.2414)	1.2448 (1.2432 – 1.2464)
	Minutes of physical activity while commuting	0.7480 (0.7466 – 0.7495)	**Replaced**	0.9275 (0.9260 – 0.9289)	0.9312 (0.9298 – 0.9326)
	Minutes of occupational physical activity	0.8065 (0.8055 – 0.8076)	1.0782 (1.0766 – 1.0798)	**Replaced**	1.0040 (1.0035 – 1.0044)
	Minutes of physical activity at home	0.8033 (0.8023 – 0.8044)	1.0739 (1.0723 – 1.0755)	0.9960 (0.9956 – 0.9964)	**Replaced**

Note: PR: Prevalence Ratios; 95%CI: 95% Confidence Interval; +The time in each variable was divided by 150 (constant), thus the increase or decrease in the PR of the occurrence of obesity is due to the increase of 150 minutes per week in the behavior; *Effect of physical activity due to the reallocation of time from one of the behaviors to the others under obesity; ++Adjusted for region of the country, age, years of schooling, marital status, screen time, consumption of fruits and vegetables, amount of ultra-processed foods consumed; Significant associations are represented by the 95%CI that does not cross the value 1. All models presented in this table showed satisfactory quality of adjustment (Omnibus test p-value <0.05).

Source: The authors.

Table 4. Analysis of reallocation between times of physical activity in different domains, based on a constant of 300 minutes per week[+], under obesity in Brazilian adults according to gender. VIGITEL, Brazil, 2019.

Outcome Variable	Variables	Physical activity not replaced			
		Minutes of leisure-time physical activity	Minutes of physical activity while commuting	Minutes of occupational physical activity	Minutes of physical activity at home
		PR (CI95%)*	PR (CI95%)*	PR (CI95%)*	PR (CI95%)*
Obesity	**Replacement physical activity**	Male[++]			
	Minutes of leisure-time physical activity	**Replaced**	0.9764 (0.9721 – 0.9807)	1.2473 (1.2447 – 1.2499)	1.2280 (1.2248 – 1.2313)
	Minutes of physical activity while commuting	1.0242 (1.0197 – 1.0287)	**Replaced**	1.2775 (1.2725 – 1.2824)	1.2577 (1.2525 – 1.2629)
	Minutes of occupational physical activity	0.8017 (0.8000 – 0.8034)	0.7828 (0.7798 – 0.7858)	**Replaced**	0.9845 (0.9830 – 0.9861)
	Minutes of physical activity at home	0.8143 (0.8122 – 0.8164)	0.7951 (0.7918 – 0.7984)	1.0157 (1.0141 – 1.0173)	**Replaced**
	Replacement physical activity	Female[++]			
	Minutes of leisure-time physical activity	**Replaced**	1.7871 (1.7800 – 1.7941)	1.5372 (1.5332 – 1.5412)	1.5495 (1.5455 – 1.5536)
	Minutes of physical activity while commuting	0.5596 (0.5574 – 0.5618)	**Replaced**	0.8602 (0.8576 – 0.8628)	0.8671 (0.8645 – 0.8697)
	Minutes of occupational physical activity	0.6505 (0.6488 – 0.6522)	1.1625 (1.1590 – 1.1660)	**Replaced**	1.0080 (1.0071 – 1.0089)
	Minutes of physical activity at home	0.6453 (0.6437 – 0.6470)	1.1533 (1.1498 – 1.1568)	0.9920 (0.9911 – 0.9929)	**Replaced**

Note: PR: Prevalence Ratios; 95%CI: 95% Confidence Interval; +The time in each variable was divided by 300 (constant), thus the increase or decrease in the PR of the occurrence of obesity is due to the increase of 300 minutes per week in the behavior; *Effect of physical activity due to the reallocation of time from one of the behaviors to the others under obesity; ++Adjusted for region of the country, age, years of schooling, marital status, screen time, consumption of fruits and vegetables, amount of ultra-processed foods consumed; Significant associations are represented by the 95%CI that does not cross the value 1. All models presented in this table showed satisfactory quality of adjustment (Omnibus test p-value <0.05).

Source: The authors.

Discussion

This study showed, in general, that the practice of physical activity during leisure time was essential to minimize the prevalence of obesity in Brazilian adults. This characteristic was observed for men, when reallocating time from physical activities at home and occupational activities to the domains of leisure and commuting. Furthermore, for women, when transferring leisure-time practice time to other domains of physical activity, there were associations with higher prevalence of obesity.

