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ORIGINAL

Association between physical inactivity in leisure, work, commuting, and household domains and nutritional status in adults in the capital cities of Brazil

Associação entre a inatividade física nos domínios do lazer, trabalho, deslocamento e domicílio e o estado nutricional em adultos das capitais do Brasil

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ABSTRACT

Objective

To investigate the association between different domains (leisure, work, commuting, and household) of physical activity, independent and cumulative, and excess weight and obesity in Brazilian adults.

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Methods

This is a cross-sectional survey, conducted in 2015, through telephone interviews with a representative sample of adults from the capitals of Brazil. Physical inactivity was defined as non-participation in predefined physical activities for each assessed domain. Excess weight (Body Mass Index≥25kg/m^2) and obesity (Body Mass Index≥30kg/m^2) were determined from self-reported measurements of weight and height. A binary logistic regression was conducted after adjusting for sociodemographic factors.

Results

Among 54,174 subjects, physical inactivity in commuting ($OR_{excess\ weight}$=1.27, 95%CI=1.13,1.42 and $OR_{obesity}$=1.25, 95%CI=1.06,1.47) and leisure ($OR_{excess\ weight}$=1.12, 95%CI=1.04,1.22 and $OR_{obesity}$=1.30, 95%CI=1.17,1.45) domains were associated with nutritional status. In addition, a linear trend was observed between increasing obesity and cumulative physical inactivity of all four domains (p<0.001).

Conclusion

Cumulative physical inactivity, especially in the commuting and leisure domains, was associated with excess weight and obesity in adults living in the capitals of Brazil. One possible explanation of these findings is that these domains involve particularly longer duration and greater intensity of physical inactivity. Public policies concerning physical activity should prioritize actions focused in promoting physical activity on commuting and leisure-time to help prevent overweight and obesity in the Brazilian adult population.

Keywords: Body Mass Index. Leisure activities. Motor activity. Nutritional status.

RESUMO

Objetivo

Investigar a associação entre a atividade física em diferentes domínios (deslocamento, domicílio, lazer e trabalho) isolados e acumulados com a ocorrência de excesso de peso e obesidade em adultos brasileiros.

Métodos

Trata-se de um inquérito transversal, realizado em 2015, por meio de entrevista telefônica com uma amostra representativa de adultos das capitais do Brasil. A inatividade física foi determinada como a não participação em atividades físicas específicas para cada domínio avaliado. O excesso de peso (Índice de Massa Corporal≥25kg/m^2) e a obesidade (Índice de Massa Corporal ≥30kg/m^2) foram definidos pelo autorrelato de peso e altura. Na estatística, empregou-se a regressão logística binária ajustada para fatores sociodemográficos.

Resultados

Dentre os 54.174 sujeitos, observou-se que a inatividade física no deslocamento (OR=1,27; IC95%:1,13;1,42 e OR=1,25; IC95%:1,06;1,47) e no lazer (OR=1,12; IC95%:1,04;1,22 e OR=1,30; IC95%:1,17;1,45) estiveram associadas ao excesso de peso e à obesidade, respectivamente. Observou-se ainda uma tendência linear de aumento da obesidade à medida que se acumulam domínios com inatividade física (p<0,001).

Conclusão

A inatividade física acumulada em diferentes domínios, particularmente no deslocamento e no lazer, apresentou associação com o excesso de peso e obesidade em adultos residentes nas capitais do Brasil. Possivelmente, importantes características da atividade física nos referidos domínios, como a maior duração e a maior intensidade, sejam potenciais justificativas para o encontro de tais achados. Portanto, recomenda-se que políticas públicas de atividade física possam priorizar ações voltadas para os domínios do deslocamento e do lazer no combate ao excesso de peso e obesidade na população adulta brasileira.

Palavras-chave: *Índice de Massa Corporal. Atividades de lazer. Atividade motora. Estado nutricional.*

INTRODUCTION

Physical inactivity is one of the most common, persistent, and important contributors to poor health; adoption of inactive lifestyles in diverse populations world-wide indicates that campaigns promoting physical activity have been unsuccessful [1]. According to estimates by the Global Health

Observatory, an initiative led by the World Health Organization (WHO), 23% of men and 32% of women over 18 years of age are physically inactive [2]. Furthermore, globally in 2016, an estimated 39% of adults were overweight and 13% were obese [3].

