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ORIGINAL ARTICLE

Association Between Active Commuting and Cardiometabolic Diseases in Primary Health Care Users

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Abstract

Background: Although active commuting is inversely related to cardiovascular disease risk factors, these associations are unknown among Brazilian primary health care users.

Objective: To investigate the association between active commuting to daily activities and the prevalence of cardiometabolic diseases.

Methods: This cross-sectional study, conducted between May and August 2019, included primary health care users from all 34 primary health care centers in Passo Fundo, a city in southern Brazil. Cardiometabolic diseases (type 2 diabetes, hypertension, hypercholesterolemia, hypertriglyceridemia, cardiovascular diseases, and overweight/obesity) were measured by self-reported medical diagnosis using a questionnaire. Active commuting was analyzed dichotomously: daily commuting on foot or by bicycle was considered active, while daily commuting by car, motorcycle, or bus was considered passive. To determine the association between cardiometabolic diseases and active commuting, crude and adjusted prevalence ratios (PR) were estimated using Poisson regression, considering $p < 0.05$ significant.

Results: The sample consisted of 1443 patients. There was an inverse association between active commuting and type 2 diabetes (PR: 0.59; 95% CI [Confidence Interval]: 0.39-0.90) and overweight/obesity (PR: 0.83: 95% CI: 0.71-0.98).

Conclusion: A lower prevalence of type 2 diabetes and obesity/overweight was observed in people who actively commute. These findings indicate that changes in urban infrastructure to enable safe active commuting will positively impact the health of the population.

Keywords: Primary Health Care; Noncommunicable Diseases; Cardiovascular Diseases; Health Promotion.

Introduction

Physical inactivity is associated with a higher prevalence of obesity, depression, and non-communicable chronic diseases, such as diabetes, systemic arterial hypertension, and osteoporosis.[1-4] Sedentarism is associated with a 20%-30% increase in all-cause mortality, especially cardiovascular diseases.[5] However, recent reviews have shown that physical activity is related to a lower risk of overall mortality, as well as other chronic conditions, such as obesity, diabetes, hypertension, and cardiovascular diseases.[6]

Although the benefits of physical activity are more directly associated with leisure time (recreational activities, exercising, and sports), other domains can also influence an individual's physical activity level. These include occupation, domestic activities, and transportation.[2-4,7] The World Health Organization's 2020 physical activity and sedentary behavior guidelines recommend that adults engage in at least 300 minutes of moderate-intensity or 150 minutes of high-intensity physical activity each week to reduce the risk of non-communicable chronic diseases, such as diabetes and hypertension.[8] Moreover, recent studies have shown

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that individuals whose primary mode of transportation is walking or biking and those who commute to public transportation stops have a significantly higher chance of achieving the recommended total physical activity time.[9]

In line with this, the Coronary Artery Risk Development in Young Adults study, which followed 2364 individuals for 20 years (1985-2006), found that active commuters (walking or biking) developed fewer cardiovascular and cardiometabolic diseases, such as hypertension, obesity, hypertriglyceridemia, and hyperglycemia.[10] Another recent study also revealed that individuals who bike as a mode of transportation had a lower risk of cardiovascular disease, cancer, and all-cause mortality.[11]

Such results highlight the importance of investing in urban infrastructure to promote active commuting and, consequently, the health of the population.[12] Several studies have already demonstrated the significant role that primary care plays in reducing morbidity and mortality from non-communicable chronic diseases, with prevention playing a fundamental role.[13-15] Improved primary care quality leads to decreased hospital admissions, which could reduce public spending, given that a well-functioning primary health system can address up to 90% of health demands in middle and low-income countries.[16] Thus, a series of multidisciplinary efforts to promote active commuting could prevent cardiometabolic diseases and improve quality of life and health resource management.[17-18]

The purpose of this study was to investigate the association between active commuting and cardiometabolic diseases among primary health care users in a midsized city in southern Brazil.

Materials and methods

This cross-sectional study was conducted between May and August 2019 with patients of 34 primary health care centers in Passo Fundo, Rio Grande do Sul, Brazil.

Adults (aged ≥ 18 years) of either sex who were primary care patients and residents of Passo Fundo were eligible for inclusion. Bedridden patients were excluded, as were those unable to answer the questionnaire due to cognitive deficits, communication dysfunction, etc.

To calculate the sample size, we considered 95% confidence interval (CI), 80% statistical power, and a 5% margin of error. Based on a non-exposed/exposed ratio of 9:1, an expected outcome prevalence of 10%, an expected outcome frequency of 9.1% in non-exposed individuals, and a prevalence ratio (PR) of 2, the minimum required sample was 1220 individuals. An additional 15% was added to control for confounding factors, resulting in 1403 participants.

