



Cycling to work in Brazil: Users profile, risk behaviors, and traffic accident occurrence

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ABSTRACT

In 2006, we carried out a cross-sectional study in the urban area of Pelotas, Southern Brazil, with the aim of outlining the profile of bicycle commuters, analyzing their use of safety equipment and risk behaviors and the association between these variables and involvement in traffic accidents in the previous 12 months. This study was based on the baseline survey carried out prior to an educational intervention aimed at reducing accidents among cyclists. The sample included 1133 male subjects aged 20 years or more, and who used a bicycle for commuting. Crude and adjusted analyses were carried out using Poisson regression. We recorded a total of 152 reported traffic accidents in the 12 months preceding the interview, involving 10.8% of subjects. Most risk behaviors studied and the use of safety equipment showed no significant association with accidents. Only commuting by bicycle seven days per week, as opposed to five or six, and a combination of extremely imprudent behaviors such as zigzagging through traffic, riding after ingesting alcohol, and high-speed riding were found to be risk factors for accidents. Our findings suggest that in the context where the study was done (poor road signaling, limited policing, aggressive driving) changing cyclist behavior may not have substantial impact in terms of accident reduction before other road traffic interventions are implemented.

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1. Introduction

Created in 1817 by German Baron Karl Von Drais, the bicycle has been, since the Nineteenth Century, a popular and efficient mode of transport among different peoples throughout the world. Benefitting the health of those who use them on a regular basis (Litman et al., 2006; Andersen et al., 2000), and preserving the environment and public areas (FHWA, 1993) are two of the many advantages of bicycle use. Furthermore, bicycles can join and integrate people, making cities more humane and healthy. In a favorable environment, the bicycle may be used as a means of transport and leisure by any person, regardless of sex, age, social class, and even of climate, as seen in several cities across Northern Europe.

In light of the increasing levels of air pollution and of the disorders caused by excess motor vehicles in large and medium-sized cities worldwide, the bicycle is currently considered as one of the

best alternatives for urban transportation. Substantial investment is being made in a number of urban centers to make non-motorized transportation a priority, and public policies based on bicycle use have been successfully implemented in countless cities in Europe and the Americas (Pucher and Buehler, 2008). Even in the United States, which has the largest number of cars per inhabitant, bicycles are being considered as a possible solution for problems of urban traffic and obesity (Pucher and Dijkstra, 2003), a disease which affects 34% of adult North-Americans (Ogden et al., 2007).

In Brazil, which has the sixth greatest fleet in the world, estimated at 75 million units, bicycles are widely employed as a mode of transportation. This is especially true in small and medium-sized cities, where lower income workers are its greatest users (Programa Bicicleta Brasil, 2007).

In Pelotas, a medium-sized city in Southern Brazil, approximately 17% of workers of both sexes rely on bicycles on a daily basis for transportation to and from work. Bicycles are also the most frequently used form of transportation among men, accounting for 27% of all transportation (Bacchieri et al., 2005). The city's climactic and topographic characteristics, as well as the cyclable distances between the city center and residential neighborhoods, promote this widespread use. However, combined with a deficient bicycle lane infrastructure, such extensive use contributes to a considerable number of accidents involving cyclists. Similar scenarios occur

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in numerous Brazilian cities of matching geographical and socio-economic characteristics (GEIPOT, 2001). In Maringá, Paraná, also in Southern Brazil, cyclists were considered as priority group for interventions aimed at reducing traffic accidents, due both to their fragility and to the predominance of bicycle users in public ways. Cyclists account for 18.5% of deaths in traffic accidents (Scalassara et al., 1998). This study also indicates that this could be a common pattern in various Brazilian non-capital cities with plane topography and mild temperatures. In this context, the bicycle is a common means of transportation, especially among the poor. A study carried out in Londrina, also in Paraná, arrived at similar conclusions. In this city, cyclists represent 20.9% of all victims of traffic accidents, and 9.2% of all deaths (Andrade and Mello Jorge, 2000). In Pelotas, a study based on police reports and hospital files found proportional mortality and lethality rates among cyclists of 18% and 5%, respectively (Barros et al., 2003). According to the Municipal Secretariat of Transit, cyclists in 2003 accounted for 16% of traffic-related injuries and 33% of deaths (SMTT, 2004). More recently, a population-based survey showed that 5.5% of workers that use bicycles for commuting are involved in traffic accidents with physical injury each year (Bacchieri et al., 2005). This proportion represents approximately one thousand cyclists injured in Pelotas every 12 months, and this is considering only those who use it for commuting purposes.

