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Bicycling and Walking for Transportation in Three Brazilian Cities

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Abstract

Background—Physical inactivity plays a role in the acquisition of heart disease, type 2 diabetes, and breast and colon cancer. The impact of such noncommunicable diseases on low- and middle-income countries is a major global health concern, but most studies in this area have focused on high-income countries. A better understanding of the factors that may influence physical activity in low- and middle-income countries is needed.

Purpose—This study describes the prevalence of cycling and walking for transportation and their association with personal and environmental factors in adults from three state capitals in Brazil.

Methods—In 2008–2009, a random-digit-dialing telephone survey was conducted with residents (aged ≥18 years) of Curitiba, Vitoria and Recife, sampled through a clustered multistage sampling process. Walking and cycling for transportation, perception of the environment related to physical activity, and demographic and health characteristics were collected. Poisson regression was used to examine associations between cycling and walking for transportation with covariates stratified by cities. All analyses were conducted in 2011.

Results—The prevalence of bicycling for transportation was 13.4%; higher in Recife (16.0%; 95% CI=13.7, 18.4) compared to Curitiba (9.6%; 95% CI=7.8, 11.4) and Vitoria (8.8%; 95% CI=7.34, 10.1); and 26.6% for walking regularly as a mode of transportation. The adjusted analysis showed that cycling is positively associated with being male (prevalence ratio [pOR]=3.4; 95% CI=2.6, 18.4) and younger (pOR =2.9; 95% CI=1.8, 4.9) and inversely associated with having a college degree (pOR =0.3; 95% CI=0.2, 0.4). Walking for transportation is inversely

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associated with having a college degree (pOR =0.6; 95% CI=0.5, 0.8). No strong evidence of association was found of environmental indicators with walking or bicycling.

Conclusions—The prevalence of active commuting was low and varied by city. Personal factors were more consistently associated with bicycling than with walking, whereas perceived environmental features were not related to active commuting.

Introduction

Noncommunicable diseases are the leading cause of death around the world, and their impact on low- and middle-income countries is a major global health concern.[1] Physical inactivity causes 6%–10% of the major noncommunicable diseases including coronary heart disease, type 2 diabetes, and breast and colon cancer.[2] Despite calls for action and global initiatives, physical inactivity is still highly prevalent.[3] It is estimated that one third of the adult population worldwide does not reach recommended levels of physical activity.[4]

Brazil, like other emerging economies, has experienced a rapid change in terms of urbanization and transportation over the last decades.[5] In this context, one of the most remarkable changes is the shift from public and collective transportation to a more private and individualized mode. As a result, the incidence of traffic-related injuries and deaths has increased, as has the prevalence of respiratory diseases and the level of stress associated with residing in urban areas.[6–9] Another potential negative effect is an increase in physical inactivity due to lower amounts of activity obtained through daily transportation.[10]

Bicycling and walking are not only a promising way to promote physical activity but also provide benefits to the individual and communities.[11–13] Initiatives and interventions to increase these modes of transportation have been documented in the peer-reviewed[14] and gray literature,[15] and they are usually designed to take into account environmental and individual characteristics. However, nearly all the information available on these characteristics originated from high-income countries, particularly from regions where walking and bicycling for transportation are more prevalent.[16–18]

The limited evidence available from low- and middle-income countries shows that walking and cycling are more prevalent among men and in low-income groups,[19–21] and that only a few built and perceived environmental characteristics are associated with these commuting choices.[20,22,23] Moreover, available evidence usually comes from specific locations and populations (e.g., workers). In addition, the variation across locations should also be considered. For instance, recent findings have shown that walking for transportation in Latino communities in the U.S. is more prevalent among women and varies according to length of time one has lived in the country.[24] Another study reported that walking for transportation is greater in areas with higher urbanization and during summer months compared to winter months, indicating that commuting behaviors are affected by the environment.[25]

The results of commuter cycling and walking studies are diverse, in part because the assessed environmental attributes and measures have varied considerably across the studies. In addition, they are mainly limited to high-income countries, as recently shown.[4] Therefore, a better understanding of the factors that may influence bicycling and walking for transportation in middle-income countries, such as Brazil, is needed. Such data will be valuable for targeting and designing interventions (e.g., identifying subgroups and potential moderators) to promote active modes of transportation,[26] which could help reverse the increase in physical inactivity. The aims of the current study were to describe the prevalence of cycling and walking for transportation; and to identify the associated personal and perceived environmental correlates in residents from three state capitals from various regions of Brazil.