Data were collected by a previously trained team, using a pre-tested and pre-coded survey developed by the researchers. After obtaining consent, the questionnaire was administered at primary health care centers in a private designated space to ensure confidentiality and that interviews did not interrupt the center's regular workflow.

The main exposure of interest, considered the independent variable, was active daily commuting, was covered in the survey's "Questions about lifestyle and health" section. Active commuting was determined with the question: "Most of the time, how do you move from one place to another?", whose response options included "(1) On foot"; "(2) By bicycle"; "(3) By bus"; "(4) By car/motorcycle". This was considered the customary means of transportation for work and other daily activities; occasional use of other transportation modes was disregarded. This response was categorized as (1) active (walking or biking) or (2) passive (bus or car/motorcycle).

The primary outcomes, considered dependent variables, were analyzed individually and included self-reported medical diagnosis of any cardiometabolic disease. This information was covered in the "Health Questions" section through the question: "Has a doctor ever told you that you are/have: (1) overweight; (2) Diabetes; (3) High Blood Pressure; (4) High Cholesterol; (5) High Triglycerides; (6) a Heart Problem?" For each self-reported diagnosis, the response options included: "(1) Yes", "(2) No", and "(3) Don't know/can't remember". These outcomes were referred to throughout the study as obesity/overweight, type 2 diabetes, hypertension, hypercholesterolemia, hypertriglyceridemia, and atherosclerotic cardiovascular disease.

Additionally, as covariates, we assessed the following sociodemographic factors: sex (male and female), age (< 40, 40-59, ≥ 60), self-reported race (White or non-White), marital status (single, married/living with a partner), education in years (≤ 8, 9-11, ≥12), and mean monthly family income, which was divided into the following tertiles: T1, BRL 1517.64; T2, BRL 2761.65; and T3, BRL 5145.45.

Statistical analysis

The prevalence of transportation modes according to sociodemographic characteristics was assessed using the chi-square test for heterogeneity or linear trend. To determine the association, the PR and 95% CI were

calculated. Since these are categorical variables from a cross-sectional study, Poisson regression with robust variance was used in both the crude and adjusted analyses. Hierarchical modeling was used in the multivariate analysis. The first level included demographic variables (sex, age, race, and marital status), the second level considered family income, and the third level considered cardiometabolic diseases.

In the final adjusted model, variables with $p < 0.20$ were retained. In all tests, an α error of 5% was used, with $p < 0.05$ considered significant. Sociodemographic factors were assessed according to their distributions in absolute (n) and relative frequencies (%). All analyses were performed in PSPP (open-source) and Stata 12.0. This study was approved by the institutional human research ethics committee (opinion 3.219.633).

Results

The sample included 1443 primary health care center patients in Passo Fundo. Regarding sociodemographic characteristics, more than two-thirds of the sample were women, 39.9% were < 40 years of age, > 60% identified as White, and 72.2% were married and/or living with a partner. A total of 54.4% had over 9 years of education, and 50.6% were in the first family income tertile (Table 1).

A total of 34.5% (95% CI: 32.0-36.9) reported active commuting (walking or biking). The prevalence of commuting mode according to sociodemographic characteristics is presented in Table 1. The analysis revealed that individuals without a partner tend to be 13% more active than those who are married or living with a partner ($p < 0.001$). Education was inversely proportional to active commuting, with an increase of approximately 8% in the prevalence of passive commuting for each year of education ($p < 0.001$). Family income was also inversely proportional to active commuting, reducing 9.9% between the first and second tertiles, and reducing 7.5% between the second and third tertiles ($p < 0.001$). This analysis determined which potential confounders would be included in the multivariate analysis.

The following cardiometabolic diseases were reported: type 2 diabetes (8.9%), hypertension (39.5%), hypercholesterolemia (25.16%), hypertriglyceridemia (19.06%), atherosclerotic cardiovascular diseases (14.5%), and overweight/obesity (37%).

The prevalence of cardiometabolic diseases according to commuting type is shown in Figure 1. Active commuters had a 4.3% lower prevalence of type 2 diabetes than those who commute by car and/or motorcycle ($p = 0.010$). Passive commuters had a 7.3% higher prevalence of overweight/obesity ($p = 0.006$). No significant associations were found between commuting type and the prevalence of hypercholesterolemia, hypertension, hypertriglyceridemia, or atherosclerotic cardiovascular diseases.

Table 2 shows the crude and adjusted PRs of the association between active commuting and cardiometabolic diseases. According to the adjusted analysis, active commuters had a 41% lower likelihood of type 2 diabetes (PR: 0.59; 95% CI: 0.39-0.90) and a 17% lower likelihood of overweight/obesity (PR: 0.83; 95% CI: 0.71-0.98). No significant differences were observed in the other cardiometabolic diseases.