Given the importance of bicycle use, the present study was aimed at describing and analyzing variables related to profile, safety equipment use, and risk behaviors among workers using bicycles as a means of transportation, and their association with the occurrence of traffic accidents in the preceding year.

2. Material and methods

In 2006, in the urban area of the city of Pelotas, in Southern Brazil, we carried out a cross-sectional study where we interviewed workers who used bicycles for commuting in order to collect information on demographic and socioeconomic conditions, transportation patterns, risk behaviors, and involvement in traffic accidents in the 12 months preceding the interview. This cross-sectional study was the baseline for an intervention study aimed at reducing traffic accidents among cyclists. Sample size was calculated in a way to guarantee at least 80% power to detect relative risks equal to or greater than 1.5 at a 5% significance level for most of the risk factors of interest. The calculations yielded a sample size of 1200 cyclists.

In order to identify bicycle commuters, we surveyed five neighborhoods in the city, covering the entire peripheral area. Based on the tracts of the 2000 Demographic Census, (IBGE, Instituto Brasileiro de Geografia e Estatística. Censo Demográfico 2000. <http://www.ibge.gov.br>, last accessed 6th February 2009), we identified 205 sectors with mean income equal to or lower than R\$ 600.00 (six hundred Brazilian Reals), based on a study (Bacchieri et al., 2005) that showed that these sectors concentrate the highest proportion of such workers. In each neighborhood, we randomly selected eight tracts in that income range, and all households in these tracts were visited in order to identify bicycle commuters. Eligibility criteria were as follows: male subjects, employed, aged 20 years or older, and who ride a bicycle at least 30 min per day for purposes of transportation to and from work at least five days per week.

Among eligible subjects, we selected 30 bicycle commuters from each tract by simple random sampling. In case more than one eligible participant was present in a single household, the other household members were also invited to participate in the study. This was done in order to prevent potential dissatisfaction from household members not included in the sample, as well from the selected subject whose family members were not included in the

Table 1

Demographic and socioeconomic profile of workers who used a bicycle as mode of transportation and prevalence of presence of traffic accidents in last 12 months. Pelotas, Brazil (2006).

Variables	N	(%)	% accident	p-Value
Age				0.238 ^a
20–29 years	326	(28.8)	12.6	
30–39 years	326	(28.8)	10.7	
40–49 years	289	(25.4)	9.3	
50 years or older	192	(17.0)	9.9	
Skin color				0.395 ^b
White	755	(66.6)	9.9	
Black	220	(19.4)	11.8	
Mixed	158	(14.0)	13.3	
Marital status				0.935 ^b
Married or w/partner	904	(79.8)	10.7	
Single or w/o partner	229	(20.2)	10.9	
Neighborhood of residence				0.101 ^b
Três Vendas I	228	(20.1)	8.3	
Três Vendas II	250	(22.1)	10.8	
Porto	248	(21.9)	9.5	
Areal	228	(20.1)	15.4	
Fragata	179	(15.8)	11.2	
Schooling				0.357 ^a
0–3 years	221	(19.5)	9.5	
4–8 years	726	(64.1)	10.7	
9 or more years	186	(16.4)	12.4	
National Economic Indicator (IEN) 1 ^c				0.118 ^a
1st quintile	168	(14.8)	14.3	
2nd quintile	240	(21.2)	12.1	
3rd quintile	347	(30.7)	9.5	
4th quintile	292	(25.8)	9.3	
5th quintile	85	(7.5)	10.6	
Major occupation 4 ^c				0.051 ^a
Production and services	683	(60.5)	9.4	
General salesman	255	(22.6)	14.9	
Other occupations	191	(16.9)	10.5	

^a Test for linear trend.

^b Test for heterogeneity of proportions.