Methods

The cities of Curitiba, Vitoria, and Recife are state capitals located in the southern, southeast, and northeast regions of Brazil, respectively. The capitals differ not only geographically but also in regard to their social and built environment (Table 1). Curitiba has the lowest inhabitant/car ratio, indicative of higher traffic density, whereas Recife has the highest population density and inhabitant/car ratio. Of the three, Recife has the highest average temperature, crime rate, Gini index (a measurement of the income distribution of a country's residents), and unemployment rate, indicative of higher social inequity. Despite these differences, the capitals have similarities in their demographics (e.g., percentage of women), physical activity environment and policies. All cities have community physical activity programs, which to some extent are linked to their environmental features (e.g., parks, plazas and beaches).[27–30]

Population and Sample

In each city, a random-digit-dialing telephone survey was carried out with the same sampling methodology used by the Brazilian Chronic Disease Risk Factor Surveillance.[31] The surveys conducted in Curitiba during 2008 and in Recife during 2007 were part of Project GUIA (Guide for Useful Interventions for Physical Activity in Brazil and Latin America), a large initiative aimed at understanding physical activity promotion in Brazil.[32] Another survey was carried out in 2009 to evaluate a local physical activity program in Vitoria as part of another project using the methods in surveying.[30]

Participants were non-institutionalized residents of the three cities (*n*=6166), who had resided for at least 1 year in the same neighborhood and were aged ≥18 years. Respondents were selected through a stratified and clustered multistage sampling process. Response rates were 60.5% (Curitiba), 75.2% (Vitoria) and 64.5% (Recife). The sampling procedure was similar in all three cities with some differences in the stratification process due to specific characteristics of the city. IRB approval was obtained prior to data collection from São Paulo Federal University, Pontiff Catholic University of Parana in Curitiba, and Washington University in St. Louis.

Measures and Data Collection

Trained interviewers administered a standardized questionnaire. All the interviewers had experience in administering telephone population surveys and received a 2-day training before the start of each survey. The International Physical Activity Questionnaire (IPAQ), long-form[33] was used to obtain information on walking and cycling for transportation, which were considered the outcome variables. Walking for transportation was categorized according to the most recent recommendations for physical activity and health (≥150 minutes/week).[34] Cycling for transportation was dichotomized into two categories (yes vs no).

Covariates included sociodemographic and health characteristics as well as perceived environment indicators. Age was divided into three categories: 18–34 years, 35–54 years, and ≥ 55 years. Education was classified as less than high school, having completes high school, or above. Marital status was classified as single, married or living together, or other (widowed/separated/divorced). BMI was based on self-reported weight and height and was grouped into two categories: underweight and normal weight (BMI <25) versus overweight/obese (BMI ≥25).

The Neighborhood Environment Walkability Scale (A-NEWS) was used to obtain perceptions on environment related to physical activity.[35] The response categories were adapted and dichotomized (yes vs no). This modified version was previously used in other face-to-face [36] and phone surveys with adequate reliability.[22] Only the measures comparable across the three data sets were used, including perceptions of safety (walking/bicycling during the day and night), traffic conditions, and presence of sidewalks.

Data Analysis

A descriptive analysis of cycling and walking according to personal and environmental factors, stratified by cities, was conducted. A description of bivariate analysis was performed using Poisson regression between cycling and walking for transportation and covariates stratified by cities. Poisson regression was chosen due to the low prevalence of cycling observed in the sample. Finally, multivariate analyses were carried out using Poisson hierarchic regressions between cycling and walking for transportation and covariates stratified by city (Level 1= demographics; Level 2=BMI and perceived health; Level 3 = all covariates plus perceived environment variables). Interaction terms were created to assess the effect modification by city. The group of commands “svy” was used in Stata 10.0 software to account for the complex sampling design using sampling weights for gender and age. All analyses were conducted in 2011.

Results

Study Population Characteristics

The study population consisted predominantly of women and adults aged 18–34 years (Table 2). Education level, marital status, and perceived health varied across the cities. Of the three cities, Recife had the highest percentage of residents in the low-education category, whereas Vitoria had the highest relative frequency in the highest education category. Being married was the most common marital status in Curitiba and Vitoria but not in Recife. Recife had the highest percentage of residents in the poor or regular health categories, compared to the other two cities. Obesity/overweight status was similar across the cities; with normal weight being the most frequent response.

Overall, cycling for transportation was 13.4% and was higher in Recife (16.0%; 95% CI=13.7%, 18.4) compared to Curitiba (9.6%; 95% CI=7.8, 11.4) and Vitoria (8.8%; 95% CI=734, 10.1). An interaction for cycling prevalence was found between Recife (prevalence OR [pOR]=1.32; 95% CI=1.03, 1.98) and Curitiba. One of four participants (26.6%) walked regularly as a mode of transportation. A lower prevalence was observed in Curitiba (23.9%) and Vitoria (23.8%) compared to Recife (27.4%), although they did not differ statistically.

The environmental characteristics varied in all three cities. For instance, although more than half of the participants reported that traffic does not make cycling/walking more difficult, this proportion was lower in Vitoria (37.9%) than in the other two cities. Three quarters of the participants reported having sidewalks in the streets, with a lower proportion reported in Vitoria (46.7%). Finally, perceived safety for cycling/walking during the night was lower in Vitoria compared to the other cities.

Individual and Environmental Correlates of Cycling for Transportation

Table 3 shows the results of the adjusted Poisson regression analysis on cycling for transportation. The associations in the adjusted analysis showed that men were 3.4 times more likely to cycle than women. Younger respondents were roughly three times more likely to cycle than were older participants. Participants with a higher level of education were 70% less likely to cycle than those in the lower education category, in all three cities. Other covariates were not consistently associated with cycling. For instance, normal weight status was associated with cycling only in the pooled analysis (pOR=1.7, 95% CI=1.3, 2.3) and in Recife (pOR=1.7, 95% CI=1.3, 2.3). No evidence of strong association was found for marital status, perceived health, and all four environmental indicators.

