Journal of Physical Activity and Health, 2013, 10, 856-862

JOURNAL OF
Physical Activity & Health
Official Journal of ISPAH
www.JPAH-Journal.com
ORIGINAL RESEARCH

Factors Associated With Physical Inactivity in Transportation in Brazilian Adults Living in a Low Socioeconomic Area

Thiago Herick Sa, Emanuel Péricles Salvador, and Alex Antonio Florindo

***Background*:** Physical inactivity in transportation is negatively related to many health outcomes. However, little is known about the correlates of this condition among people living in regions of low socioeconomic level. ***Methods*:** Cross-sectional study aimed to assess factors associated with physical inactivity in transportation among adults in the Eastern Zone of São Paulo, Brazil. Home-based interviews were conducted between May 2007 and January 2008 on a probabilistic sample of the adult population (≥18 years), totaling 368 men and 522 women. Factors associated with physical inactivity in transportation (less than 10 minutes per week of walking or cycling) were assessed using multivariate Poisson regression with hierarchical selection of variables. ***Results*:** Physical inactivity in transportation was associated with the presence of vehicles in the household in men (PR = 2.96) and women (PR = 2.42), with linear trend for both sexes ($P < .001$ and $P = .004$, respectively), even after adjusting for age, schooling level and chronic diseases (this last factor, only among women). ***Conclusions*:** Presence of vehicles in the household was associated positively with physical inactivity in transportation, both for men and for women. This should be taken into consideration in drawing up public policies for promoting physical activity.

***Keywords*:** motor activity, vulnerable populations, urban health, automobile

Moving around through one's own exertions is the most ancestral means of getting from one place to another. Walking or cycling are associated with prevention of cardiovascular diseases[1,2] and type 2 diabetes.[3] It strengthens the sense of community[4] and may contribute toward reduced emissions of greenhouse gases such as carbon dioxide.[5] With regard to walking, this is one of the most accessible forms of physical activity that can be incorporated into people's daily lives.[6]

Nevertheless, in the metropolitan region of São Paulo, active transportation accounted for only one-third of the almost 40 million journeys made every day in 2007.[1] Moreover, most of these journeys seem to be made by a small number of individuals, since less than 10% of the population of the municipality of São Paulo performs more than 150 minutes of physical activity per week in transportation.[7] Overall, among Brazilian state capitals, this proportion is 11.7%.[8]

So far, there is only sparse evidence regarding the main factors associated with Brazilian adults' use of walking or cycling to travel,[9] particularly among those living in regions of low socioeconomic level. Such information could assist in formulating public policies for encouraging physical activity practices, with additional benefits through mitigation of problems relating to traffic and atmospheric pollution.

The aim of this study was to investigate factors associated with physical inactivity in transportation, among adults living in a region of low socioeconomic level in the Eastern Zone of the municipality of São Paulo.

Methods

This was a cross-sectional population-based study conducted in the Ermelino Matarazzo district of the Eastern Zone of São Paulo, Brazil.

According to data produced in 2010 by the State of São Paulo's data analysis system (SEADE Foundation),[II] the municipality of São Paulo has around 11 million inhabitants. The Eastern Zone is the most populous region, accounting for around 35% of the city's population. The Ermelino Matarazzo district is at the eastern extremity of the city, covering an area of 8.95 km^2, with 143 census tracts and approximately 117,000 inhabitants.

The sample for this study was composed of 368 men and 522 women (890 people in total), all aged 18 years or over, who participated in the research project "Physical activity and its relationship with the environment among the adult population of the Ermelino Matarazzo district of the Eastern Zone of the municipality of São Paulo." To calculate the sample size, the following algebraic expression for sample estimation was used:[10]

$$n_0 = [P \times (1 - P) \div (d/z)^2] \times deff$$

Sa and Salvador are with the Dept of Nutrition, School of Public Health, University of São Paulo, Brazil. Florindo is with the Dept of Physical Activity Sciences, School of Arts, Sciences, and Humanities, University of São Paulo, Brazil.

where:

- P = proportion of individuals to be estimated. Based on data from the "ISA-Capital" health survey conducted in the municipality of São Paulo in 2003, the value of 0.85 was used for this parameter, since it has been found that the prevalence of individuals who do not reach the recommendation of at least 150 minutes of physical activities per week in transportation or as leisure activities is 85%[7]
- z = 1.96. This was the value on the reduced normal curve corresponding to a 95% confidence level that is used to determine the confidence interval
- *deff* = 2.6. This was the design effect estimated from the data of the ISA-Capital survey
- d = 0.05 and 0.065. These were the sampling errors accepted for adults and elderly people, respectively.

