

Quantitative and qualitative aspects of barriers to bicycle use for adults from Curitiba, Brazil

Aspectos quantitativos e qualitativos sobre as barreiras para o uso de bicicleta em adultos de Curitiba, Brasil

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Abstract – The implementation of bicycling promotion programs should consider the barriers to this behavior. The aim of this study was to quantitatively and qualitatively characterize barriers to leisure and commuting bicycle use for adults from Curitiba, Brazil. The first phase comprised a cross-sectional household survey involving 677 adults (53% women). Of these, 16.7% and 11.2% reported leisure and commuting bicycle use, respectively. Then, 24 bicycle users (50% women) were recruited and participated in focus group interviews. The content of answers was analyzed with a conceptual matrix. The most reported barriers to leisure bicycle use were “bad weather” (65.5%), “heavy traffic” (53.1%), “lack of bike lanes” (48.7%) and “lack of security” (44.2%). In commuting, the most reported were “bad weather” (69.7%), “heavy traffic”, “lack of safety” and “fear of accidents” (51.3% each). The comparative analysis between barriers reported in the survey and those reported in the focus groups showed a combination of seven of the 11 barriers reported in questionnaires. Some of the barriers identified in the survey were not mentioned in the focus groups (“poor street quality”, “pollution”, “not having a bicycle”, “lack of parking”, “distance to destinations”). The main barriers to bicycle use are related to physical environment and safety aspects, regardless of approach adopted and purpose of use.

Key words: Bicycling; Epidemiologic factors; Epidemiologic studies; Motor activity; Quantitative analysis; Qualitative research.

Resumo – A implementação de programas de promoção para o uso de bicicleta deve considerar as barreiras para este comportamento. Objetivou-se caracterizar quantitativa e qualitativamente as barreiras para o uso de bicicleta no lazer e no transporte em adultos de Curitiba, Brasil. A primeira etapa compreendeu um inquérito domiciliar transversal em que participaram 677 adultos (53% mulheres). Destes, 16,7% e 11,2% reportaram utilizar a bicicleta no tempo de lazer e no transporte, respectivamente. Em seguida, 24 usuários de bicicleta (50% mulheres) foram recrutados e participaram de entrevistas em grupos focais. O conteúdo das respostas foi analisado com uma matriz conceitual. As barreiras mais reportadas para o uso de bicicleta no lazer foram o “clima ruim” (65,5%), “tráfego intenso” (53,1%), “falta de ciclovias” (48,7%) e “falta de segurança” (44,2%). No transporte, as mais relatadas foram o “clima ruim” (69,7%), “tráfego intenso”, “falta de segurança” e “medo de acidentes” (51,3% cada). A análise comparativa entre as barreiras reportadas no inquérito e aquelas relatadas nos grupos focais mostraram combinação entre sete das 11 barreiras. Algumas barreiras identificadas no inquérito não foram mencionadas nos grupos focais (“má qualidade das ruas”, “poluição”, “não ter bicicleta”, “falta de estacionamento”, “distância até os destinos”). As principais barreiras para o uso de bicicleta estão relacionadas com aspectos do ambiente físico e segurança, independente da abordagem empregada e finalidade de uso.

Palavras-chave: Análise quantitativa; Atividade motora; Ciclismo; Estudos epidemiológicos; Fatores epidemiológicos; Pesquisa qualitativa.

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INTRODUCTION

Bicycle is an advantageous means of commuting and physical activity (PA) promotion. In general, bicycle offers a relatively inexpensive and accessible way for a great part of the population¹, without requiring large investments from the public administration in terms of infrastructure^{2,1}. In addition, its use is associated with several health benefits^{1,3} and is often considered important for the reduction of physical inactivity⁴, which is one of the main causes of morbidities worldwide⁵. In addition to individual aspects, bicycle use can contribute to the reduction of traffic jams, consequent reduction of carbon emissions and consumption of fossil fuels⁶. Despite these benefits, bicycle use is still low in countries regardless of high⁷ or middle-low income⁸.

The low frequency of bicycle use may be related to social and environmental aspects that possibly influence this behavior⁹, such as cycling infrastructure², traffic volume, aggressive behavior of drivers, protection of cyclists in traffic^{1,2,4} and distance to destinations⁸, among others. In addition, individual characteristics such as gender, age and schooling have also been related to the use of bicycles¹⁰. These characteristics can influence the perception of people in relation to leisure or commuting bicycle use¹¹.

The perception of barriers is important to identify individual, social or environmental aspects that are relevant to the implementation of programs to promote the use bicycles in the community^{2,10,12}. However, studies are in general conducted with standardized questionnaires¹³, which limit the understanding of aspects that are not represented in the instrument. For this reason, studies with qualitative approaches have been used to capture contextual aspects, and thus, give greater meaning to perceptions about bicycle use¹⁴. However, these studies have limitations on the generalization of their results¹⁵. In this sense, the use of mixed quantitative and qualitative method has been proposed to reduce the inherent limitations of studies that include only one approach¹⁶.

One of the important factors for success in promoting physical activity is to identify aspects that limit the participation and/or maintenance of individuals in the practice¹⁷. Therefore, analyzing barriers to bicycle use may represent an advance in the identification of aspects that may limit the implementation of incentive programs in this modality in the community². In Brazil, although some studies have explored barriers to bicycle use for adults^{13,14,18}, there are no studies that have used mixed approaches¹⁵. Thus, the aim of this study was to quantitatively and qualitatively characterize barriers to leisure and commuting bicycle use for adults from Curitiba, Paraná, Brazil.