New paradigms for the reduction of physical inactivity are fundamental. There is a need to understand how the individual domains of physical activity interact with health. Evidence suggests that the practice of physical activity in leisure promotes health benefits, including physical and mental well-being and the maintenance of a healthy body weight [4]. However, the relationship of other physical activity domains, such as physical activity at work, has presented controversial evidence regarding benefits to health [5-7].

The conditions that impede or favor the adoption of a physically active lifestyle can vary based on country and culture [8]. Consequently, studies have shown that the health benefits associated with the individual domains of physical activity can show significant discrepancies and are highly dependent on environmental context [9,10]. Recent evidence in Brazil establishes that both the practice of physical activity in leisure and the percentage of Brazilians attaining the recommended levels of physical activity have increased [11]. Yet, in the period of approximately a decade, a notable increase in indicators of excess weight [12], suggests poor management of body mass.

It is important to consider that the domains of physical activity are not independent, and instead are related through complex interactions. As such, the level of physical activity in one domain may strongly influence the level of physical activity in the others [8,9]. Analyzing the domains of physical inactivity may also contribute to the broader conceptualization of health [13]. In this way, physical activity can be used to better understand the weight status of Brazilians and guide prevention interventions to address the alarming pandemic of obesity in Brazil. This study aims to investigate the association between different domains (leisure, work, commuting, and household) of physical inactivity, independent and cumulative, and excess weight and obesity in Brazilian adults.

METHODS

This study used a population-based cross-sectional design. Data were extracted from databases, obtained from the *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico* (VIGITEL, Vigilance of Risk Factors and Protection of Chronic Diseases by Telephone Inquiry). A telephone interview was conducted in 2015 whereby adult men and women (≥18 years old) were interviewed who had a fixed telephone line and who resided in one of the 26 Brazilian capitals or in the Federal District. The sample of the population was selected from each studied city's registers of fixed telephone lines. Each register was systematically drawn from 5,000 telephone lines, of which at least 2,000 lines were selected according to the postal code. The interviews were carried out by a specialized company and the interviewers applied a previously validated questionnaire [14]. The answers to the questionnaire were recorded in an electronic database. More detailed information concerning the sampling process and the questionnaire utilized are reported in the original VIGITEL report [15].

Body Mass Index (BMI) was calculated using interviewees' self-reported measures of weight in kilograms and height in meters squared. Missing data were imputed using the hot deck technique.

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BMI values defined as being excess weight or obese were ≥25kg/m² and ≥30kg/m², respectively. Furthermore, physical inactivity was defined as not participating in specified physical activities for each domain. In the leisure domain, not engaging in any physical exercise and/or sport within the previous three months was considered inactive. Inactivity within the domain of commuting was defined as not using walking or cycling as a mode of transportation for school, travel or work. Inactivity at home was classified as not being involved in heavy household work. At work, individuals who did not carry weight and/or did not walk during work activities were considered inactive. The sum of physical inactivity was calculated by using a combination of the four domains of physical activity and was categorized into: Inactive in none, one, two, three, or all domains, independently of the domain evaluated. The sociodemographic factors of sex (male *vs*. female), age (in complete years), and schooling (categorized as 0 to 8, 9 to 11, and ≥12 years of study) were utilized as confounding variables and controlled for in subsequent analysis.

For each variable investigated, descriptive analysis was reported, including the absolute (n), and relative (%) frequencies of the variables with a 95% Confidence Interval (95%CI). We conducted a binary logistic regression analysis, with hierarchical adjustment, to quantify the association between nutritional status and either the individual domains of physical activity or the sum of the domains. In the hierarchical adjustment, the first level comprised of sex and age, and the second level consisted of schooling and the other domains. The significance level was p-value≤0.05. All analyses were performed using statistical software Stata® Standard Edition, version 15.0 (Stata Corp., College Station, Texas, United States). Data weighting and complex sampling were taken into account.

Participants consented verbally via phone call to participating in this study. VIGITEL was approved by the National Commission for Ethics in Research for Human Subjects, of the Ministry of Health, with the opinion No.749/2006 and the registry No.13.081.