Discussion

We found inverse associations between active commuting and type 2 diabetes and overweight/obesity among primary health care users. The prevalence of active commuting in our sample (34.5%) was lower than in studies conducted abroad, although differences in the population and economic development between countries should be taken into consideration.[19-20] On a national level, the prevalence of active commuting was similar to other studies in Paraíba (29.9% men and 18.5% women) and Rio Grande do Sul (26.5% general prevalence).[21-22]

Regarding the demographic factors associated with commuting type, individuals living without a partner tend to be more active than those who are married or living with a partner. Another Brazilian study found this association in high-income families, although low and medium income families had a higher prevalence of active commuting than singles in the same economic stratum.[23] However, a Polish study found a higher prevalence of passive commuting among single men, with no association found among women.[24] Similar studies have found no association between active commuting and marital status.[20,25] The higher prevalence of active commuting among singles, as found in the present study, may be related to lower family income, ie, fewer vehicle purchases and less spending on public transportation.

There was an inverse association between active commuting and socioeconomic factors, such as income and education. This indicates that as family income and education increase, active commuting decreases. These findings are in line with previous Brazilian studies and, to a lesser extent, with studies conducted abroad.[21,22,24] However, in high-income countries, the direction of this association is positive, ie, there is a higher prevalence of active commuting,

Table 1 – Sample characteristics and prevalence of daily commuting methods according to sociodemographic characteristics in primary health care users (n = 1443)

	Total sample	Active commuting		Passive commuting		
	n (%)	n	%	n	%	p
Sex						0.066
Male	418 (29)	129	30.9	289	69.1	
Female	1025 (71)	368	35.9	656	64.1	
Age (years)						0.373
< 40	574 (39.9)	186	32.5	387	67.5	
40-59	461 (32.1)	161	34.9	300	65.1	
≥ 60	403 (28)	148	36.7	255	63.3	
Race (self-reported)						0.098
White	931 (64.8)	307	33.0	623	66.9	
Non-White	506 (35.2)	189	37.4	317	62.7	
Marital status						**<0.001***
Married/living with a partner	1037 (72.2)	317	30.6	720	69.4	
Single	399 (27.8)	176	44.2	222	55.8	
Education (years)						**<0.001****
≤ 8	610 (45.6)	241	39.6	368	60.4	
9-11	454 (33.9)	143	31.5	311	68.5	
≥12	274 (20.5)	70	25.6	204	74.5	
Household income (tertiles)						**<0.001****
T1	681 (50.6)	275	40.4	405	59.6	
T2	334 (24.8)	102	30.5	232	69.5	
T3	334 (24.8)	77	23.1	894	76.9	

**chi-square test of heterogeneity **linear trend test*

especially by bicycle, among people with higher income and education levels. The reason for this inversion might be explained by differences in urban infrastructure and local socioeconomic patterns, which may facilitate this type of transportation.[20,26,27] Another explanation for these differences could be that in developing countries, active commuting is more economically accessible, indicating its use out of necessity rather than choice.[21-24]

We found no association between active commuting and sex, age, or race. However, other national and foreign studies have found a higher prevalence of active commuting among men and a trend towards inactivity as age increases.[20,21,23,26,28] The lack of such associations in our study may be due to the homogeneity of the sample, predominantly consisting of women and individuals > 40 years of age.

A higher prevalence of type 2 diabetes and obesity/overweight was found among passive commuters, which aligns with previous studies.[28-30] Active commuting reduces body mass index levels and adiposity, as well as the risk of type 2 diabetes, with some studies showing reductions of up to 30%.[31] The biological plausibility of this association is well-established in the literature, given physical activity's potential to reduce insulin resistance by stimulating glucose transporters on the surface of skeletal muscle cells and thereby improve glucose uptake.[32]

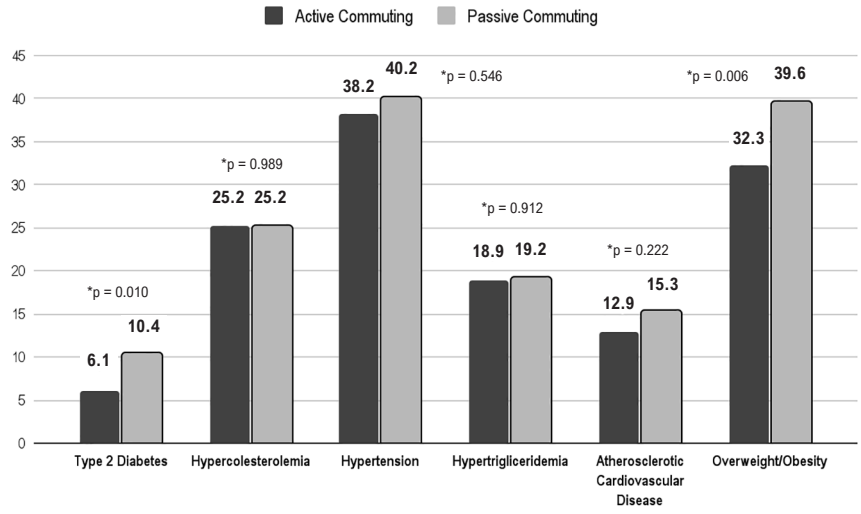

Figure 1 – Prevalence of cardiometabolic diseases according daily commuting method in primary health care users.