METHODOLOGICAL PROCEDURES

The data used in this study are part of a broad project carried out in Curitiba, Paraná, Brazil (*“Entendimento Sobre a Prática de Atividade Física nas Comunidades”* - E.S.P.A.Ç.O.S)¹⁹. Between 2010 and 2011, an observational

cross-sectional study with home interviews was conducted to identify the association between the characteristics of the built environment and the practice of physical activity in adults (aged 18-65 years) living in different census tracts in the city^{8,19}. To that end, 32 census tracts were intentionally selected (16 with a high walkability score [8 with low income and 8 with high income] and 16 with low walkability [8 with low income and 8 with high income]). Further details on the selection of sectors, residences and participants are available in literature^{8,19}.

In total, 1,052 households were visited, 697 people were interviewed and the refusal rate for participation in the study was 34%. About 17% and 11% of respondents reported using the bicycle at leisure (n = 113) and for commuting (n = 76), respectively (table 1). Interviewees were invited to participate in focus group interviews to identify barriers and facilitators for bicycle use (qualitative aspect)¹⁴.

Both phases of the project were approved by the Ethics Research Committee of the Pontifical Catholic University of Paraná (quantitative study: 3034/2009 | qualitative study: 5418/2011) and individuals agreed to voluntarily participate in the research by signing the free and informed consent form.

QUANTITATIVE ASPECTS

Barriers for bicycle use

Barriers for bicycle use for leisure and commuting were identified in a specific way, with a previously validated questionnaire¹³. Participants reported the presence (“no”, “yes”) of some barrier that could hinder cycling at leisure (“heavy traffic”, “bad weather”, “lack of safety”, “fear of accidents”, “lack of will”, “poor quality of streets”, “not having a bicycle”, “lack of bicycle lanes”, “lack of parking”, “pollution”, “lack of support”) and in commuting (“heavy traffic”, “bad weather”, “lack of safety”, “fear of accidents”, “lack of will”, “poor quality of streets”, “not having a bicycle”, “distance to destinations”, “lack of parking”, “lack of changing rooms”, “pollution”).

Individual, sociodemographic, health and behavioral variables

Based on a literature review and a conceptual model^{10,20}, some individual, sociodemographic, health and behavioral variables potentially associated with barriers and/or bicycle use were identified: gender, age, marital status, schooling, socioeconomic level, number of motor vehicles in the residence, body mass index, health perception, quality of life and level of physical activity. These variables were measured and used in analyses.

Variables gender (“male”, “female”), age range (“18-39” and “≥40 years”), marital status (“married” or “not married”) and schooling (“up to higher education” or “higher education / graduate”)²¹ were self-reported. Socioeconomic level was defined through information about the possession of household utensils in the residence, presence of a monthly employee, and the degree of instruction of the household financial officer²¹. Based

on data collected, individuals were classified into two levels: “low” (classes C1 + C2 + D + E) and “intermediate / high” (B1 + B2 + A1 + A2). The number of motor vehicles in the residence was classified into two categories (“0” and “≥ 1”)⁸.

Body mass index (BMI) was calculated with self-reported measures of body mass (kg) and height (cm), and classified into two categories (“≤ 24.9” and “≥ 25.0” kg/m²)⁸. Health perception and quality of life were measured with a questionnaire from the World Health Organization (WHOQOL) and classified as “negative” and “positive” perception²³.

The practice of walking at leisure, commuting and total physical activity in the last week was identified with the long version of the International Physical Activity Questionnaire²⁴. The walking scores were attributed by the product between the weekly frequency and the average time spent in each activity. While the total leisure physical activity score was identified by the equation: [min/wk of walking + min/wk moderate activity + (min/wk vigorous activity x 2)]. Leisure and commuting walking, and total leisure physical activity were classified into two levels (“0-149 min/wk” and “≥150 min/wk”)⁸. The purpose of bicycle use (leisure and commuting) was measured based on the dichotomous response (“no”, “yes”) to the following questions: “Do you use bicycle in your leisure time?” And “Do you use bicycle to go from one place for another as a form of commuting?”^{8,24}.

Qualitative aspects

After collecting quantitative data, participants who reported using bicycles at leisure or commuting were eligible to participate in focus groups. This technique was used to identify participants’ feelings, perceptions, attitudes and ideas about barriers to bicycle use in order to complement information collected in the household survey, which presented questions with dichotomous responses^{14,25}.

Elaboration of focus groups and data collection

The number of participants in each group was determined according to literature recommendations¹⁶, which suggests a maximum of 12 individuals per focal group. Thus, 48 subjects were invited to participate, 12 in each of the four groups, subdivided by sex, to attend at a scheduled time and place. At the end, 24 individuals accepted to participate and attended the interviews¹⁴.

Interviews were conducted between September and October 2011 and followed a script previously tested in a pilot study conducted by a researcher familiar with the technique¹⁴. The questionnaire was developed with open questions and topics related to bicycle use. The group dynamics were divided into three stages: a) presentation of the group mediator, of individuals and the study objectives; b) presentation of topics on bicycle use; c) discussion with the help of images on the subject. Responses and discussions were collected and recorded by the researcher, having at the end of each interview a manuscript containing observations and comments of the researcher and an audio record of dialogues. The recording

started with the authorization of participants and finalized after the end of the discussion. All discussions were conducted in an appropriate room, soundproofed, on the premises of the university¹⁴.