It is substantially observed that transferring the time spent practicing physical activities during leisure time to other domains corresponded with an increase in the prevalence of obesity, especially in women. On the other hand, when substituting time from other domains of physical activity for leisure, a reduction in the prevalence of obesity was observed consistently for the

transfer of 150 and 300 minutes per week. Maintaining physical activities during leisure time, which allow, for example, the use of systematized actions, through aerobic practices, could possibly promote weight loss, especially when combined with balanced diets[23], as well as minimizing risks of cardiovascular diseases[5]. Previous information, from the 2015 VIGITEL survey, showed that leisure-time physical inactivity was associated with a greater chance of obesity in adults (OR: 1.30; 95%CI: 1.17 – 1.45)[24], in this way, it is possible to characterize the relevance of maintaining the practice of physical activities during leisure-time. Physical activity, and physical exercise carried out in this domain, comprise important behaviors aimed at maintaining weight loss, which should potentially be encouraged for Brazilian adults[23].

It is important to consider the role of physical activity during commuting, as when reallocating the different times investigated in this study per week to this domain, in men, an association was observed with a lower prevalence of obesity, however, in women, an association was observed as a potential factor risk. It is noteworthy that the practice of physical activity such as commuting plays an essential role in protecting against chronic diseases and risks[25,26]. However, sociocultural aspects and the built environment regarding the routes for traveling on foot or by bicycle represent factors that may limit women from carrying out this practice[27]. The greater distances for traveling, such as to places of study and work in Brazilian adults in large urban centers, inhibit the adoption of this practice, especially on foot, due to insecurity and fear of urban violence, and when carried out, occur in places such as sidewalks and walking or cycling paths, respectively, but without adequate structures[27], so that it is possible to carry out these actions at greater intensities.

It is interesting to note that, in men, when reallocating time from other contexts of practice to the domain of work activities, a higher prevalence of obesity was observed, with this characteristic having a lesser effect of occupational physical activities on health levels, within the scope of cardiovascular health, previously characterized[28]. On the other hand, in women, there were lower prevalences of obesity in this domain when taking time from other practice contexts, with the exception of reallocating leisure-time minutes. High levels of occupational physical activity are associated with reduced risk of chronic non-communicable diseases, which are associated with obesity, but also prove to be a determinant of other unfavorable outcomes, such as depression, anxiety, osteoarthritis, and lower quality and quantity of sleep-in men[29].

Although caloric expenditure in occupational activities may be similar between men and women[26], they seem to be better benefited by transferring time from physical activities at home and commuting to physical activities at work, which may possibly be linked to the increase in women's participation in occupational activities in the country over the years[30], and a potential protective factor observed in women with a higher level of education[31], or who are in university[32], or even due to the smaller number of children, which may possibly favor dedication to work[30]. But, it is essential to consider that physical activity in Brazil, normally not represent a choice, but a necessity[15]. This practice can be carried out in unhealthy places and without the minimum adequation, even in the context of leisure. Work routines tend to be exhausting, especially in the most vulnerable population segment, which in this case reinforces the transfer of time to work, something extremely complex.

Regarding domestic physical activities, in most time replacement situations between men and women, associations were observed with higher prevalence of obesity. It is initially possible to estimate that the practices carried out in this domain, such as heavy cleaning of the home, largely require less energy expenditure, approaching three METs (metabolic equivalents), which is characterized as the lower limit of the moderate intensity of practice of physical activities[18], as well as they can be performed with small movements, and thus have a smaller effect on obesity when compared to practices with greater intensity variation, from moderate to vigorous[14]. Furthermore, physical activities carried out in the home context are

important in the total volume of physical activities and thus contribute to preventing body weight gain, by complying with practice recommendations[20,21,24].

Regarding the guidelines for practicing physical activities, it is recommended to accumulate at least 150 minutes at moderate intensity or 75 minutes at vigorous intensity, or even a combination of practice at both intensities[20,21], as well as the possibility of obtaining additional benefits through practicing at least 300 minutes at moderate intensity or 150 at vigorous intensity[21]. However, regular physical activity is difficult to achieve because adults, for example, with overweight or obesity experience several barriers to participation[33]. These barriers are multifactorial and can include physical, psychological, and environmental components[34], and are specific to the domain of physical activity practice. This study sought to characterize how the transposition of this time per week between domains is associated with the prevalence of obesity in adults. There is a need to implement simple and objective messages for the population, such as "sit less and move more"[13], and to know how transferring practice time to certain everyday actions can impact different health indicators, such as obesity. This investigation does not intend to minimize the relevance of the practice contexts that were associated with higher prevalences of obesity, however, it is better to observe in the social context of Brazil, how the practice may be associated with this important public health problem.