RESULTS

Among 76,703 subjects who were eligible for this study, 54,174 adults were interviewed (70.6%). Table 1 describes the sociodemographic characteristics, domain-specific physical inactivity, and excess weight and obesity within the sample population. Over half of participants were women (54.0%; 95%CI:53.1;54.9). The mean age of interviewees was 47.5 (±17.5) years. Approximately 35.0% (95%CI:33.6;35,5) of participants were schooled up to eight years. The majority of the sample population were considered inactive in the commuting (85.9%; 95%CI:87.3;88.7), household (58.4%; 95%CI: 57.5;59.3), and work (62.2%; 95%CI:61.2;63.1) domains. Moreover, in the leisure domain, physical inactivity was present in 48.8% (95%CI:47.8;49.7) interviewees. Over 52.0% (95%CI:53.0;54.8) of the participants were excess weight, while 18.9% (95%CI:18.2;19.7) were obese.

Table 2 demonstrates how physical inactivity within the four domains is associated with being excess weight in adults living in the capitals of Brazil. In the sociodemographic adjusted analysis, physical inactivity in the commuting (Odds *Ratio* [OR]=1.27, 95%CI:1.13;1.42) and leisure (OR=1.12,

Table 1. Sociodemographic characteristics, domain-specific physical inactivity, and nutritional status of adults living in Brazilian capitals. Brazil, 2015.

Variable	n=54,174		
	n	%[a]	95%CI
Sex			
Men	20,368	46.0	(45.1;47.0)
Women	33,806	54.0	(53.0;54.9)
Schooling (years)			
0 to 8	14,924	34.6	(33.6;35.5)
9 to 11	19,525	38.1	(37.2;39.0)
≥12	19,725	27.3	(26.5; 28.1)
Physical Inactivity in work			
No	16,239	37.8	(36.9; 38.7)
Yes	37,656	62.2	(61.2; 63.1)
Physical Inactivity in household			
No	22,288	41.6	(40.7; 42.5)
Yes	31,886	58.4	(57.5; 59.3)
Physical Inactivity in commuting			
No	5,380	14.1	(13.4;14.7)
Yes	48,678	85.9	(85.2;86.6)
Physical Inactivity in leisure			
No	28,938	51.2	(50.3; 52.2)
Yes	25,236	48.8	(47.8;49.7)
Excess weight			
No	23,993	46.1	(45.1;47.0)
Yes	30,181	53.9	(53.0; 54.8)
Obesity			
No	43,830	81.1	(80.3;81.8)
Yes	10,344	18.9	(18.2;19.7)

Note: n: absolute frequency; %[a]: relative frequency for weighted sample; 95%CI: 95% Confidence Interval.

95%CI:1.04;1.22) domains was associated with being excess weight. In addition, inactive adults in the household domain were less likely to be excess weight compared to their peers (OR=0.79, 95%CI:0.72;0.86).

Table 3 demonstrates the association between physical inactivity within the four domains and obesity in adults living in the capitals of Brazil. In the adjusted analysis, it was observed that physical inactivity in the commuting (OR=1.25, 95%CI:1.06;1.47) and leisure (OR=1.30, 95%CI:1.17;1.45) domains were associated with obesity.

Figures 1 and 2 establish the aggregate physical inactivity within the four domains relates to excess weight and obesity in adults in the Brazilian capitals. A linear trend of increased obesity was observed as physical inactivity accumulated in the four domains (p<0.001).

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Table 2. Domain-specific physical inactivity and its association with excess weight in adults living in the capitals cities of Brazil, 2015 (n=54,174).

Variable	Excess weight	Crude analysis		Adjusted analysis	
	%[a]	OR (95%CI)	*P* value	OR (95%CI)	*P* value
Physical Inactivity in commuting			<0.001		<0.001
No	12.3	1.00		1.00	
Yes	87.7	1.37 (1.22;1.53)		1.27 (1.13;1.42)	
Physical Inactivity in household			<0.001		<0.001
No	43.1	1.00		1.00	
Yes	56.9	0.87 (0.81;0.94)		0.79 (0.72;0.86)	
Physical Inactivity in leisure			<0.001		0.004
No	49.1	1.00		1.00	
Yes	50.9	1.21 (1.12;1.30)		1.12 (1.04;1.22)	
Physical Inactivity in work			0.030		0.343
No	38.8	1.00		1.00	
Yes	61.2	0.92 (0.84;0.99)		0.96 (0.88;1.04)	

Note: [a]relative frequency for weighted sample; OR: Odds *Ratio*; 95%CI:95% Confidence Interval.
P value obtained by binary logistic regression. Analysis adjusted by hierarchical model, being the first level the sex and age the second level the schooling and the other domains.