Data analysis

- **Analysis of quantitative data**

Barriers to leisure and commuting bicycle use were analyzed by absolute and relative frequency distribution. The association between individual, sociodemographic, health and behavioral variables with barriers to bicycle use was analyzed with the chi-square test of heterogeneity in SPSS 20.0 software.

- **Analysis of qualitative data**

The files of recordings of focus groups were transcribed in full, each participant being assigned a code (P1, P2, ...) to maintain anonymity. The content analysis was then applied using Atlas.ti software 5.0. Initially, reports were grouped according to their negative influence on bicycle use. For example, the report "...the lack of a bicycle lane makes it difficult to use a bicycle, as well as the lack of safety,... I often give up for fear", was classified as a barrier^{14,25}.

- **Description of reports according to barriers**

A comparative matrix was elaborated with the aim of combining reports of barriers to leisure and commuting bicycle use according to the most self-reported barriers in the quantitative analyses. For this combination, reports that best exemplify barriers identified in the qualitative aspect were selected. Furthermore, barriers were classified according to influence factors and grouped into dimensions^{14,25}. This grouping was carried out with the aim of identifying the influence factors found and the dimensions to which they belong.

RESULTS

Among participants who reported using leisure cycling (n = 113), the highest proportion were males (71.7%), aged 18-39 years (59.3%), married (52.2%), reported having completed high school (56.6%), belong to intermediate/high socioeconomic level (69.0%) and had at least one motor vehicle in the residence (77.9%) (Table 1). Regarding health variables, the highest proportion had BMI ≥ 25 kg/m² (56.3%), positive health perception (80.5%) and quality of life (77.0%). The majority of participants performed ≥ 150 min/week total physical activity at leisure time (56.6%) and walked 0-149 min/week in commuting (56.6%) (Table 1). Participants who reported commuting bicycle use (n = 76) had similar profile, except for the lower schooling level f (78.9%), low socioeconomic level (57.9%) and lower total leisure time physical activity (53.9%) (Table 1).

Quantitative aspects of barriers to bicycle use

"Bad weather" (65.5%) and "lack of support" (7.1%) were, respectively, the

most and least reported barriers to leisure bicycle use (Table 2). Female gender was associated with the “lack of will” barrier ($p = 0.047$), age range ≥ 40 years with “fear of accidents” ($p = 0.034$), while $BMI \leq 24.9 \text{ kg} / \text{m}^2$ ($p = 0.018$) and lower commuting walking volume (0-149 min / wk), were associated with the “lack of parking” barrier ($p = 0.011$) (Table 2).

Table 1. Individual, sociodemographic, health and behavioral characteristics of participants by purpose of use. Curitiba, Brazil, 2010.

Variables	Category	Leisure n=113 (16.7%)		Commuting n=76 (11.2%)	
		n	%	n	%
Individual and sociodemographic					
Sex	Male	81	71.7	61	80.3
	Female	32	28.3	15	19.7
Age group (years)	18-39	67	59.3	43	56.6
	≥ 40	46	40.7	33	43.4
Marital Status	Married	59	52.2	40	52.6
	Not married	54	47.8	36	47.4
Schooling	Up to complete high school	64	56.6	60	78.9
	Higher Education / Graduate	40	43.4	16	21.1
Socioeconomic level	Low	35	31.0	44	57.9
	Intermediate / High	78	69.0	32	42.1
Number of motor vehicles	0	25	22.1	29	38.2
	≥ 1	88	77.9	47	61.8
Health					
Body mass index (kg/m ²)	≤ 24.9	45	43.7	33	45.8
	≥ 25.0	58	56.3	39	54.2
Health perception	Negative	22	19.5	12	15.8
	Positive	91	80.5	64	84.2
Quality of life perception	Negative	26	23.0	24	31.6
	Positive	87	77.0	52	68.4
Behavioral					
Total leisure physical activity (min/week)	0-149	49	43.4	41	53.9
	≥ 150	64	56.6	35	46.1
Commuting walking (min/week)	0-149	64	56.6	41	53.9
	≥ 150	49	43.4	35	46.1

“Bad weather” (69.7%) and “not having a bicycle” (6.6%) were, respectively, the most and least reported barriers to commuting bicycle use (table 3). The age range of 18-39 years was associated with the “distance to destinations” barrier ($p = 0.033$), $BMI \leq 24.9 \text{ kg} / \text{m}^2$ with “lack of parking” barriers ($p = 0.023$) and “lack of changing rooms” ($p = 0.041$). Lower total leisure physical activity volume (0-149 min / wk) was associated with “lack of safety” ($p = 0.022$) and “pollution” barriers ($p = 0.016$).

Table 2. Frequency of barriers to leisure bicycle use according to individual, sociodemographic, health and behavioral variables. Curitiba, Brazil, 2010 (n = 113).