^c Missings.

study. Trained interviewers visited each household in order to carry out the baseline survey, administering an individual pre-tested, pre-coded questionnaire. Presence of safety gear on bicycles was identified based on direct observation. Cyclists that could not be found due to change of address or who refused to participate after two attempts by interviewers and one by the study coordinator were replaced by another cyclist, selected using the same procedure described above. We carried out quality control interviews by telephone in a randomly selected 10% of the sample. Demographic and socioeconomic variables are presented in Table 1. Economic level, based on the National Economic Indicator (*Indicador Econômico Nacional*—IEN) (Barros and Victora, 2005), was categorized in quintiles, and the worker's primary occupation was categorized according to the Brazilian Occupation Classification (CBO, *Classificação Brasileira de Ocupações*. Ministério do Trabalho e Emprego. <http://www.mteco.gov.br/busca.asp>, last accessed 3rd October 2008). Table 2 presents variables related to bicycle use, and Fig. 1 presents data on the use of mandatory safety equipment as predicted by the Brazilian Traffic Code (Sobrinho et al., 2002), as well as of non-mandatory equipment. Risk behavior variables, obedience to traffic rules, and fear of accidents while riding a bicycle in traffic are described in Table 3. Risk behaviors were chosen based on their being considered as potential determinants of the occurrence of accidents involving cyclists. In order to detect these behaviors, we used a technique that allowed the interviewer to respond positively in a spontaneous manner, based on risk behavior mentioned by the subject, or in an induced manner, based on

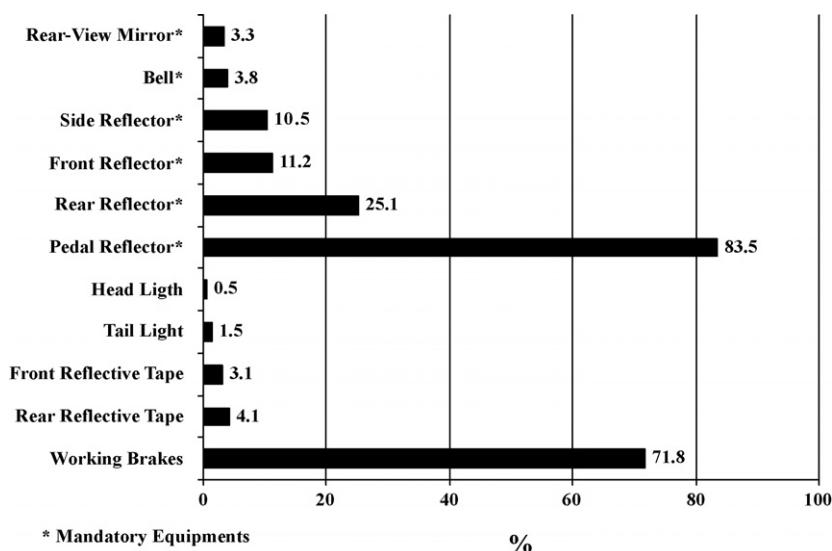


Fig. 1. Proportion of bicycles bearing mandatory and non-mandatory safety equipment according to the Brazilian Traffic Code used as a means of commute by workers in the city of Pelotas, Southern Brazil.

behaviors listed by the interviewer. For analysis purposes, answers classified as “yes, spontaneous,” and “yes, induced” were combined into a dichotomized yes/no variable. Risk behavior variables were also studied based on principal component analysis in order to define groups of risk behaviors. Variables included in each of the groups are listed as a footnote in Table 3. The outcome was defined as “having suffered a traffic accident on a bicycle on the way to or from work in the 12 months preceding the interview.”

Descriptive analysis presents the sample distribution with respect to independent variables, and the crude analysis is aimed at demonstrating the association between these variables and the occurrence of traffic accidents. Adjusted analysis included variables associated with the outcome with p -values ≤ 0.4 , and those

with $p \leq 0.2$ were kept in the model. Variables significantly associated with the outcome ($p \leq 0.05$) are presented, along with their respective relative risks and confidence intervals. We used Poisson regression with robust variance for crude and adjusted analyses. All analyses were carried out using Stata 9.0 statistical software (Stata Corporation, College Station, Texas, USA). Data entry – performed twice and with automatic consistency and amplitude checking – and sample size calculations were carried out using Epi-info 6.0.

The present study was approved by the Federal University of Pelotas research ethics committee. Interviews were conducted only after the study aims and the commitment to confidentiality of information were explained and after the subject provided verbal consent to participation.

Table 2

Characteristics of bicycle use and among workers using a bicycle as mode of transportation and prevalence of presence of traffic accidents in last 12 months. Pelotas, Brazil (2006).