Further details on the sample size calculation can be found in Salvador et al.[11] (2009). The final response rates were 72.6% and 81.7% for elderly people and adults, respectively.

Assessment of Physical Activity

To assess physical activity practiced in transportation, the International Physical Activity Questionnaire (IPAQ), long version, was used. This questionnaire has been validated in several countries around the world, including Brazil,[12] and it has already been used in a health survey in the municipality of São Paulo.[7]

Social, Demographic, and Lifestyle Variables

The sociodemographic variables studied were sex, age group (18–39, 40–59 or ≥60 years), schooling level (0–3, 4–7 or ≥8 years of study), marital status (single, separated/widowed or married), comorbidities (0, 1, or 2 or more chronic diseases), and number of vehicles at the home (0, 1, or 2 or more vehicles). Adherence to a religion was ascertained from an open question ("What is your religion or cult?"), and the responses were grouped as Catholic, Evangelical, or others. Skin color was classified as white or nonwhite (the questionnaire contained the choices of white, black, mixed, oriental, indigenous, or others).

Obesity was determined according to the body mass index (obesity = BMI ≥ 30 kg/m^2), calculated from the weight (kg) divided by the square of the height (m), which were both self-reported. Excessive alcohol consumption (yes/no) took into account whether the individual consumed alcohol every day; whether, on a single day, the individual usually consumed more than 2 doses (in the case of men) or more than 1 dose (in the case of women); and whether, over the past month, the individual had reached consumption of more than 5 doses on any single occasion. Smoking (yes/no) was defined from the question: "Do you smoke at the moment?" Reported health and quality of life were grouped as good/excellent or fair/poor/very poor.

Data Analysis

The dependent variable of this study was the amount of time spent on physical activity practice consisting of transportation on foot or by bicycle. This variable was created from the weekly frequency and daily duration in minutes. Individuals who did less than 10 minutes of walking or cycling per week in transportation were considered to be inactive.

For the data analysis, sample weighting factors were incorporated based on the age group and the sampled fraction of the census tract. These were estimated using information from the 2000 census of the Brazilian Institute for Geography and Statistics (Instituto Brasileiro de Geografia e Estatística; IBGE). All the analyses were stratified by sex. The bivariate and multiple regression analyses were carried out using the Stata 9.1 software. The prevalence ratio (PR) and its respective 95% confidence interval (95% CI) for the group of inactive individuals were estimated by Poisson regression with robust variance. To define which variables would be retained for multiple analysis, the significance level of $P < .20$ was used in the bivariate analysis.[13] Variables entered the model using hierarchical selection, to control for confounding factors,[14] through division into 3 sets of variables. The first set included age, skin color, and number of chronic diseases. The second set included schooling level and marital status. The third set included nutritional status, religion, smoking, excessive alcohol consumption, reported health, reported quality of life and number of vehicles per household. Variables were kept in the final model if their entry caused a change of more than 10% in the estimated prevalence ratio.[15] Variables that presented descriptive levels of less than 5% ($P < .05$) were considered to be factors associated with inactivity in transportation.

Ethical Issues

This study was approved by the Ethics Committee of the School of Public Health, University of São Paulo. All the participants signed a free and informed consent statement.

Results

Table 1 presents the characteristics of the study population. These results were very similar to those of the population of the municipality of São Paulo, according to data from the 2000 census (IBGE) and the SEADE Foundation (2007).

Among the variables analyzed, 3 showed P-values < 0.20 among the men and 7 showed P-values < 0.20 among the women. These variables were selected for performing Poisson regression analysis (Table 2).