	Bad weather	Heavy traffic	Lack of cycle lanes	Lack of safety	Poor quality of streets	Fear of accidents	Lack of parking	Lack of will	Pollution	Not having a bicycle	Lack of support
General	65.5%	53.1%	48.7%	44.2%	44.2%	42.5%	31.0%	30.1%	16.8%	10.6%	7.1%
Sociodemographic variables											
Sex, sig.	0.390	0.678	0.810	0.106	0.626	0.552	0.388	0.047	0.832	0.281 ^f	0.595 ^f
Male	67.9	54.3	49.4	39.5	45.7	40.7	33.3	24.7	17.3	12.3	7.4
Female	59.4	50.0	46.9	56.2	40.6	46.9	25.0	43.8	15.6	6.2	6.2
Age group (years), sig.	0.392	0.170	0.194	0.526	0.803	0.034	0.352	0.236	0.892	0.065 ^f	0.421 ^f
18-39	68.7	47.8	53.7	41.8	43.3	34.3	34.3	34.3	16.4	14.9	6.0
≥ 40,0	60.9	60.9	41.3	47.8	45.7	54.3	26.1	23.9	17.4	4.3	8.7
Marital status, sig.	0.886	0.380	0.107	0.968	0.968	0.721	0.604	0.757	0.141	0.166	0.109 ^f
Married	66.1	57.7	55.9	44.1	44.1	44.1	28.8	31.5	11.9	6.8	3.4
Not married	64.8	49.2	40.7	44.4	44.4	40.7	33.3	28.8	22.2	14.8	11.1
Schooling, sig.	0.218	0.443	0.662	0.903	0.205	0.143	0.629	0.603	0.699	0.900	0.067 ^f
Up to complete high school	70.3	56.2	46.9	43.8	39.1	48.4	32.8	28.1	15.6	10.9	3.1
Higher Education / Graduate	59.2	49.0	51.0	44.9	51.0	34.7	28.6	32.7	18.4	10.2	12.2
Socioeconomic level, sig.	0.644	0.564	0.424	0.842	0.543	0.641	0.610	0.497	0.250	0.543	0.525 ^f
Low	68.6	51.3	54.3	42.9	40.0	41.0	34.3	25.7	14.1	11.4	7.7
Intermediate / High	64.1	57.1	46.2	44.9	46.2	45.7	29.5	32.1	22.9	10.3	5.7
Amount of motor vehicles, sig.	0.765	0.563	0.596	0.347	0.628	0.458	0.538	0.796	0.090	0.523 ^f	0.436 ^f
0	68.0	48.0	44.0	36.0	40.0	36.0	36.0	28.0	28.0	12.0	4.0
≥ 1	64.8	54.5	50.0	46.6	45.5	44.3	29.5	30.7	13.6	10.2	8.0
Health											
Body mass index (kg/m ²), sig.	0.085	0.527	0.611	0.246	0.447	0.888	0.018	0.528	0.099	0.138 ^f	0.360 ^f
≤ 24,9	73.3	48.9	53.3	51.1	48.9	40.0	42.2	33.3	22.2	15.6	8.9
≥ 25,0	56.9	55.2	48.3	39.7	41.4	41.4	20.7	27.6	10.3	6.9	5.2
Health perception, sig.	0.482	0.202	0.417	0.545	0.725	0.868	0.542	0.475	0.657	0.575 ^f	0.486 ^f
Negative	59.1	40.9	40.9	50.0	40.9	40.9	36.4	36.4	13.6	9.1	9.1
Positive	67.0	56.0	50.5	42.9	45.1	42.9	29.7	28.6	17.6	11.0	6.6
Quality of life perception, sig.	0.354	0.419	0.877	0.498	0.261	0.355	0.611	0.931	0.707	0.284 ^f	0.268 ^f
Negative	73.1	46.2	50.0	38.5	53.8	34.6	26.9	30.8	19.2	15.4	11.5
Positive	63.2	55.2	48.3	46.0	41.4	44.8	32.2	29.9	16.1	9.2	5.7
Behavioral											
Total leisure physical activity (min/week), sig.	0.972	0.451	0.482	0.305	0.795	0.649	0.942	0.178	0.699	0.458	0.485 ^f
0-149	65.3	57.1	44.9	38.8	42.9	44.9	30.6	36.7	18.4	8.2	8.2
≥ 150	65.6	50.0	51.6	48.4	45.3	40.6	31.2	25.0	15.6	12.5	6.2
Commuting walking (min/week), sig.	0.972	0.995	0.279	0.614	0.520	0.401	0.011	0.915	0.529	0.175	0.240 ^f
0-149	65.6	53.1	53.1	42.2	46.9	39.1	40.6	29.7	18.8	14.1	9.4
≥ 150	65.3	53.1	42.9	46.9	40.8	46.9	28.4	30.6	14.3	6.1	4.1

Sig: significance value of the chi-square test for p < 0.05; ^f: significance value for the Fisher exact test.

Table 3. Frequency of barriers for commuting bicycle use according to individual, sociodemographic, health and behavioral variables. Curitiba, Brazil, 2010 (n = 76).