Individual and Environmental Correlates of Walking for Transportation

Adjusted Poisson regressions on walking for transportation are presented in Table 4. Education level was the only covariate consistently associated with walking across all three cities, showing that people in the highest education category are less likely to walk regularly compared to those with less education. Other covariates showed divergent patterns. For instance, married and single respondents were roughly twice as likely to walk regularly in the combined data set and also in Recife but not in the other cities. Positive perception of health was associated with walking in the pooled analysis, and in Curitiba. All four environmental indicators, age, and BMI did not present strong associations with walking for transportation.

Discussion

This study describes the prevalence of cycling and walking for transportation and their association with personal and environmental factors across three state capitals in Brazil. This is one of the first studies to analyze active commuting in a low- to middle-income country in a large sample. The prevalence of cycling for transportation was 13.4%, and one of four (26%) participants walked regularly as a mode of transportation. These prevalences varied among cities and were associated with gender, age and education. Health and environmental indicators were not consistently associated across all the cities and were more frequently associated with walking than bicycling.

Overall, the prevalence of cycling for transportation was higher in Recife compared with that in Curitiba and Vitoria. The prevalence of cycling for transportation remained higher than that observed in North America, where it is four[37] to six times[38] lower. However, when compared to some Europeans countries, figures in the present study are low. For example, survey data from Belgium[16], Germany[39] and Austria[40] has shown prevalences of 55.0%, 44.6% and 41.4% respectively, which are roughly three times higher than the findings from these Brazilian cities. Comparisons with other middle- and low-income countries are limited by the scarce data available, as recently noted in a comprehensive review.[4] Yet, a prevalence of 15% has been reported in Bogota (Colombia),[20] which is similar to the overall prevalence found in the current study.

Approximately one of four participants walked regularly as a mode of transportation. A slightly lower prevalence was observed in Curitiba and Vitoria (~24%) compared with Recife (27.4%). Comparisons with other studies and settings are difficult, mainly because of three factors. First, walking for transportation is rarely analyzed separately from cycling as a mode of transport;[4] second, the vast majority of the available evidence that analyzed such outcomes separately comes from high-income countries;[4] and third, such studies have rarely used the most recent physical recommendation cut-point as an outcome variable.[34] Despite these factors, the results are consistent with previous evidence. For instance, data from the U.S. National Health Survey have shown that 28.2% of adults walk for transportation for at least 10 minutes. More recently, a study with Latino adults from San Diego CA showed that 29% of respondents adhered to current physical activity guidelines through walking for transportation.[39]

Prevalence of cycling and walking for transportation in these three Brazilian cities should be interpreted in light of contextual changes. For instance, a recent survey conducted in 22 African countries showed that physical activity for transport, including walking, contributes largely to overall physical activity.[41] Notably, this contribution was lower in countries with a medium or high human development index ,[41] suggesting a country-specific effect. In fact, the social and economic changes experienced by Latin America, including rapid urbanization[42] and a steady increase in car ownership might have influenced patterns of active transportation.[43] Such changes may partially explain the relatively low prevalence found compared to that in European countries, where such characteristics (e.g., urbanization and car ownership) have been relatively stable over the past decade. In the U.S., increasing prevalence of physical inactivity is partially explained by declining rates of transportation-related physical activity.[10]

Finally, city-specific differences should be considered in light of the results of the current study. The prevalence of cycling in Recife was almost twice that in Curitiba. Recife also has a slightly higher prevalence of walking, but the difference is not as great. Recife has the lowest human development index, and the highest crime rate, population density, unemployment rate, and social inequality; therefore, it is likely that physical activity is a needed means of transportation regardless of safety. In fact, physical activity for transport is more prevalent in areas with a higher population density and low income[20]; however, higher crime rates have shown an inconsistent association with both cycling and walking for transportation.[44]

Personal characteristics were associated with physical activity for transportation, which is consistent with the current body of evidence. Several studies[11,20,37,38] have reported that gender (female), age and schooling are inversely associated with cycling for transportation while walking for transportation is more frequent in groups with a lower level of education.[17,18,20] Cycling and walking for transportation were not associated with perceived environment. This lack of association with perceived-environment variables could be explained by contextual, design and measurement limitations of this study. Since crime is highly prevalent in all cities, regular bikers or walkers may be more likely to report an unsafe environment. As previously noted, Recife and Vitoria have the highest crime rates among the cities, supporting the hypothesis that lack of safety is over-reported among those who are regular walkers.

Additionally, the overall population density is high, which could offer a more walkable environment[45] but also increase the exposure to greater traffic volume. Finally, three of four participants reported sidewalks in the streets nearby. These characteristics could reduce the variability of the exposure (e.g., safety and sidewalks), while the cross-sectional design may affect the direction of associations. The combination of these factors may help to explain the lack of association. Nonetheless, the available literature is not conclusive on the association between safety from crime and traffic with physical activity for transportation,[44] which also makes it difficult to draw evidence-based hypotheses.