Table 3. Association between physical inactivity in different domains and obesity in adults living in the capitals cities of Brazil, 2015 (n=54,174).

Variable	Obesity	Crude analysis		Adjusted analysis	
	%[a]	OR (95%CI)	*P* value	OR (95%CI)	*P* value
Physical Inactivity in commuting			<0.001		0.006
No	11.5	1.00		1.00	
Yes	88.5	1.33 (1.13;1.55)		1.25 (1.06;1.47)	
Physical Inactivity in household			<0.001		0.065
No	44.7	1.00		1.00	
Yes	55.3	0.85 (0.77;0.94)		0.91 (0.83;1.04)	
Physical Inactivity in leisure			<0.001		<0.001
No	43.7	1.00		1.00	
Yes	56.3	1.45 (1.31;1.61)		1.30 (1.17;1.45)	
Physical Inactivity in work			0.003		0.164
No	36.8	1.00		1.00	
Yes	63.2	1.05 (94.7;1.17)		1.09 (0.97;1.22)	

Note: [a]relative frequency for weighted sample; OR: Odds *Ratio*; 95%CI: 95% Confidence Interval.
P value obtained by binary logistic regression. Analysis adjusted by hierarchical model, being the first level the sex and age the second level the schooling and the other domains.

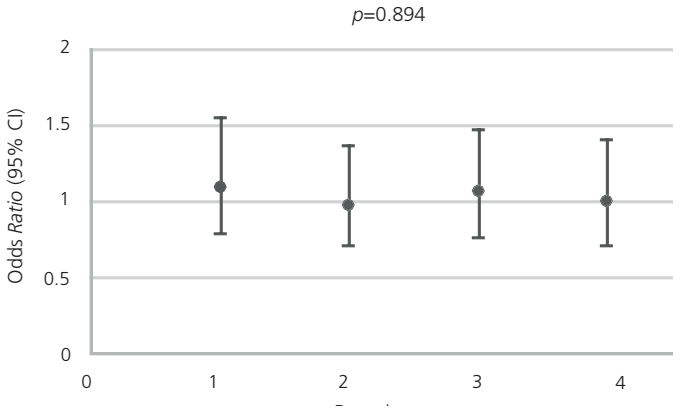

Figure 1. Aggregated association between physical inactivity and excess weight in adults living in the capitals cities of Brazil, 2015.

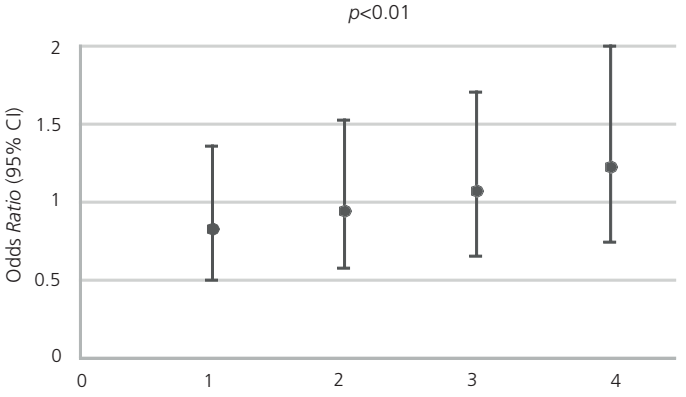

Figure 2. Aggregated association between physical inactivity and obesity in adults living in the capitals cities of Brazil, 2015.

DISCUSSION

The present study investigated the association between of physical inactivity in leisure, work, commuting, and household and excess weight and obesity in Brazilian adults. One possible explanation of our findings is that a sedentary lifestyle is associated with physical inactivity in commuting and leisure domains, thereby causing excess weight and obesity in adults. This interpretation is supported by experimental evidence which indicates that leisure-specific physical inactivity is related to an increased adiposity [16,17]. In addition, inactive commuting has been reported to inhibit both general health benefits [18] and an improved body composition [19].

Commuting-specific physical inactivity was present in 85.9% of study participants and increased the odds of being excess weight. Consequently, public health policies which focus on increasing active commuting, are critical. Advantageously, active commuting is accessible, and is particularly common in low- and middle-income countries [20,21]. Walking and cycling are ideal ways for people to incorporate more physical activity in their daily routines [22]. Unfortunately, in Brazil, active commuting is still not as culturally accepted, in part as a result of its association with lower socioeconomic levels and social status [23-25]. An additional challenge in Brazil is the feeling of insecurity, which can reduce the time spent travelling, in spite of the health benefits

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associated with active commuting [17,18]. Moreover, there are numerous structural barriers, such as, a lack of bicycle lanes hindering accessibility [26]. However, those who manage to become active commuters demonstrate significant benefits in their health status, for example, have reduced risk for cardiovascular disease [21,27].