Among the men, all of these variables remained in the final model (age, schooling level and number of vehicles in the household). As can be seen from Table 3, the prevalence of inactivity in transportation among men was almost twice as great among those who had 1 vehicle

Table 1 Numerical and Percentage Distribution of the Study Population According to Sex, Sociodemographic Variables, and Lifestyle Variables*; Ermelino Matarazzo District, São Paulo, 2007

	Men (n = 368)		Women (n = 522)		Total (n = 890)	
Variables	**n**	**%**	**n**	**%**	**n**	**%**
Physical activity in transportation						
Inactive[a]	50	16.1	80	12.4	130	14.1
Insufficiently active[b]	143	40.7	276	54.1	419	48.1
Active[c]	175	43.2	166	33.5	341	37.8
Age (years)						
18–39	130	55.8	172	49.0	302	52.0
40–59	86	32.8	117	37.5	203	35.4
60+	152	11.4	233	13.5	385	12.6
Skin color						
Nonwhite	177	51.8	224	42.3	401	46.6
White	191	48.2	297	57.7	488	53.4
Chronic diseases						
None	151	49.0	151	40.1	302	44.1
One	100	26.1	111	20.3	211	22.9
Two or more	117	24.9	260	39.6	377	33.0
Schooling level (years)						
0–4	86	15.1	156	17.0	242	16.1
5–8	137	33.1	163	27.5	300	30.0
9 or more	145	51.8	203	55.5	348	53.9
Marital status						
Single	55	5.2	198	18.4	253	12.4
Separated/widowed	79	36.0	101	26.5	180	30.8
Married	234	58.8	223	55.1	457	56.8
Nutritional status						
Nonobese	313	84.2	437	86.2	750	85.3
Obese	55	15.8	85	13.8	140	14.7
Smoking						
No	278	70.6	448	85.5	726	78.9
Yes	90	29.4	74	14.5	164	21.1
Excessive alcohol consumption						
No	333	90.4	500	96.2	833	93.6
Yes	35	9.6	19	3.8	54	6.4
Self-reported health						
Fair or poor	149	39.6	267	48.0	416	44.2
Good or very good	219	60.4	255	52.0	474	55.8
Quality of life						
Fair or poor	175	45.3	244	44.4	419	44.8
Good or very good	193	54.7	278	55.6	471	55.2
Religion						
Catholic	224	56.1	289	49.3	513	52.3
Protestant	81	23.7	146	31.0	227	27.8
Others	63	20.2	87	19.7	150	19.9
Vehicle in the household						
None	201	54.3	333	56.6	534	55.6
1	127	32.7	154	35.9	281	34.4
2+	40	13.0	35	7.5	75	10.0

* Values weighted according to age group and sampling fraction of the census tract, estimated using information from the 2000 demographic census (IBGE).

[a] Less than 10 minutes of physical activity per week.

[b] From 10–149 minutes of physical activity per week.

[c] 150 minutes or more of physical activity per week.

Table 2 Percentage Distribution of Individuals Who Were Inactive in Transportation, and Bivariate Analysis According to Sex, Sociodemographic Variables, and Lifestyle Variables; Ermelino Matarazzo District, São Paulo, 2007

	Men (n = 50)		Women (n = 80)	
Variables	**%**	**Crude PR (95% CI)**	**%**	**Crude PR (95% CI)**
Level 1				
Age (years)*†				
18–39	55.9	1	29.9	1
40–59	36.6	1.11 (0.58–2.14)	48.0	2.10 (1.00–4.38)
60+	7.5	0.65 (0.33–1.30)	22.1	2.68 (1.42–5.04)
Skin color†				
Nonwhite	42.0	1	36.3	1
White	58.0	1.48 (0.79–2.78)	63.7	1.29 (0.68–2.43)
Chronic diseases†				
None	47.5	1	29.2	1
One	33.2	1.32 (0.64–2.72)	16.7	1.94 (0.87–4.34)
Two or more	19.3	0.80 (0.37–1.72)	54.1	2.44 (1.22–4.86)
Level 2				
Schooling level (years)*†				
0–4	5.8	1	29.2	1
5–8	33.6	2.65 (0.86–8.22)	22.4	0.48 (0.23–1.01)
9+	60.7	3.06 (0.99–9.41)	48.4	0.51 (0.26–0.99)
Marital status†				
Single	5.1	1	21.3	1
Separated/widowed	38.6	1.10 (0.42–2.86)	12.5	0.40 (0.15–1.06)
Married	56.3	0.98 (0.41–2.31)	66.2	1.03 (0.58–1.85)
Level 3				
Nutritional status				
Nonobese	86.1	1	85.4	1
Obese	14.9	0.86 (0.37–1.98)	14.6	1.06 (0.49–2.33)
Smoking†				
No	61.7	1	77.6	1
Yes	38.3	1.49 (0.79–2.82)	22.4	1.71 (0.84–3.50)
Excessive alcohol consumption				
No	86.4	1	94.6	1
Yes	13.6	1.49 (0.67–3.28)	5.4	1.45 (0.40–5.31)
Self-reported health				
Fair or poor	35.6	1	44.1	1
Good	64.4	1.19 (0.62–2.26)	55.9	1.17 (0.65–2.09)
Quality of life				
Fair or poor	45.4	1	42.3	1
Good	54.6	1.00 (0.53–1.86)	57.7	1.09 (0.62–1.90)
Religion				
Catholic	48.8	1	53.7	1
Protestant	25.1	1.22 (0.57–2.60)	22.5	0.66 (0.33–1.35)
Others	26.1	1.49 (0.70–3.14)	23.8	1.11 (0.52–2.38)
Vehicles in the household*†				
None	21.7	1	37.4	1
1	40.7	3.11 (1.37–7.09)	51.2	2.16 (1.19–3.93)
2+	37.6	7.21 (3.20–16.26)	11.4	2.30 (0.89–5.92)