This is not the case for the presence of sidewalks, which is positively associated with physical activity for transport.[17,46] However, the studies reporting such association employed objective environmental measures (e.g., GIS), limiting the comparisons that can be made to the current findings. Moreover, the measure employed did not account for the quality of the sidewalks, which may also be an important factor in whether they are used, as reported in the literature.[44] Finally, the outcome variables were self-reported, although providing reliable information on the total physical activity volume [47] does not capture details in travel time and physical activity intensity (e.g., walking speed), which may be important factors for light and moderate levels of activity such as cycling and walking.

Several strengths should be noted in this study. First, the sample size was large enough to provide precise prevalence estimates and to detect small effects on the exposure variables. Commuting physical activity was analyzed as a separate outcome, which is rarely reported in the literature, particularly in low- or middle-income countries.[4] All the analyses were conducted to account for the main confounders.

This study offered a unique opportunity to compare various social and environmental characteristics across three main state capital cities. Findings should help to disentangle the myriad factors related to active transportation in low- to middle-income countries with high rates of urbanization. The standardization of the outcome measure and independent variables allows comparability across studies. Additionally, these findings suggest that lower-income populations and women are potential subgroups that need intensive intervention for promoting active transportation regardless of country income.

Although environmental correlates were not associated with commuting physical activity, this research could be supplemented with natural experiments in urban planning and transportation as observed in some cities in Latin America.[20,27] In that sense, researchers should explore whether changes in policies and practices (e.g., improvements in street lighting, safety of street crossing, and sidewalk continuity) in similar settings are effective in promoting active transportation.

Conclusion

The prevalence of cycling and walking for transportation was low in the current study compared to that found in certain high-income countries, particularly in Europe, and was slightly higher in the cities with the most unequal and unsafe environments. Personal factors were more consistently associated with bicycling than with walking, whereas perceived environmental features were not associated with active commuting.

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References

1. Rodgers A, Ezzati M, Vander Hoorn S, Lopez AD, Lin RB, Murray CJ. Distribution of major health risks: findings from the Global Burden of Disease study. PLoS Med. 2004; 1(1):e27. [PubMed: 15526049]
2. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet. 2012; 380(9838):219–29. [PubMed: 22818936]
3. Dumith SC, Hallal PC, Reis RS, Kohl HW 3rd. Worldwide prevalence of physical inactivity and its association with human development index in 76 countries. Prev Med. 2011
4. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet. 2012; 380(9838):247–57. [PubMed: 22818937]
5. Comaru FA, Westphal MF. Housing, urban development and health in Latin America: contrasts, inequalities and challenges. Rev Environ Health. 2004; 19(3-4):329–45. [PubMed: 15742677]
6. Reynolds CCO, Harris AM, Teschke K, Cripton PA, Winters M. The impact of transportation infrastructure on bicycling injuries and crashes: a review of the literature. Environmental Health. 2009; 8(47):1–19. [PubMed: 19138417]
7. Dratva J, Phuleria HC, Foraster M, et al. Transportation Noise and Blood Pressure in a Population-Based Sample of Adults. Environ Health Perspect. 2011
8. Brunekreef B, Beelen R, Hoek G, et al. Effects of long-term exposure to traffic-related air pollution on respiratory and cardiovascular mortality in the Netherlands: the NLCS-AIR study. Res Rep Health Eff Inst. 2009; (139):5–71. discussion 73-89. [PubMed: 19554969]
9. Lederbogen F, Kirsch P, Haddad L, et al. City living and urban upbringing affect neural social stress processing in humans. Nature. 2011; 474(7352):498–501. [PubMed: 21697947]