Our results demonstrate that physical inactivity in leisure-time is positively associated with excess weight and obesity and is present in 50.9% of the excess weight population and 56.3% of those with obesity. This practice is strongly associated with body mass, in which those who practice activities of moderate/vigorous intensity in this field present positive results in their composition, helping to reduce and maintain the weight, corroborating to lower chances of triggering obesity [16,28]. Participating in leisure-time sports in adulthood leads to lower sedentary behavior in old age and therefore, a reduction in health problems, including obesity [29]. These studies highlight principal characteristics of physical activity in leisure-time, such as duration and intensity, that must be incorporated within the leisure domain so as to maximize the benefits of intentional practice.

We demonstrate that the sum of physical inactivity across the four activity domains increased the risk of obesity. Samitz *et al*. [4], demonstrate that increases in time spent in domain-specific physical activity (*e.g.*, leisure) and total physical activity are associated with a reduction of all-cause mortality. Evidence confirms that increasing an individual's total time spent engaging in physical activity can protect against cardiovascular disease [30], in addition to being an important behavior for the positive regulation of pro-inflammatory and anti-inflammatory cytokines that may be related to obesity and diabetes [31].

While physical inactivity in the domains of commuting and leisure was associated with greater occurrences of both excess weight and obesity in the Brazilian adult population, the same cannot be observed for physical inactivity at household. In the present study, inactive individuals in the domestic environment were less likely to be excess weight. This result is quite conflicting with the literature. However, a likely explanation for this is the interaction between domains. A study of patterns of activity aggregation in different domains found a high possibility of subjects with high physical activity volume at leisure presenting low level of physical activity at household [32]. It is worth noting that, in our adjusted analysis, all domains are adjusted to each other, but the total volume of physical activity in each domain was not taken into account. The present analysis refers only to the dichotomy between whether or not to do some physical activity in each domain. In our database (unpublished results), we observed a direct association between physical inactivity at household and the reach of physical activity recommendations in leisure, which helps us elucidate the total volume of physical activity in each domain as a possible confounding factor in dichotomous analyzes.

Some limitations are present in this study. Eating behavior as well as time in sedentary behavior were not accounted in the present study. Furthermore, data analysis included individual domains rather than combining different active and inactive domains. In addition, there is the possibility of bias in the questionnaire regarding the self-reported values for weight, height, and physical activity. However, through the use of the VIGITEL procedures, the data collection is reliable. On the other hand, the use of procedures by VIGITEL that supervise and monitor the quality of the data and the constant training of the interviewers, with checks and audits in about 10% of the daily connections in random samples, guarantee reliability of the answers. Likewise, the sample size with the use of capital data, allows the results to be representative of the Brazilian adult population living in the capitals of Brazil with telephone line coverage. In this sense, the other cities in the country may present different prevalence of the variables evaluated, but the

contribution of the evidence of the relation between the sum of physical inactivity in domains and the deleterious effects on health is plausible in the general population. Another point to be highlighted is the use of two categories linked to nutritional status, making possible different associations with inactivity.

CONCLUSION

It was concluded that physical inactivity accumulated across four domains (particularly commuting and leisure) is associated with excess weight and obesity among Brazilian adults from capital cities. Important physical activity characteristics in these domains, such as longer duration and greater intensity, are potential justifications for such findings. In order to design effective strategies to encourage physical activity, this study sought to identify which specific domains where Brazilian adults are more physically inactive; and thus, drivers of weight gain and obesity. Therefore, it is recommended that public health promotion policies should emphasize and stimulate voluntary participation in an active lifestyle. In addition, it is important to emphasize that specifically promoting physical activity in commuting and leisure are most effective in protecting against overweight and obesity among the Brazilian adult population.

CONTRIBUTORS

AR STREB, TS MATIAS and GF DEL DUCA participated in the study conception and design, data analysis and interpretation, article review, and approval of the final version. LS LEONEL, WR TOZETTO and CG VIEIRA participated in the study interpretation, article review, and approval of the final version.

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