* $P < .20$ for men; † $P < .20$ for women.

Abbreviations: PR, Prevalence Ratio.

in the household [Prevalence Ratio (PR) = 2.96; $P = .014$] and almost 6 times as greater among men who had 2 or more vehicles in the household (PR = 6.84; $P < .001$).

Among the women, 4 variables remained in the final model (age, number of chronic diseases, schooling level, and number of vehicles in the household). The PR for physical inactivity in transportation, between women without vehicles and those who had 1 vehicle in the household, was 2.42 ($P = .003$). Both for the men and for the women, a linear trend could be seen between the number of vehicles in the household and physical inactivity in transportation ($P < .001$ and $P = .004$, respectively).

Discussion

The main result from this study was the demonstration that the presence of vehicles in the household was associated with physical inactivity in transportation, among the adult population living in Ermelino Matarazzo. This is, to the best of our knowledge, the first population-based study to present a relationship between physical inactivity in transportation and the presence of vehicles in the household, in Brazil.

This finding is similar to what has been found in other cities such as Perth (Australia)[16] and Valencia (Spain),[17] including in regions of low socioeconomic level (Glasgow, Scotland).[18] It needs to be emphasized that all these studies were conducted in high-income countries and that some of the explanations for this association within the Brazilian situation seem to differ from the explanations in these other countries.[19] In these countries, the public transport system is usually efficient, even in economically disadvantaged regions.[18] This favors physical activity practices, given that simply walking to the bus stop or train station to use public transport contributes toward increasing the general level of physical activity.[20] On the other hand, in Brazil, living in region without good-quality public transport, such as in Ermelino Matarazzo, makes the possibility of acquiring a vehicle particularly attractive, especially in a metropolis like São Paulo, with a high concentration of jobs in the center of the city. This urban layout implies long journeys that are more difficult to do on foot or by bicycle.[18,21]

A representative study on some municipalities in the state of São Paulo and on part of the municipality of São Paulo found a direct association between car ownership and overall physical inactivity among men [PR = 1.08 (1.02–1.15)].[22] The smaller magnitude of this association in relation to that of our study [PR = 2.96 (1.24–7.06)] may be an indication of how the overall assessment of physical activity hides distinct relationships between access to vehicles and the different domains of physical activity (leisure, transportation, work and household activities). The results from the abovementioned study,[22] for example, indicated that there was an

Table 3 Factors Associated With Physical Inactivity in Transportation, Identified in Poisson Regression Analysis, for Men and Women; Ermelino Matarazzo District, São Paulo, 2007