10. Brownson RC, Boehmer TK, Luke DA. Declining rates of physical activity in the U.S.: what are the contributors? Annu Rev Public Health. 2005; 26:421–43. [PubMed: 15760296]
11. Gordon-Larsen P, Boone-Heinonen J, Sidney S, Sternfeld B, Jacobs DR Jr. Lewis CE. Active commuting and cardiovascular disease risk: the CARDIA study. Arch Intern Med. 2009; 169(13): 1216–23. [PubMed: 19597071]
12. Hamer M, Chida Y. Active commuting and cardiovascular risk: a meta-analytic review. Prev Med. 2008; 46(1):9–13. [PubMed: 17475317]
13. Marshall JD, Brauer M, Frank LD. Healthy neighborhoods: walkability and air pollution. Environ Health Perspect. 2009; 117(11):1752–9. [PubMed: 20049128]
14. Pucher J, Dill J, Handy S. Infrastructure, programs, and policies to increase bicycling: an international review. Prev Med. 2010; 50(Suppl 1):S106–25. [PubMed: 19765610]
15. Kahlmeier, S.; Dinsdale, H.; Cavill, N., et al. Economic assessment of transport infrastructure and policies : Health Economic Assessment Tools (HEAT) for walking and cycling) : methodology and user guide. WHO Regional Office for Europe; Copenhagen: 2011.
16. de Geus B, De Bourdeaudhuij I, Jannes C, Meeusen R. Psychosocial and environmental factors associated with cycling for transport among a working population. Health Educ Res. 2008; 23(4): 697–708. [PubMed: 17947248]
17. Saelens BE, Handy SL. Built environment correlates of walking: A review. Med Sci Sports Exerc. 2008; 40(7S):S550–S566. [PubMed: 18562973]
18. Saelens BE, Sallis JF, Frank LD. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. Ann Behav Med. 2003; 25(2):80–91. [PubMed: 12704009]
19. Bacchieri G, Gigante DP, Assuncao MC. Determinants and patterns of bicycle use and traffic accidents among bicycling workers in Pelotas, Rio Grande do Sul, Brazil. Cad Saude Publica. 2005; 21(5):1499–508. [PubMed: 16158156]
20. Cervero R, Sarmiento OL, Jacoby E, Gomez LF, Neiman A. Influences of Built Environments on Walking and Cycling: Lessons from Bogotá. International Journal of Sustainable Transportation. 2009; 3(4):37–41.
21. Gomes GA, Reis RS, Parra DC, Ribeiro I, Hino AA, Hallal PC, et al. Walking for leisure among adults from three Brazilian cities and its association with perceived environment attributes and personal factors. Int J Behav Nutr Phys Act. 2011; 8(1):111. [PubMed: 21995846]
22. Parra DC, Hoehner CM, Hallal PC, Ribeiro IC, Reis R, Brownson RC, et al. Perceived environmental correlates of physical activity for leisure and transportation in Curitiba, Brazil. Prev Med. 2011; 52(3-4):234–8. [PubMed: 21195726]
23. Hallal PC, Reis RS, Parra DC, Hoehner C, Brownson RC, Simoes EJ. Association between perceived environmental attributes and physical activity among adults in recife, Brazil. J Phys Act Health. 2010; 7(Suppl 2):S213–22. [PubMed: 20702909]
24. Martinez SM, Arredondo EM, Roesch S, Patrick K, Ayala GX, Elder JP. Walking for transportation among latino adults in san diego county: who meets physical activity guidelines? J Phys Act Health. 2011; 8(7):898–906. [PubMed: 21885880]
25. Yang Y, Roux AV, Bingham CR. Variability and seasonality of active transportation in U.S.: evidence from the 2001 NHTS. Int J Behav Nutr Phys Act. 2011; 8:96. [PubMed: 21917136]
26. Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW. Correlates of physical activity: why are some people physically active and others not? Lancet. 2012
27. Reis RS, Hallal PC, Parra DC, et al. Promoting physical activity through community-wide policies and planning: findings from curitiba, Brazil. J Phys Act Health. 2010; 7(Suppl 2):S137–45. [PubMed: 20702902]
28. Simoes EJ, Hallal P, Pratt M, Ramos L, Munk M, Damascena W, et al. Effects of a community-based, professionally supervised intervention on physical activity levels among residents of Recife, Brazil. Am J Public Health. 2009; 99(1):68–75. [PubMed: 19008499]
29. Venturim, LMdVP.; Molina, MDCB. Mudanças no estilo de vida após as ações Realizadas no serviço de orientação ao exercício – Vitória/ES. Rev. Bras Ativ Fís Saúde. 2005; 10(2):4–16.

30. Reis RS, Hino AA, da Silva Filho LE, Cruz DK, Malta DC, Domingues MR, et al. Promoting physical activity and quality of life in Vitoria, Brazil: evaluation of the Exercise Orientation Service (EOS) Program. J Phys Act Health. in press.
31. Vigitel. Vigitel Brasil 2008: Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico. Ministério da Saúde, Secretaria de Vigilância em Saúde, Secretaria de Gestão Estratégica e Participativa; Brasília: 2009.
32. Pratt M, Brownson RC, Ramos LR, Malta DC, Hallal PC, Reis RS, et al. Project GUIA: A Model for Understanding and Promoting Physical Activity in Brazil and Latin America. J Phys Act Health. 2010; 7(Suppl 2):S131–4. [PubMed: 20702900]
33. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003; 35(8):1381–95. [PubMed: 12900694]
34. WHO. Global recommendations on physical activity for health. WHO; Geneva: 2010.
35. Cerin E, Saelens BE, Sallis JF, Frank LD. Neighborhood Environment Walkability Scale: validity and development of a short form. Med Sci Sports Exerc. 2006; 38(9):1682–91. [PubMed: 16960531]
36. Florindo AA, Salvador EP, Reis RS, Guimaraes VV. Perception of the environment and practice of physical activity by adults in a low socioeconomic area. Rev Saude Publica. 2011; 45(2):302–310. [PubMed: 21412570]
37. Butler GP, Orpana HM, Wiens AJ. By your own two feet: factors associated with active transportation in Canada. Can J Public Health. 2007; 98(4):259–64. [PubMed: 17896732]
38. Rashad I. Associations of cycling with urban sprawl and the gasoline price. Am J Health Promot. 2009; 24(1):27–36. [PubMed: 19750960]
39. Huy C, Becker S, Gomolinsky U, Klein T, Thiel A. Health, medical risk factors, and bicycle use in everyday life in the over-50 population. J Aging Phys Act. 2008; 16(4):454–64. [PubMed: 19033605]
40. Titze S, Giles-Corti B, Knuiman MW, Pikora TJ, Timperio A, Bull FC, et al. Associations between intrapersonal and neighborhood environmental characteristics and cycling for transport and recreation in adults: baseline results from the RESIDE study. J Phys Act Health. 2010; 7(4):423–31. [PubMed: 20683083]
41. Guthold R, Louazani SA, Riley LM, et al. Physical activity in 22 African countries: results from the World Health Organization STEPwise approach to chronic disease risk factor surveillance. Am J Prev Med. 2011; 41(1):52–60. [PubMed: 21665063]
42. Cerrutti, M.; Bertoncello, R. Urbanization and internal migration patterns in Latin America. Centro de Estudios de Población; Argentina: 2003.
43. Roberts I, Wentz R, Edwards P. Car manufacturers and global road safety: a word frequency analysis of road safety documents. Inj Prev. 2006; 12(5):320–2. [PubMed: 17018674]
44. Wendel-Vos GC, van Hooijdonk C, Uitenbroek D, Agyemang C, Lindeman EM, Droomers M. Environmental attributes related to walking and bicycling at the individual and contextual level. J Epidemiol Community Health. 2008; 62(8):689–94. [PubMed: 18621953]
45. Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J. An ecological approach to creating active living communities. Annu Rev Public Health. 2006; 27:297–322. [PubMed: 16533119]
46. Panter JR, Jones A. Attitudes and the Environment as Determinants of Active Travel in Adults: What Do and Don't We Know? J Phys Act Health. 2010; 7:551–561. [PubMed: 20683098]
47. Hallal PC, Victora CG. Reliability and validity of the International Physical Activity Questionnaire (IPAQ). Med Sci Sports Exerc. 2004; 36(3):556. [PubMed: 15076800]