Table 2 – Crude and adjusted analysis of the association between cardiometabolic diseases and the daily commuting method of primary health care users (n = 1443).

	Type 2 diabetes						
		Crude			Adjusted		
	%	PR	95% CI	p	PR	95% CI	p
Commuting				0.012			0.015[a]
Passive	10.4	1.00	-		1.00	-	
Active	6.1	0.59	0.39-0.89		0.59	0.39-0.90	
	Hypercholesterolemia						
		Crude			Adjusted		
	%	PR	95% CI	p	PR	95% CI	p
Commuting				0.989			0.590[b]
Passive	25.2	1.00	-		1.00	-	
Active	25.2	0.99	0.83-1.20		1.05	0.87-1.27	
	Hypertension						
		Crude			Adjusted		
	%	PR	95% CI	p	PR	95% CI	p
Commuting				0.467			0.148[c]
Passive	38.2	1.00	-		1.00	-	
Active	40.2	0.96	0.83-1.09		0.91	0.79-1.04	

Hypertriglyceridemia							
		Crude			Adjusted		
	%	PR	95% CI	p	PR	95% CI	p
Commuting		Crude		Adjusted	Crude		Adjusted
Passive	18.9	1.00	-		1.00	-	
Active	19.2	0.99	0.79-1.24		1.08	0.85-1.37	
Atherosclerotic cardiovascular disease							
		Crude			Adjusted		
	%	PR	95% CI	p	PR	95% CI	p
Commuting				0.225			0.500[e]
Passive	12.9	1.00	-		1.00	-	
Active	15.3	0.84	0.64-1.10		1.00	0.98-1.03	
Overweight/obesity							
		Crude			Adjusted		
	%	PR	95% CI	p	PR	95% CI	p
Commuting				0.008			0.023[f]
Passive	32.3	1.00	-		1.00	-	
Active	39.6	0.82	0.70-0.95		0.83	0.71-0.98	

PR: Prevalence ratio. CI: Confidence interval.
[a] adjusted for age and household income.
[b] adjusted for sex, age, marital status, and education.
[c] adjusted for age and education.
[d] adjusted for age, marital status, income, and education.
[e] adjusted for skin color, income, and education.
[f] adjusted for sex, age, marital status, and education.

However, no significant association was found between active commuting and the prevalence of hypertriglyceridemia, atherosclerotic cardiovascular diseases, systemic arterial hypertension, and hypercholesterolemia. This contrasts with the findings of other studies, in which active commuting was associated with a lower risk of cardiovascular diseases, cancer, and overall mortality. Studies in Brazil and abroad have shown that active commuting is a protective factor against hypertension and hypercholesterolemia.[33,34] One reason for the lack of a significant difference in our study may be the characteristics of the sample, which mainly consisted of individuals aged ≥ 40 years who commute passively and most commonly present cardiometabolic diseases.[5]

To our knowledge, this study is a pioneer in analyzing the association between active commuting and the prevalence of cardiometabolic diseases among primary health care users in Brazil. Our findings can inform public policies to enable safe active commuting through changes in urban infrastructure. This could result in a more active lifestyle and help prevent cardiometabolic diseases.

However, certain limitations should be recognized. The survey's self-report method could have led to over- or underestimation of the magnitude of certain behaviors.[35,36] Furthermore, the majority of the sample was women and people > 40 years of age, as has been observed in another study of primary care patients.[37] Finally, we cannot rule out the possibility of reverse causality, a limitation inherent to cross-sectional designs.

Conclusion

In summary, we found that one third of primary health care users are active commuters (walking or biking), and there is a relationship between active commuting and

certain sociodemographic characteristics, such as marital status, education, and income. There is also a higher prevalence of type 2 diabetes and obesity/overweight among passive commuters (motor vehicles).

Given that cardiometabolic diseases are the main cause of death worldwide and are preventable, health promotion strategies must be intensified to reduce these comorbidities. Further research linking active commuting to better health status can strengthen public health programs, and changes in urban infrastructure are needed to facilitate active commuting, not out of necessity, but as a healthier lifestyle choice.

Author Contributions

Conception and design of the research: Acrani GO, Lindermann IL; analysis and interpretation of the data, statistical analysis and writing of the manuscript: Pes Bressan L, Silva SG; critical revision of the manuscript for intellectual content: Acrani GO, Lindermann IL, Silva SG.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

There were no external funding sources for this study.

Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Universidade Federal da Fronteira Sul under the protocol number 3.219.633. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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