	Bad weather	Heavy traffic	Lack of cycle lanes	Lack of safety	Poor quality of streets	Fear of accidents	Lack of parking	Lack of will	Pollution	Not having a bicycle	Lack of support
General	69.7%	51.3%	51.3%	48.7%	44.7%	39.5%	28.9%	27.6%	27.6%	23.7%	6.6%
Sociodemographic variables											
Sex, sig.	0.360	0.453	0.453	0.861	0.867	0.525	0.676	0.068	0.349 ^f	0.501	--
Male	72.1	49.2	49.2	49.2	44.3	37.7	27.9	23.0	29.5	24.6	8.2
Female	60.0	60.0	60.0	46.7	46.7	46.7	33.3	46.7	20.0	20.0	0.0
Age group (years), sig.	0.311	0.976	0.156	0.622	0.912	0.337	0.819	0.033	0.330	0.323	0.273 ^f
18-39	74.4	51.2	44.2	51.2	44.2	44.2	27.9	37.2	23.3	27.9	9.3
≥ 40,0	63.6	51.5	60.6	45.5	45.5	33.3	30.3	15.2	33.3	18.2	3.0
Marital status, sig.	0.958	0.809	0.828	0.498	0.331	0.400	0.424	0.978	0.589	0.426	--
Married	69.4	50.0	52.5	45.0	50.0	35.0	25.0	52.4	30.6	20.0	0.0
Not married	70.0	52.8	50.0	52.8	38.9	44.4	33.3	27.8	25.0	27.8	13.9
Schooling, sig.	0.427	0.906	0.496	0.906	0.929	0.056	0.289 ^f	0.469 ^f	0.110	0.200	0.718 ^f
Up to complete high school	68.3	51.7	53.3	48.3	45.0	45.0	26.7	26.7	31.7	26.7	6.7
Higher Education / Graduate	75.0	50.0	43.8	50.0	43.8	18.8	37.5	31.2	12.5	12.5	6.2
Socioeconomic level, sig.	0.242	0.509	0.509	0.260	0.749	0.764	0.374	0.547	0.935	0.818	0.649 ^f
Low	75.0	46.9	46.9	56.2	43.2	40.9	25.0	25.0	27.3	22.7	6.8
Intermediate / High	62.5	54.5	54.5	43.2	46.9	37.5	34.3	31.2	28.1	25.0	6.2
Amount of motor vehicles, sig.	0.529	0.374	0.677	0.317	0.059	0.789	0.212	0.288	0.593	0.942	0.363 ^f
0	65.5	44.8	48.3	41.4	31.0	41.4	20.7	20.7	24.1	24.1	3.4
≥ 1	72.3	55.3	53.2	53.2	53.2	38.3	34.0	31.9	29.8	23.4	8.5
Health											
Body mass index (kg/m ²), sig.	0.845	0.334	0.984	0.813	0.751	0.023	0.333	0.660	0.135	0.041	0.627 ^f
≤ 24,9	69.7	57.6	51.5	51.5	42.4	54.5	33.3	30.3	36.4	36.4	6.1
≥ 25,0	71.8	46.2	51.3	48.7	46.2	28.2	23.1	25.6	20.5	15.4	5.1
Health perception, sig.	0.477	0.246	0.596	0.921	0.302	0.866	0.234 ^f	0.566 ^f	0.199 ^f	0.418	0.175
Negative	75.0	66.7	58.3	50.0	58.3	41.7	41.7	14.3	41.7	16.7	16.7
Positive	68.8	48.4	50.0	48.4	42.2	39.1	18.5	28.1	25.0	25.0	4.7
Quality of life perception, sig.	0.692	0.185	0.406	0.253	0.105	0.811	0.606	0.839	0.450	0.119	0.177
Negative	66.7	62.5	58.3	58.3	58.3	37.5	25.0	29.2	33.3	12.5	12.5
Positive	71.2	46.2	48.1	44.2	38.5	40.4	30.8	26.9	25.0	28.8	3.8
Behavioral											
Total leisure physical activity (min/week), sig.	0.021	0.022	0.068	0.348	0.219	0.931	0.566	0.866	0.016	0.875	--
0-149	58.5	63.4	61.0	53.7	51.2	39.0	31.7	26.8	39.0	24.4	12.2
≥ 150	82.9	37.1	40.0	42.9	37.1	40.0	25.7	28.6	14.3	22.9	0.0
Commuting walking (min/week), sig.	0.767	0.173	0.985	0.348	0.090	0.072	0.343	0.730	0.866	0.875	0.424 ^f
0-149	68.3	58.5	51.2	53.7	53.7	48.8	24.4	57.1	26.8	24.4	4.9
≥ 150	71.4	42.9	51.4	42.9	34.3	28.6	34.3	25.7	28.6	22.9	8.6

Sig: significance value of the chi-square test for p <0.05; f: significance value for the Fisher exact test..

Quantitative and qualitative aspects of barriers to bicycle use

Box 1 presents the reports of barriers to leisure bicycle use, identified in focus group interviews (qualitative aspect) according to barriers reported by questionnaire (quantitative aspect). Participants did not mention reports about the “poor quality of streets”, “lack of parking”, “pollution” and “not having a bicycle” barriers. Reports of barriers to commuting bicycle use are presented in Box 2. Participants did not mention “poor quality of streets”, “distance to destinations”, “pollution” and “not having a bicycle”.

Box 1. Barriers to leisure bicycle use identified in focus groups and in questionnaire interviews.