In this study, conducted based on information from VIGITEL system for the year 2019, obesity was estimated in 20 out of every 100 Brazilian adults, with a higher prevalence in women. In previous studies of this system, an increase in obesity was observed over time, for example, between 2006 and 2012 (average increase of 0.89% per year)[31] and between 2006 and 2017, an increase in the prevalence of morbid obesity in adults was estimated, with emphasis on women[35]. Furthermore, it is projected that obesity in Brazilian adults could reach 29.6% in 2030 (30.2% in women and 28.8% in men)[36]. Such information reinforces the process of transition of the nutritional, physical activity and socioeconomic status of the Brazilian population, which deserves attention regarding the executive power, through actions to favor the provision of physical activity, aiming to minimize the impact on public health, and the economic burden of physical activity at insufficient levels under health systems[37].

Carrying out this study must consider some limitations. Among them, there is the use of time constants per week that are presented as guidelines for practice behavior in all domains, with the minimum amounts not being specific for each context[20,21], however, these cutoff points were used to better characterize compliance with these guidelines in just one of the practice manifestations. The transformation from categorical to quantitative data may represent a limitation, as VIGITEL system, categorically measures the domains of leisure and commuting; however, the aforementioned measures of physical activity present satisfactory quality compared to another research instrument (Global Activity Questionnaire Physics – GPAQ)[38].

Furthermore, as a limitation, the use of isotemporal substitution analyzes in cross-sectional surveys must be observed with caution and allow us to characterize potential hypotheses of the relationship between physical activity and the occurrence of obesity in Brazilian adults, which could better be explained through of longitudinal studies[5]. Another point, the generalization of results to adults who do not reside in the capitals of Brazilian states must be considered carefully, given the peculiarities between different cities, but the sample size and application of weighting procedures are robust, as they allow us to generalize to the adult population residing in the participating cities[3]. The characteristic of simultaneous investigation of all domains of physical activity allows a holistic observation of this phenomenon in adults in Brazil, instead of estimates based on isolated results of each behavior[22].

Conclusion

It is concluded that, when reallocating practice time in the domains of commuting, home and occupational to leisure, in Brazilian adults, there was an association with a reduction in the prevalence of obesity, especially in women. It is considered that the adoption of physical activity in different domains is essential for the control and maintenance of body weight gain throughout life, through compliance with recommendations to obtain health benefits, however, involvement in activities physical activities in leisure time correspond to the context that could be better provided for the adult population of Brazil.