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Table 1

Description of city's social and environmental characteristics[a]

Characteristics	Curitiba	Recife	Vitoria
Population, *n*	1,851,215	1,561,659	320,156
Women aged >18 years (%)	53.5	55.6	54.5
Unemployment (%)[b]	4.6	12.2	6.8
Area (Km^2)	435	217	93
Population density (Inhabitants/Km^2)	4255.7	7196.6	3442.5
Average temperature (degrees Fahrenheit)	62	78	76
Automobile fleet (units)	867,066	307,166	109,305
Inhabitants/cars	2.1	5.1	2.9
Crime rate (Homicides/100,000 inhabitants)	45.5	87.5	75.4
Human Development Index (HDI)	0.85	0.79	0.85
Gini index	0.59	0.68	0.61

[a]Source: Brazilian Institute of Geography and Statistics (IBGE, 2010)

[b]Percentage of the population aged ≥16 years, economically active and not employed.

Table 2

Demographic characteristics of participants according to the city of residence

Variables and Categories	Curitiba		Recife		Vitória		Combined	
	n	% (95% CI)[a]	*n*	% (95% CI)[a]	*n*	% (95% CI)[a]	*n*	% (95% CI)[a]
Gender								
Women	1329	62.6 (59.8, 65.3)	1285	56.3 (52.4, 60.1)	1276	62.2 (59.8, 64.6)	3890	58.8 (56.3, 61.4)
Men	768	37.4 (34.7, 40.2)	761	43.7 (39.9, 47.6)	747	37.8 (35.4, 40.2)	2276	41.2 (38.6, 43.7)
Age categories								
55+	625	15.6 (14.1, 17.2)	585	18.3 (16.1, 20.5)	611	20.2 (18.5, 22.0)	1821	17.4 (16.0, 18.8)
35-45	861	37.3 (34.7, 39.9)	761	34.1 (30.7, 37.4)	798	35.0 (32.7, 37.2)	2420	35.3 (33.1, 37.5)
18–34	611	47.0 (44.1, 49.9)	700	47.6 (43.8, 51.5)	614	44.8 (42.2, 47.3)	1925	47.3 (44.8, 49.8)
Education level								
<High	671	28.6 (26.2, 31.1)	631	46.1 (42.1, 50.1)	492	20.4 (18.5, 22.2)	1794	38.5 (35.7, 41.2)
High school	724	41.2 (38.4, 44.1)	765	38.2 (34.9, 41.6)	652	33.6 (31.2, 36.0)	2141	39.2 (36.9, 41.4)
>High school	692	30.1 (27.5, 32.7)	612	15.7 (14.0, 17.4)	879	46.0 (43.6, 48.5)	2183	22.4 (20.8, 23.9)
Marital status								
Other	376	9.3 (8.0, 10.6)	342	10.9 (8.7, 13.0)	367	10.9 (9.6, 12.2)	1085	10.3 (8.9, 11.6)
Married	1199	56.0 (53.1, 58.9)	940	42.9 (39.2, 46.5)	1053	50.4 (47.9, 52.9)	3192	48.0 (45.5, 50.4)
Single	522	34.7 (31.8, 37.7)	764	46.3 (42.4, 50.1)	603	38.7 (36.1, 41.2)	1889	41.7 (39.2, 44.3)
Perceived health								
Poor/Regular	541	24.6 (22.2, 26.9)	774	37.8 (34.3, 41.4)	608	27.7 (25.5, 29.8)	1923	32.5 (30.3, 34.8)
Good	963	48.0 (45.1, 50.8)	822	41.6 (37.7, 45.5)	771	38.8 (36.3, 41.2)	2556	43.8 (41.3, 46.3)
Very good/excellent	592	27.5 (25.0, 30.0)	450	20.6 (17.8, 23.4)	631	33.6 (31.2, 35.9)	1673	23.7 (21.7, 25.6)
BMI								
Overweight/Obese	912	60.2 (57.4, 62.9)	830	58.1 (54.1, 62.1)	888	56.7 (54.2, 59.2)	2630	58.8 (56.3, 61.4)
Normal	1133	39.8 (37.1, 42.6)	1115	41.9 (37.9, 45.9)	1.01	43.3 (40.8, 45.8)	3258	41.2 (38.6, 43.7)
Bike use								
Yes	160	9.6 (7.8, 11.4)	248	16.0 (13.7, 18.4)	166	8.8 (7.4, 10.1)	574	13.4 (11.8, 14.9)
No	1937	90.4 (88.6, 92.2)	1798	84.0 (81.6, 86.3)	1857	91.2 (89.9, 92.6)	5592	86.6 (85.1, 88.2)
Walking for transportation regularly (150min/week)								
Yes	458	23.9 (21.4, 26.4)	480	27.4 (23.7, 31.1)	477	23.8 (21.7, 25.9)	1415	26.0 (23.6, 28.3)