	Reports from focus group	Frequency of self-reported barriers	Reports from focus group
Environment	“... Curitiba in particular rains a lot. For women, it is more complicated, rain and cold discourages cycling, I prefer to use the car these days ... “	Bad weather 65.5%	“... when it rains, I do other things. I get out of by car. I only use it if it does not rain. Because I always ride my bicycle with the kids when it does not rain. “
	“... People use the bicycle on the street, with all the traffic problems, lack of respect ... we need space to use the bicycle safely ...”	Heavy traffic 53.1%	“... we use it more at the weekend and we are always with the children, I always perceive the lack of respect from some drivers, which discourages. “
	“... I get out of the car and take the bicycle to use in the park, because bicycle paths are poorly maintained, maintenance is bad ...”	Lack of cycle lanes 48.7%	“... There are bicycle lanes that connect parks. But to get from the neighborhood to these bicycle paths, we use the street. It's complicated, they need to increase bicycle lanes that leave the neighborhoods, so that we can also walk ... “
	“... as much as the park has security, guards, I like to be together. In parks and squares that do not have security, we do not go by bicycle. I'm afraid they steal it”	Lack of safety 44.2%	“... in the park, I do not see any problems. But as long as I am with them (“children”). I'm afraid they'll steal them (“children”), do some violence with them (“children”) to steal their bike ... “
Intrapersonal	“... bicycle is not respected in traffic, lack of respect, lack of culture. Many times I stopped using it because I felt frightened about the fact of respect in traffic “	Fear of accidents 42.5%	“... I'm afraid sometimes because women are more vulnerable. Many times I stopped using my bike because I felt afraid in a certain neighborhood or at certain times of the day / night. “
	“... if I have a lot of things to study over the weekend, I'm not in the mood. It gives laziness. It's so complicated when it's up to me ... “	Lack of will 30.1%	“... sometimes I'm lazy if I'm alone. When I'm alone, I'm not in the mood. It seems that I do not have the strength alone, I do not have the courage ... “
Interpersonal	“... if I have company I go every day. Because with a friend it is better, time passes faster, is safer, is fun. Otherwise I do not feel like it. “	Lack of support 7.1%	“... I have a group that always uses bicycle. It makes a lot of difference with friends, without them, I do not know if I would use it “

Box 2. Barriers to commuting bicycle use identified in focus groups and in questionnaire interviews.

	Reports from focus group	Frequency of self-reported barriers	Reports from focus group
Environment	"... the rain becomes a barrier because we do not have a shower at work. If we had, I would not care for the weather (cold, heat, rain ...)"	Bad weather 69.7%	"With rain and cold I do not use it. As the climate in Curitiba is colder and rainier, I am sincere, I do not use a bicycle every day, I rather use the car ..."
	"... if there were laws and if they were fulfilled, heavy traffic should not be a problem, because cars and bicycles would comply with the established law, what they need are laws and compliance ..."	Heavy traffic 51.3%	"... with women it is more complicated, they offend, they speak rude, as if we were disturbing the traffic and in fact we want to reduce the traffic with the bicycle ..."
	"... I was already robbed going to work. Now we only go in two, me and my friend from work. My wife was robbed too. She does not use it anymore. "	Lack of safety 51.3%	" <i>I am afraid about my children and my wife. It's dangerous.</i> "
Intrapersonal	"... cars do not respect the space between car and bicycle ..."	Fear of accidents 44.7%	"...They always throw the car on the bicycle and still offend, as if the space was only for the car ..."
Environment	"... I worry about where to leave it, sometimes I stop using it if I know I will not have a place to keep it"	Lack of parking 39.5%	"... Even to go to the pharmacy, market and others. If I know where to park I use it, if not, I do not use it ..."
Intrapersonal	"I'm lazy sometimes, not every day I use it. For example, when I have a meeting, I do not feel like it. And there are days that we want to wear other clothes, jump, skirt ... these days I do not feel like it, but it's a day or another that it happens ..."	Lack of will 28.9%	"... the reasons for not using are other. But every now and then my will to use loses to the weather, especially cold and rain, I do not have the courage ..."
Environment	"... what's troubling is not having a shower. Because we need to take a shower when we get there, we need to change clothes. I believe that people do not use it, because they have nowhere to change, to take a shower ..."	Lack of changing rooms 23.7%	"... companies need to put changing rooms for employees, it would make a lot of difference. Why do many women worry about the clothes they will wear, with the bath. And they stop using it because they cannot be sweaty all day ..."

DISCUSSION

This study aimed to characterize the barriers to bicycle use for adults using mixed research methods. The combination of quantitative and qualitative approaches allowed us testing associations and exploring the meaning inherent to participants' reports, which is one of the study's strengths and innovations¹⁶. The main quantitative results showed that environmental barriers were the most reported for bicycle use and that some occurred regardless of purpose of use ("bad weather" and "heavy traffic"); while others are specific to leisure ("lack of bicycle lanes") or commuting bicycle use ("lack of parking" and "lack of changing room"). Among intrapersonal barriers, "fear of accidents" and "lack of will" were the most reported in both purposes of use, while "lack of will" and "lack of support" were present only for leisure bicycle use. Most barriers were not associated with leisure or commuting bicycle use. Finally, the reports from the focus groups showed that barriers to bicycle use are related to safety, such as fear of traffic, lack of respect by drivers, fear of accidents, robberies and assaults, as well as the physical and social environment ("lack of bicycle lanes" and "lack of

support from close people”).

A recent literature review has shown that the physical (“lack of bicycle lanes”), natural (“bad weather”) and social environment (“support from friends”), as well as individual (sex and age) and psychosocial characteristics (“lack of will” and “low self-efficacy”) are associated with barriers to leisure and commuting bicycle use¹². These findings corroborate those found in the present study, where the most reported barriers were “bad weather”, “heavy traffic”, “lack of safety” (leisure and commuting) and “lack of bicycle lanes” (leisure). In part, these results can be explained by low urban planning, with inadequate structures for bicycle use, associated with intense traffic in most cities, which cause greater sensation of fear of accidents¹⁰. The high number of rainy days or low temperatures in Curitiba may have contributed to the high frequency of reports of “bad weather” barrier. For example, in the year of the survey, rainfall occurred on 44% of days²⁶.