References

1. Gadde KM, Martin CK, Berthoud HR, Heymsfield SB. Obesity. J Am Coll Cardiol 2018;71(1):69–84. DOI: https://doi.org/10.1016/j.jacc.2017.11.011
2. World Health Organization. Noncommunicable diseases country profiles 2018. Geneva: World Health Organization; 2018. [cited 2024 may 24]. Available from: www.who.int/publications/i/item/ncd-country-profiles-2018
3. Vigitel Brasil 2019 - Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico — Ministério da Saúde; 2020. [cited 2024 may 24]. Available from: www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/cartilhas/2019/vigitel-brasil-2019-vigilancia-fatores-risco-pdf/view
4. Jakicic JM, Powell KE, Campbell WW, Dipietro L, Pate RR, Pescatello LS, et al. Physical activity and the prevention of weight gain in adults: a systematic review. Med Sci Sports Exerc 2019;51(6):1262–9. DOI: https://doi.org/10.1249/MSS.0000000000001938
5. Cleven L, Krell-Roesch J, Nigg CR, Woll A. The association between physical activity with incident obesity, coronary heart disease, diabetes and hypertension in adults: a systematic review of longitudinal studies published after 2012. BMC Public Health 2020;20(1):726. DOI: https://doi.org/10.1186/s12889-020-08715-4
6. De Munter JS, Tynelius P, Magnusson C, Rasmussen F. Longitudinal analysis of lifestyle habits in relation to body mass index, onset of overweight and obesity: Results from a large population-based cohort in Sweden. Scand J Public Health 2015;43(3):236–45. DOI: https://doi.org/10.1177/1403494815569865
7. Miller K, Morley C, Fraser BJ, Gall SL, Cleland V. Types of leisure-time physical activity participation in childhood and adolescence, and physical activity behaviours and health outcomes in adulthood: a systematic review. BMC Public Health 2024;24(1789):1-12. DOI: https://doi.org/10.1186/s12889-024-19050-3
8. Byambasukh O, Vinke P, Kromhout D, Navis G, Corpeleijn E. Physical activity and 4-year changes in body weight in 52,498 non-obese people: the Lifelines cohort. Int J Behav Nutr Phys Act 2021;18(75):1-12. DOI: https://doi.org/10.1186/s12966-021-01141-8
9. Chen C, Menifield CE. An ecological study on means of transportation to work and obesity: Evidence from U.S. states. Transport Policy. 2017;59(C):174–80. DOI: https://doi.org/10.1016/j.tranpol.2017.07.017
10. Wanner M, Martin BW, Autenrieth CS, Schaffner E, Meier F, Brombach C, et al. Associations between domains of physical activity, sitting time, and different measures of overweight and obesity. Prev Med Rep 2016;3:177-84. DOI: https://doi.org/10.1016/j.pmedr.2016.01.007
11. Jassen TI, Voelcker-Rehage C. Leisure-time physical activity, occupational physical activity and the physical activity paradox in healthcare workers: A systematic overview of the literature. Int J Nurs Stud 2023;141:104470. DOI: https://doi.org/10.1016/j.ijnurstu.2023.104470
12. Hallal PC, Umpierre D. Guia de atividade física para a população brasileira. Rev Bras Ativ Fís Saúde 2021;26:1–2. DOI: https://doi.org/10.12820/rbafs.26e0211
13. Dunstan DW, Dogra S, Carter SE, Owen N. Sit less and move more for cardiovascular health: emerging insights and opportunities. Nat Rev Cardiol 2021;18(9):637–48. DOI: https://doi.org/10.1038/s41569-021-00547-y
14. Grgic J, Dumuid D, Bengoechea EG, Shrestha N, Bauman A, Olds T, et al. Health outcomes associated with reallocations of time between sleep, sedentary behaviour, and physical activity: a systematic scoping review of isotemporal substitution studies. Int J Behav Nutr Phys Act 2018;15(1):69. DOI: https://doi.org/10.1186/s12966-018-0691-3
15. Varrela AR, Hallal PC. Does every move really count towards better health? Lancet Glob Health 2024;12(8):e1215–6. DOI: https://doi.org/10.1016/S2214-109X(24)00173-6