	Men (n = 50)			Women (n = 80)*		
Variables	**PR (95% CI)**	***P***	***P*-trend**	**PR (95% CI)**	***P***	***P*-trend**
Age (years)			0.634			0.115
18–39	1			1		
40–59	1.02 (0.58–1.79)	0.951		1.61 (0.77–3.38)	0.205	
60+	0.71 (0.34–1.51)	0.372		1.83 (0.83–4.01)	0.133	
Chronic diseases						0.065
None				1		
1				1.99 (0.89–4.46)	0.095	
2+				2.03 (0.96–4.31)	0.065	
Schooling level (years)			0.698			0.350
0–4	1			1		
5–8	1.74 (0.61–5.00)	0.300		0.48 (0.22–1.05)	0.067	
9+	1.54 (0.50–4.73)	0.448		0.66 (0.33–1.32)	0.241	
Vehicle in the household			<0.001			0.004
None	1			1		
1	2.96 (1.24–7.06)	0.014		2.42 (1.36–4.33)	0.003	
2+	6.84 (2.82–16.57)	<0.001		2.30 (0.86–6.14)	0.096	

* Among women, the presence of smoking and the marital status did not change the results or the conclusions.

Abbreviations: PR, Prevalence Ratio.

inverse association between physical inactivity during leisure time and car ownership, in bivariate analysis. Unfortunately, this study presents the results considering all the areas together, without discriminating from socioeconomic level, which make it impossible to observe if the associated factors would have been the same from high socioeconomic areas in Sao Paulo comparing to our study area. In addition, the study does not present the association between car ownership and physical inactivity in transportation, but only physical inactivity in leisure or in total.

It is possible that the presence of a vehicle in the household may be an indicator of the individual's income, as observed in other countries.[23] Some studies in Brazil have found a positive association between physical inactivity in transportation and higher schooling level,[7] which is another important indicator of income.[24] The fact that the association between presence of a vehicle in the household and physical inactivity in transportation is maintained even after adjusting for schooling level adds strength to the hypothesis that access to vehicles is closer to the outcome in the causal chain than are schooling or income levels.

Another factor that is expected to contribute toward the linear trend between the number of vehicles in the household and physical inactivity in transportation is the road space rationing ("vehicle use rotation") in force in the municipality of São Paulo, which restricts the circulation of part of the vehicle fleet at critical hours of the day. To get around the restriction, many families have taken up the habit of having a second car as a "rotation car."

In the bivariate analysis, physical inactivity in transportation was greater among women with 2 or more chronic diseases [PR: 2.44 (1.22–4.86)],[18] possibly because of the high prevalence of joint diseases among the women (data not presented). It was also observed that the prevalence of physical inactivity in transportation increased with the women's ages (P-trend < 0.001), like in other studies.[8,18,25,26] However, Trinh et al[23] found the opposite result in a population in Ho Chi Min City (Vietnam), which emphasizes the need for cautious assessment in extrapolating the patterns of active commuting in different cultures. In the current study, neither the association with age nor the number of chronic diseases remained statistically significant in the final model.

One important limitation in the current study was its cross-sectional design, which made it impossible to establish a cause-effect relationship. This design made it unfeasible to analyze whether the preference for one method of getting around gave rise to acquisition of a vehicle, or vice versa. Nonetheless, the association between physical inactivity in transportation and the presence of vehicles in the household continues to be relevant for formulation of public policies for combating physical inactivity in the population as well as the air pollution caused by traffic and our fossil fuel dependency.[5,27] On the other hand, without good-quality longitudinal studies, and given the different levels of causal determination and the interrelations between the different sectors involved, it will be difficult to assess the impact of any new strategy for promoting active transportation.[9] Woodcock et al[5] pointed out that only a modest increase in active transportation methods (walking and cycling) would be needed to avoid 530 premature deaths per million inhabitants per year in London. Such an increase would also considerably reduce the social cost of chronic diseases such as diabetes and hypertension. In this respect, a recent Brazilian federal policy of stimulating vehicle purchases through reducing the rate of the Manufactured Product Tax (Imposto sobre Produtos Industrializados; IPI)[III] did not favor promotion of physical activity in transportation, and it may have brought in future impairment of the health of the population,[5] in view of the World Bank's estimate that the worldwide vehicle fleet will quadruple by the year 2050.[28]

There have already been some successful experiences of public policies directly or indirectly related to healthcare on which adaptations to Brazilian realities could be based.[18,29–32] Action toward encouraging the adoption and maintenance of healthy habits could be taken, such as making improvements to pavements and public lighting and constructing cycle tracks and cycle lanes.[16] Action could also be taken to discourage behaviors posing a risk to health; for example, by increasing vehicle parking costs.[26]

The current study showed that having a vehicle in the household was associated positively with physical inactivity in transportation, both among men and among women.