Among the 11 barriers for commuting bicycle use examined in this study, more than half (55%) had some association with the tested variables. Among sociodemographic variables, only the “distance to destinations” barrier was associated with the age group. For health variables, “lack of parking” and “lack of changing rooms” barriers were the only that showed association with BMI. As for leisure bicycle use, only 27% of barriers (3/11) tested were associated with the examined variables. Among sociodemographic variables, sex was related to “lack of will”; and the age group with “fear of accidents”. For health and behavioral aspects, BMI and commuting walking were related to “lack of parking”. Only one study that analyzed the association between presence of barriers to physical activity practice and some of these variables in adults was found²⁷, corroborating the presence of barriers associated in the present study, such as age and BMI²⁷. Several reasons may explain some of these associations in leisure and commuting bicycle use. For example, distance to work¹⁰, especially when it is greater than 4 km, may be related to low self-efficacy of overcoming major courses, which may be influenced by the quality of the environment²⁰ and the lack of company or invitation from friends or family²⁸, as well as lack of safe places to park the bicycle and lack of changing rooms in the workplace, representing an important barrier due to the fear of having the bicycle stolen and the discomfort of being sweaty during the workday¹⁰. Several studies have shown positive association between having a bicycle and its use during leisure or commuting and consequently higher total physical activity indexes^{8,10,11}.

The comparative matrix between the most reported barriers in quantitative research with those reported by focal groups has shown that barriers to bicycle use have reports that combined with seven of the 11 barriers of the questionnaire for both purposes of use. Barriers, “bad weather”, “heavy traffic”, “lack of safety”, “fear of accidents”, “lack of will” showed combination both in leisure and commuting in both research approaches. Specifically, “lack of bicycle lane” and “lack of social support” barriers showed combination for leisure; and “lack of parking” and “lack of changing room” for

commuting. On the other hand, some barriers to bicycle use, identified by the questionnaire, did not present combinations with reports mentioned by the focus groups, being “poor quality of streets”, “pollution” and “not having a bicycle” for both use modalities; and specifically for leisure, “lack of parking” and for commuting “distance to destinations”.

The reports identified in the focus group interviews contributed to the identification of the main barriers to bicycle use. For example, the reports referring to “heavy traffic” presented differences between sexes, regardless of purpose of use. Women reported problems of verbal disrespect of drivers who feel disturbed by the presence of bicycles (Leisure: “... we use it more at the weekend and we are always with the children, I always perceive the lack of respect from some drivers, which discourages”. Commuting: “... with women it is more complicated, they offend, they speak rude, as if we were disturbing the traffic and in fact we want to reduce traffic with the use of bicycle...”). However, men report problems related to the lack of respect by drivers and lack of supervision of traffic laws (Leisure: “... even if there are laws for cycling, many drivers do not respect. They think the bike is there to hinder traffic...”). Commuting: “... if there are laws and they are enforced, heavy traffic should not be a problem, why cars and bicycles would comply with the established law, what they need are laws and compliance ...”. On the other hand, other barriers presented similar reports between sexes. For example, for the “fear of accidents” barrier to leisure bicycle use, men and women reported lack of respect from drivers (Men: “... they always throw the car on the bike and still offend, as if the space was just for cars ... “. Women: “... cars do not respect the space between car and bicycle ... “. Similar reports, among others, have been identified in literature, which vary by sex, purpose of use, weather and cultural aspects related to bicycle use in each country¹².

Some limitations should be considered for the adequate interpretation and extrapolation of the study results. The sample is not representative of adults from Curitiba, being restricted to individuals who reported the use of bicycles in leisure or commuting and who resided in census tracts with different socioeconomic levels and characteristics of the environment built for the practice of physical activity. Due to the low frequency of leisure and commuting bicycle use among women (28.3% and 19.7%, respectively), it was not possible to test the association between presence of barriers and use of bicycles in analyses stratified by sex. Focus group interviews were conducted with a relatively low number of participants, which may not have been sufficient to capture reports for all barriers identified in the qualitative approach. This can be partly attributed to the selection bias of participants for interviews, since all reported leisure or commuting bicycle use; therefore, they had this equipment in conditions of use in their residences, as a consequence, no participant expressed opinion or feelings about “not having a bicycle” barrier. Furthermore, the cross-sectional design limits the adequate interpretation of the causal relationship between presence of barriers and use of bicycle for adults.

CONCLUSION

The main barriers to bicycle use are related to aspects of the physical environment and safety, regardless of approach adopted and purpose of use. The results obtained by the household survey and focus group interviews showed similarity in the most reported barriers. The results reinforce the importance of public and traffic safety, as well as the implementation and improvement of cycling structures and the prioritization of traffic education. Future studies could analyze the cost-effectiveness of environmental interventions, the cycling structure of cities, use of bicycles and perception of barriers.