Variables and Categories	Curitiba		Recife		Vitória		Combined	
	n	**% (95% CI)[a]**	***n***	**% (95% CI)[a]**	***n***	**% (95% CI)[a]**	***n***	**% (95% CI)[a]**
No	1639	76.1 (73.6, 78.6)	1551	72.6 (68.9, 76.3)	1499	76.2 (74.1, 78.3)	4689	74.0 (71.7, 76.4)
Sidewalks in the streets nearby								
Yes	1556	70.7 (68.0, 73.3)	1762	81.1 (77.5, 84.8)	936	46.7 (44.2, 49.2)	4254	75.9 (73.6, 78.2)
No	541	29.3 (26.7, 32.0)	284	18.9 (15.2, 22.5)	1036	53.3 (50.8, 55.8)	1861	24.1 (21.8, 26.4)
Traffic make it difficult to cycle/walk								
Yes	1130	54.9 (52.1, 57.8)	968	43.6 (40.0, 47.3)	1231	62.1 (59.7, 64.6)	3329	48.5 (46.1, 51.0)
No	967	45.1 (42.2, 47.9)	1077	56.4 (52.7, 60.0)	692	37.9 (35.4, 40.3)	2736	51.5 (49.0, 53.9)
Safe to cycle/walk during the night								
Yes	775	37.2 (34.5, 40.0)	806	44.4 (40.5, 48.2)	408	21.6 (19.5, 23.7)	1989	40.8 (38.3, 43.4)
No	1322	62.8 (60.0, 65.5)	1240	55.6 (51.8, 59.5)	1530	78.4 (76.3, 80.5)	4092	59.2 (56.6, 61.7)
Safe to cycle/walk during the day								
Yes	1760	84.8 (82.8, 86.8)	1551	79.5 (77.0, 82.0)	1128	58.2 (55.7, 60.7)	4439	80.6 (78.9, 82.3)
No	337	15.2 (13.2, 17.2)	495	20.5 (18.0, 23.0)	816	41.8 (39.3, 44.3)	1648	19.4 (17.7, 21.1)

[a]Weighed prevalence

Table 3

Personal and environmental factors associated with cycling for transportation in Curitiba, Vitoria and Recife, Brazil, pOR (95% CI)