Notes

[I] Pesquisa Origem e Destino 2007. Companhia do Metropolitano de São Paulo (Metro) [cited 2010 (Nov 10]. Available at: http://www.metro.sp.gov.br/empresa/pesquisas/od_2007/teodc.asp

[II] SEADE—Fundação Sistema Estadual de Análise de Dados de São Paulo. [cited 2010 (Nov 10)]. Available at: http://www.seade.gov.br/

[III] Presidência da República. Casa Civil. Decreto nº 7222, de 29 de junho de 2010. Altera a Tabela de Incidência do Imposto sobre Produtos Industrializados—TIPI, aprovada pelo Decreto nº 6006, de 28 de dezembro de 2006. *Diário Oficial da União.* 29 jun 2010; Seção 1—edição extra; 122.

References

1. von Huth Smith L, Borch-Johnsen K, Jorgensen T. Commuting physical activity is favourably associated with biological risk factors for cardiovascular disease. *Eur J Epidemiol*. 2007;22:771–779. PubMed doi:10.1007/s10654-007-9177-3
2. Wennberg P, Wensley F, Johansson L, et al. Reduced risk of myocardial infarction related to active commuting: inflammatory and haemostatic effects are potential major mediating mechanisms. *Eur J Cardiovasc Prev Rehabil*. 2010;17(1):56–62. PubMed doi:10.1097/HJR.0b013e32832f3b11
3. Hu G, Qiao Q, Silventoinen K, et al. Occupational, commuting, and leisure time physical activity in relation to