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REFERENCES

1. 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):259–264.
2. Pucher J, Dill J, Handy S. Infrastructure, programs, and policies to increase bicycling: An international review. *Prev Med* 2010;50(Suppl.):106–125.
3. Oja P, Titze S, Bauman A, de Geus B, Krenn P, Reger-Nash B, et al. Health benefits of cycling: A systematic review. *Scand J Med Sci Sports* 2011;21(4):496–509.
4. Engbers LH, Hendriksen IJ. Characteristics of a population of commuter cyclists in the Netherlands: perceived barriers and facilitators in the personal, social and physical environment. *Int J Behav Nutr Phys Act* 2010;7:89.
5. Sallis JF, Bull F, Guthold R, Health G, Inoue S, Kelly P, et al. Progress in physical activity over the Olympic quadrennium. *Lancet* 2016;388(10051):1325–1336.
6. Woodcock J, Banister D, Edwards P, Prentice A, Roberts I. Energy and transport. *Lancet* 2007;370(9592):1078–1088.
7. Sener I, Eluru N, Bhat C. An analysis of bicycle route choice preferences in Texas, US. *Transportation* 2009;36(5):511–539.
8. Kienteka M, Reis RS, Rech CR. Personal and behavioral factors associated with bicycling in adults from Curitiba, Paraná State, Brazil. *Cad Saude Publica* 2014;30(1):79–87.
9. Chataway E, Kaplan S, Nielsen T, Prato C. Safety perceptions and reported behavior related to cycling in mixed traffic: A comparison between Brisbane and Copenhagen. *Transp Res Part F Traffic Psychol Behav* 2014;23:32–43.
10. Kienteka M, Fermino RC, Reis RS. Fatores individuais e ambientais associados com o uso de bicicleta por adultos: Uma revisão sistemática. *Rev Bras Ativ Fís Saúde* 2014;19(1):12–24.
11. Dill J, McNeil N. Four types of cyclists? Examination of typology for better understanding of bicycling behavior and potential. *Transp Res Rec J Transp Res Board* 2013;2387:129–138.
12. Camargo EM, Fermino RC, Reis RS. Barriers and facilitators to bicycle use in adults: A systematic review. *Rev Bras Ativ Fís Saúde* 2015;20(2):103–112.
13. Kienteka M, Rech CR, Fermino RC, Reis RS. Validade e fidedignidade de um instrumento para avaliar as barreiras para o uso de bicicleta em adultos. *Rev Bras Cineantropom Desempenho Hum* 2012;14(6):624–635.
14. Camargo E, Fermino R, Añez C, Reis RS. Barriers and facilitators to bicycle use for transport and leisure among adults. *Rev Bras Ativ Fís Saúde* 2014;19(2):256–265.

15. Hallal PC, Knuth AG. Epidemiologia da atividade física e a aproximação necessária com as pesquisas qualitativas. *Rev Bras Ciências do Esporte* 2011;33(1):181–192.
16. Turato ER. Métodos qualitativos e quantitativos na área da saúde: definições, diferenças e seus objetos de pesquisa. *Rev Saúde Pública* 2005;39(3):507–514.
17. Sallis JF, Cervero RB, Ascher W, Ascher W, Henderson K, Kraft M, Kerr J. An ecological approach to creating active living communities. *Annu Rev Public Health* 2006;27:297–322.
18. Sousa A, Sanches SP, Ferreira M. Perception of Barriers for the Use of Bicycles. *Procedia - Soc Behav Sci* 2014;160:304–313.
19. Hino AAF, Rech CR, Gonçalves PB, Hallal P, Reis RS. Project ESPAÇOS of Curitiba, Brazil: Applicability of mixed research methods and geo-referenced information in studies about physical activity and built environments. *Rev Panam Salud Public* 2012;32(3):226–232.
20. Saelens BE, Sallis JF, Frank LD. Environmental correlates of walking and cycling: Findings from the transportation, urban design, and planning literatures. *Ann Behav Med Publ Soc Behav Med* 2003;25(2):80–91.
21. ABEP. Associação Brasileira de Empresa de Pesquisa. Critério de classificação econômica do Brasil. 2017; Available from: <<http://www.abep.org/criterio-brasil>>[2017 jun 12].
22. World Health Organization. Global recommendations on Physical activity for health. 2017; Available from: <<http://www.who.int>>[2017 jun 12].
23. Fleck MP, Louzada S, Xavier M, Chachamovich E, Vieira G, Santos L, et al. Application of the Portuguese version of the abbreviated instrument of quality life WHOQOL-bref. *Rev Saude Publica* 2000;34(2):178–183.
24. Matsudo S, Araújo T, Matsudo V, Andrade D, Andrade E. International physical activity questionnaire (IPAQ): Study of validity and reliability in Brazil. *Rev Bras Ativ Fís Saude* 2001;6(2):5–18.
25. Cassou AC, Fermino RC, Santos MS, Rodriguez-Añez C, Reis RS, et al. Barreiras para a atividade física em idosos: Uma análise por grupos focais. *Rev Educ Física/uem* 2008;19(3):353–360.
26. INMET. Instituto Nacional de Meteorologia. 2016; Available from: <<http://www.inmet.gov.br/portal>>[2015 jun 01]
27. Reichert FF, Barros AJD, Domingues MR, Hallal P. The Role of Perceived Personal Barriers to Engagement in Leisure-Time Physical Activity. *Am J Public Health* 2007;97(3):515–519.
28. Bauman AE, Reis RS, Sallis JF, Wells J, Loos R, Martin B. Correlates of physical activity: Why are some people physically active and others not? *Lancet* 2012;380(9838):258–271.

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