Variables		Curitiba[a]			Recife[a]			Vitoria[a]			Combined[b]		
Gender	Women	Ref			Ref			Ref			Ref		
	Men	**2.8**	**1.9**	**4.1**	**3.7**	**2.7**	**4.9**	**3.4**	**2.6**	**4.9**	**3.4**	**2.6**	**4.4**
Age categories, years	55+	Ref			Ref			Ref			Ref		
	35–45	**1.8**	**1.1**	**3.4**	**3.1**	**1.7**	**4.6**	**2.0**	**1.2**	**3.3**	**2.6**	**1.7**	**4.2**
	16–34	**2.4**	**1.2**	**4.7**	**3.4**	**1.7**	**6.7**	**2.6**	**1.5**	**4.6**	**2.9**	**1.8**	**4.9**
Education level	<High	Ref			Ref			Ref			Ref		
	High school	0.7	0.4	1.1	0.8	0.6	1.1	**0.6**	**0.4**	**0.8**	0.8	0.6	1.0
	>High school	**0.3**	**0.1**	**0.5**	**0.3**	**0.2**	**0.5**	**0.2**	**0.1**	**0.3**	**0.3**	**0.2**	**0.4**
Marital status	Other	Ref			Ref			Ref			Ref		
	Married	1.1	0.5	2.4	0.7	0.4	1.1	1.5	0.7	3.2	0.8	0.5	1.2
	Single	1.6	0.7	3.7	0.6	0.4	1.1	1.6	0.7	3.5	0.8	0.5	1.3
Perceived health	Poor/Regular	Ref			Ref			Ref			Ref		
	Good	1.3	0.7	2.2	1.0	0.7	1.4	0.7	0.5	1.1	1.1	0.8	1.4
	Very good/excellent	1.7	0.9	2.9	1.2	0.8	1.7	0.9	0.6	1.5	1.3	0.9	1.7
BMI	Overweight/Obese	Ref			Ref			Ref			Ref		
	Normal	1.4	0.9	2.0	**1.9**	**1.4**	**2.8**	1.1	0.8	1.5	**1.7**	**1.3**	**2.3**
Sidewalks in the streets nearby	Yes	Ref			Ref			Ref			Ref		
	No	1.1	0.7	1.6	0.9	0.6	1.4	0.9	0.7	1.3	0.9	0.7	1.3
Traffic make it difficult to cycle/walk	Yes	Ref			Ref			Ref			Ref		
	No	1.0	0.7	1.5	0.8	0.6	1.1	1.2	0.8	1.6	0.9	0.7	1.1
Safe to cycle/walk during the night	Yes	Ref			Ref			Ref			Ref		
	No	1.1	0.7	1.6	1.2	0.8	1.6	1.0	0.7	1.4	1.1	0.8	1.4
Safe to cycle/walk during the day	Yes	Ref			Ref			Ref			Ref		
	No	1.1	0.6	1.9	0.7	0.5	1.0	0.9	0.7		0.8	0.6	1.1

[a]Weighed prevalence OR adjusted for Gender, Age categories, Education level, Marital status, Perceived health and BMI;

[b]Weighed prevalence OR adjusted for Gender, Age categories, Education level, Marital status, Perceived health, BMI and City.

Table 4

Personal and environmental factors associated with walking for transportation in Curitiba, Vitoria and Recife, Brazil, pOR (95% CI)

Variables		Curitiba[a]			Recife[a]			Vitoria[a]			Combined[b]		
Gender	Women	Ref			Ref			Ref			Ref		
	Men	1.0	0.8	1.2	0.9	0.7	1.2	1.0	0.8	1.2	0.9	0.8	1.1
Age, years	55+	Ref			Ref			Ref			Ref		
	35–45	1.0	0.8	1.3	1.1	0.8	1.6	1.0	0.8	1.3	1.1	0.9	1.4
	16–34	1.1	0.8	1.5	1.1	0.7	1.7	1.0	0.8	1.4	1.1	0.8	1.4
Education level	<High	Ref			Ref			Ref			Ref		
	High school	0.9	0.7	1.1	1.0	0.7	1.4	0.9	0.7	1.1	0.9	0.8	1.2
	>High school	**0.6**	**0.5**	**0.9**	**0.6**	**0.4**	**0.8**	**0.6**	**0.4**	**0.7**	**0.6**	**0.5**	**0.8**
Marital status	Other	Ref			Ref			Ref			Ref		
	Married	1.2	0.8	1.6	**1.6**	**1.1**	**2.4**	**0.7**	**0.6**	**0.9**	**1.4**	**1.1**	**1.8**
	Single	1.4	0.9	2.0	**2.0**	**1.3**	**3.0**	0.9	0.6	1.2	**1.7**	**1.3**	**2.2**
Perceived health	Poor/Regular	Ref			Ref			Ref			Ref		
	Good	1.1	0.8	1.5	1.1	0.8	1.4	1.1	0.9	1.4	1.1	0.9	1.3
	Very good/excellent	**1.4**	**1.0**	**1.8**	1.3	0.9	1.8	0.9	0.7	1.2	**1.3**	**1.0**	**1.6**
BMI	Overweight/Obese	Ref			Ref			Ref			Ref		
	Normal	1.2	0.9	1.4	1.2	0.9	1.8	1.2	0.9	1.4	1.2	0.9	1.5
Sidewalks in the streets nearby	Yes	Ref			Ref			Ref			Ref		
	No	1.1	0.8	1.4	1.3	0.9	1.9	1.0	0.8	1.2	1.2	0.9	1.5
Traffic makes it difficult to cycle/walk	Yes	Ref			Ref			Ref			Ref		
	No	0.9	0.7	1.2	0.9	0.8	1.2	1.0	0.8	1.2	1.0	0.8	1.1
Safe to cycle/walk during the night	Yes	Ref			Ref			Ref			Ref		
	No	1.0	0.8	1.3	1.2	0.9	1.6	1.0	0.8	1.3	1.2	0.9	1.4
Safe to cycle/walk during the day	Yes	Ref			Ref			Ref			Ref		
	No	1.2	0.9	1.6	0.9	0.7	1.3	1.0	0.8	1.2	1.0	0.8	1.3

[a]Weighed prevalence OR adjusted for Gender, Age categories, Education level, Marital status, Perceived health and BMI;

[b]Weighed prevalence OR adjusted for Gender, Age categories, Education level, Marital status, Perceived health, BMI and City.