16. Conde WL, Oliveira DR, Borges CA, Baraldi LG. Consistência entre medidas antropométricas em inquéritos nacionais. Rev Saúde Pública 2013;47(1):69–76. DOI: https://doi.org/10.1590/S0034-89102013000100010
17. Monteiro CA, Florindo AA, Claro RM, Moura EC. Validity of indicators of physical activity and sedentariness obtained by telephone survey. Rev Saúde Pública 2008;42(4):575–81. DOI: https://doi.org/10.1590/S0034-89102008000400001
18. Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR, Tudor-Locke C, et al. 2011 compendium of physical activities: a second update of codes and met values. Med Sci Sports Exerc 2011;43(8):1575–81. DOI: https://doi.org/10.1249/MSS.0b013e31821ece12
19. Hallal PC, Victora CG, Wells JCK, Lima RC. Physical inactivity: prevalence and associated variables in Brazilian adults. Med Sci Sports Exerc 2003;35(11):1894–1900. DOI: https://doi.org/10.1249/01.MSS.0000093615.33774.0E
20. Ministry of Health of Brazil. (2021). Physical activity guidelines for the Brazilian population (J. C. M. dos Santos, Trad.). Ministry of Health of Brazil; 2021. [cited 2024 may 24]. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/physical_activity_guidelines_brazilian_population.pdf
21. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med 2020;54(24):1451–62. DOI: https://doi.org/10.1136/bjsports-2020-102955
22. Mekary RA, Willett WC, Hu FB, Ding EL. Isotemporal substitution paradigm for physical activity epidemiology and weight change. Am J Epidemiol 2009;170(4):519–27. DOI: https://doi.org/10.1093/aje/kwp163
23. Swift DL, McGee JE, Earnest CP, Carlisle E, Nygard M, Johannsen NM. The effects of exercise and physical activity on weight loss and maintenance. Prog Cardiovasc Dis 2018;61(2):206–13. DOI: https://doi.org/10.1016/j.pcad.2018.07.014
24. Streb AR, Matias TS, Leonel LDS, Tozetto WR, Vieira CG, Del Duca GF. Association between physical inactivity in leisure, work, commuting, and household domains and nutritional status in adults in the capital cities of Brazil. Rev Nutr 2019;32:e180276. DOI: https://doi.org/10.1590/1678-9865201932e180276
25. Bernabe-Ortiz A, Carrillo-Larco RM, Gilman RH, Smeeth L, Checkley W, Miranda JJ. Leisure time and transport-related physical activity and the risk of mortality: the cronicas cohort study. J Phys Act Health 2022;19(2):118–24. DOI: https://doi.org/10.1123/jpah.2021-0672
26. Almeida LABD, Pitanga FJG, Freitas MM, Pitanga CPS, Dantas EHM, Beck CC. Gasto calórico dos diferentes domínios de atividade física como preditor da ausência de diabetes em adultos. Rev Bras Med Esporte 2012;18(1):17–21. DOI: https://doi.org/10.1590/S1517-86922012000100003
27. Dias JA. Influência do ambiente urbano na escolha do transporte ativo e sua relação com sedentarismo [dissertação]. Belo Horizonte (MG): Universidade Federal de Minas Gerais. 2020. [cited 2024 may 24]. Available from: http://hdl.handle.net/1843/35832
28. Holtermann A, Krause N, Van Der Beek AJ, Straker L. The physical activity paradox: six reasons why occupational physical activity (Opa) does not confer the cardiovascular health benefits that leisure time physical activity does. Br J Sports Med 2018;52(3):149–50. DOI: https://doi.org/10.1136/bjsports-2017-097965
29. Cillekens B, Lang M, Van Mechelen W, Verhagen E, Huysmans MA, Holtermann A, et al. How does occupational physical activity influence health? An umbrella review of 23 health outcomes across 158 observational studies. Br J Sports Med 2020;54(24):1474–81. DOI: https://doi.org/10.1136/bjsports-2020-102587
30. Barbosa ALNDH. Tendências na alocação do tempo no Brasil: trabalho e lazer. Rev Bras Estud Popul 2018;35(1):1–28. DOI: https://doi.org/10.20947/S102-3098a0063
31. Malta DC, Andrade SC, Claro RM, Bernal RTI, Monteiro CA. Trends in prevalence of overweight and obesity in adults in 26 Brazilian state capitals and the Federal District from 2006 to 2012. Rev Bras Epidemiol 2014;17(suppl 1):267–76. DOI: https://doi.org/10.1590/1809-4503201400050021
32. Sousa TF, Barbosa AR. Prevalence of body weight excess in undergraduate students: analysis of repeated surveys. Rev Bras Epidemiol 2017;20(4):586–97. DOI: https://doi.org/10.1590/1980-5497201700040003
33. Hamer O, Larkin D, Relph N, Dey P. Fear-related barriers to physical activity among adults with overweight and obesity: A narrative synthesis scoping review. Obes Rev 2021;22(11):e13307. DOI: https://doi.org/10.1111/obr.13307
34. Aibar-Almazán A, Martínez-Amat A, Cruz-Díaz D, Jiménez-García JD, Achalandabaso A, Sánchez-Montesinos I, et al. Sarcopenia and sarcopenic obesity in Spanish community-dwelling middle-aged and older women: association with balance confidence, fear of falling and fall risk. Maturitas 2018;107:26-32. DOI: https://doi.org/10.1016/j.maturitas.2017.10.001

35. Malta DC, Silva AGD, Tonaco LAB, Freitas MIDF, Velasquez-Melendez G. Time trends in morbid obesity prevalence in the Brazilian adult population from 2006 to 2017. Cad Saúde Pública 2019;35(9):e00223518. DOI: https://doi.org/10.1590/0102-311X00223518
36. Estivaleti JM, Guzman-Habinger J, Lobos J, Azeredo CM, Claro R, Ferrari G, et al. Time trends and projected obesity epidemic in Brazilian adults between 2006 and 2030. Sci Rep 2022;12(1):12699. DOI: https://doi.org/10.1038/s41598-022-16934-5
37. Prodel E, Mrejen M, Mira PADC, Britto J, Vargas MA, Nobrega ACL. The burden of physical inactivity for the public health care system in Brazil. Rev Saúde Pública 2023;57(1):37. DOI: https://doi.org/10.11606/s1518-8787.2023057004589
38. Moreira AD, Claro RM, Felisbino-Mendes MS, Velasquez-Melendez G. Validity and reliability of a telephone survey of physical activity in Brazil. Rev Bras Epidemiol 2017;20(1):136–46. DOI: https://doi.org/10.1590/1980-5497201700010012

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