risk for type 2 diabetes in middle-aged Finnish men and women. *Diabetologia*. 2002;45:214. PubMed
4. Wood L, Frank LD, Giles-Corti B. Sense of community and its relationship with walking and neighborhood design. *Soc Sci Med*. 2010;70(9):1381–1390. PubMed doi:10.1016/j.socscimed.2010.01.021
5. Woodcock J, Edwards P, Tonne C, et al. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *Lancet*. 2009;374(9705):1930–1943. PubMed doi:10.1016/S0140-6736(09)61714-1
6. Salvador EP, Reis RS, Florindo AA. A prática de caminhada como forma de deslocamento e sua associação com a percepção do ambiente em idosos. *Revista Brasileira de Atividade Física e Saúde*. 2009;14(3):197–205.
7. Florindo AA, Guimaraes VV, Cesar CL, Barros MB, Alves MC, Goldbaum M. Epidemiology of leisure, transportation, occupational, and household physical activity: prevalence and associated factors. *J Phys Act Health*. 2009;6(5):625–632. PubMed
8. Florindo AA, Hallal PC, de Moura EC, Malta DC. Practice of physical activities and associated factors in adults, Brazil, 2006. *Rev Saude Publica*. 2009;43(Suppl 2):65–73. PubMed doi:10.1590/S0034-89102009000900009
9. Santos CM, Barbosa JMV, Cheng LA. Júnior RdSW, Barros MVG. Atividade física no contexto dos deslocamentos: revisão sistemática dos estudos epidemiológicos no Brasil. *Revista Brasileira de Atividade Física e Saúde.* 2009;14(1):15–22.
10. Kish L. A procedure for objective respondent selection within the household. *J Am Stat Assoc*. 1949;44(247):380–387. doi:10.1080/01621459.1949.10483314
11. Salvador EP, Florindo AA, Reis RS, Costa EF. Perception of the environment and leisure-time physical activity in the elderly. *Rev Saude Publica*. 2009;43(6):972–980. PubMed doi:10.1590/S0034-89102009005000082
12. Craig CL, Marshall AL, Sjostrom M, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*. 2003;35(8):1381–1395. PubMed doi:10.1249/01.MSS.0000078924.61453.FB
13. Hocking RR. The analysis and selection of variables in linear regression. *Biometrics*. 1976;32(1):1–49. doi:10.2307/2529336
14. Victora CG, Huttly SR, Fuchs SC, Olinto MTA. The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. *Int J Epidemiol*. 1997;26(1):224–227. PubMed doi:10.1093/ije/26.1.224
15. Greenland S. Modeling and variable selection in epidemiologic analysis. *Am J Public Health*. 1989;79(3):340–349. PubMed doi:10.2105/AJPH.79.3.340
16. Titze S, Giles-Corti B, Knuiman MW, 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):423–431. PubMed
17. Molina-Garcia J, Castillo I, Sallis JF. Psychosocial and environmental correlates of active commuting for university students. *Prev Med*. 2010;51(2):136–138. PubMed doi:10.1016/j.ypmed.2010.05.009
18. Ogilvie D, Mitchell R, Mutrie N, Petticrew M, Platt S. Personal and environmental correlates of active travel and physical activity in a deprived urban population. *Int J Behav Nutr Phys Act*. 2008;27:5–43. PubMed
19. Makinen T, Borodulin K, Laatikainen T, Fogelholm M, Prattala R. Twenty-five year socioeconomic trends in leisure-time and commuting physical activity among employed Finns. *Scand J Med Sci Sports*. 2009;19(2):188–197. PubMed doi:10.1111/j.1600-0838.2007.00739.x
20. Besser LM, Dannenberg AL. Walking to public transit steps to help meet physical activity recommendations. *Am J Prev Med*. 2005;29(4):273–280. PubMed doi:10.1016/j.amepre.2005.06.010
21. Pucher J, Dijkstra L. Promoting safe walking and cycling to improve public health: Lessons from the Netherlands and Germany. *Am J Public Health*. 2003;93(9):1509–1516. PubMed doi:10.2105/AJPH.93.9.1509
22. Zanchetta LM, Barros MB, Cesar CL, Carandina L, Goldbaum M, Alves MC. Physical inactivity and associated factors in adults, Sao Paulo, Brazil. *Rev Bras Epidemiol*. 2010;13(3):387–399. PubMed doi:10.1590/S1415-790X2010000300003
23. Trinh OTH, Nguyen ND, Dibley MJ, Phongsavan P, Bauman AE. The prevalence and correlates of physical inactivity among adults in Ho Chi Minh City. *BMC Public Health*. 2008;8:204. PubMed doi:10.1186/1471-2458-8-204
24. Winkleby MA, Jatulis DE, Frank E, Fortmann SP. Socioeconomic-status and health—how education, income, and occupation contribute to risk-factors for cardiovascular-disease. *Am J Public Health*. 1992;82(6):816–820. PubMed doi:10.2105/AJPH.82.6.816
25. Kwasniewska M, Kaczmarczyk-Chalas K, Pikala M, Broda, Kozakiewicz K, Pajak A, et al. Socio-demographic and lifestyle correlates of commuting activity in Poland. *Prev Med*. 2010;50(5-6):257–261. PubMed doi:10.1016/j.ypmed.2010.02.011
26. Merom D, Miller YD, van der Ploeg HP, Bauman A. Predictors of initiating and maintaining active commuting to work using transport and public health perspectives in Australia. *Prev Med*. 2008;47(3):342–346. PubMed doi:10.1016/j.ypmed.2008.03.014
27. Giles-Corti B, Foster S, Shilton T, Falconer R. The co-benefits for health of investing in active transportation. *N S W Public Health Bull*. 2010;21(5-6):122–127. PubMed doi:10.1071/NB10027
28. Campbell T, Campbell A. Emerging disease burdens and the poor in cities of the developing world. *J Urban Health*. 2007;84(3, Suppl):i54–i64. PubMed doi:10.1007/s11524-007-9181-7
29. Burke NM, Chomitz VR, Rioles NA, Winslow SP, Brukilacchio LB, Baker JC. The path to active living physical activity through community design in Somerville, Massachusetts. *Am J Prev Med*. 2009;37(6):S386–S94. PubMed doi:10.1016/j.amepre.2009.09.010
30. Deehr RC, Shumann A. Active Seattle: achieving walkability in diverse neighborhoods. *Am J Prev Med*. 2009;37(6):S403–S11. PubMed doi:10.1016/j.amepre.2009.09.026
31. Dobson NG, Gilroy AR. From partnership to policy: the evolution of active living by design in Portland, Oregon. *Am J Prev Med*. 2009;37(6):S436–S44. PubMed doi:10.1016/j.amepre.2009.09.008
32. Huberty JL, Dodge T, Peterson K, Balluff M. Activate Omaha: the journey to an active living environment. *Am J Prev Med*. 2009;37(6):S428–S35. PubMed doi:10.1016/j.amepre.2009.09.024