Variables	N	(%)	% accident	p -Value
Days of use/week				0.004 ^a
5 days	415	(36.6)	8.9	
6 days	544	(48.0)	9.6	
7 days	174	(15.4)	19.0	
Time of use/day				0.043 ^a
30 min	180	(15.9)	7.2	
31–45 min	202	(17.8)	11.9	
46–60 min	366	(32.2)	10.7	
61–90 min	199	(17.6)	8.5	
91–120 min	114	(10.1)	13.2	
Over 120 min	72	(6.4)	19.4	
Bicycle use				0.295 ^a
Over 20 years	291	(25.7)	8.3	
16–20 years	176	(15.5)	11.4	
11–15 years	163	(14.4)	11.0	
6–10 years	254	(22.4)	14.6	
Up to 5 years	249	(22.0)	9.2	
Use at night				0.976 ^b
No	103	(9.1)	10.7	
Yes	1030	(90.9)	10.8	
Use under rain				0.293 ^b
No	217	(19.2)	8.8	
Yes	916	(80.8)	11.2	

^a Test for linear trend.

^b Test for heterogeneity of proportions.

3. Results

By surveying the census tracks included in the sample, we were able to locate 2075 eligible bicycle commuters, of which 1479 were recruited to participate in the study. Between the initial search and recruitment, 21.7% of cyclists lost eligibility due to changing address, losing their job, or no longer using a bicycle for commute. There were 1.7% losses. In the Fragata neighborhood, in addition to the eight selected sectors, we also incorporated another two sectors with similar characteristics due to our inability to recruit the predicted number of cyclists for that neighborhood. In total, we surveyed 42 census tracts and interviewed 1133 bicycle commuters, which composed the study sample.

One hundred fifty-two accidents were reported in the 12 months preceding the interview, involving 10.8% of subjects.

Table 1 describes the studied population in terms of socioeconomic and demographic variables as well as the proportion of cyclists that suffered accidents in the 12 months prior to the interview. The majority of the sample consisted of young adults (between 20 and 39 years of age), with white skin, and who were married or living with a partner. Over 80% of subjects had up to complete elementary schooling, and the majority of subjects were in the intermediary quintiles of the economic level distribution (National Economic Indicator). A large fraction of bicycle commuters were employed in the production of goods and services, working mostly as masons or mason’s assistants, painters, longshoremen, or cargo loaders. Approximately 22% were employed as service providers and salesmen (doormen, garbage disposal workers, and general

Table 3
Risk behaviors and safety-related variables among workers who used a bicycle as mode of transportation and prevalence of presence of traffic accidents in last 12 months. Pelotas, Brazil (2006).

Variables	N	(%)	% accidents	p-Value
Running red lights				0.819 ^a
No	698	(61.6)	10.6	
Yes	453	(38.4)	11.0	
Riding the wrong way on one-way street				0.108 ^a
No	698	(61.6)	9.6	
Yes	435	(38.4)	12.6	
Riding on left side of street				0.194 ^a
No	844	(74.5)	10.1	
Yes	289	(25.5)	12.8	
Riding side-by-side with another cyclist				0.152 ^a
No	722	(63.7)	11.8	
Yes	411	(36.3)	9.0	
Riding on sidewalk				0.555 ^a
No	753	(66.5)	11.2	
Yes	380	(33.5)	10.0	
Stopping over pedestrian crossings				0.117 ^a
No	785	(69.3)	9.8	
Yes	348	(30.7)	12.9	
Zigzagging through traffic				0.022 ^a
No	1057	(93.3)	10.2	
Yes	76	(6.7)	18.4	
Crossing streets with right-of-way without stopping				0.561 ^a
No	974	(86.0)	11.0	
Yes	159	(14.0)	9.4	
Riding rapidly				0.069 ^a
No	979	(86.4)	10.1	
Yes	154	(13.6)	14.9	
Not using bicycle lane when available				0.564 ^a
No	1037	(91.5)	10.6	
Yes	96	(8.5)	12.5	
Riding after ingestion of alcohol				0.294 ^a
No	1048	(92.5)	10.5	
Yes	85	(7.5)	14.1	
Risk behaviors–Group 1 [*]				0.160 ^a
No	542	(47.8)	9.4	
Yes	591	(52.2)	12.0	
Risk behaviors–Group 2 ^{**}				0.005 ^a
No	882	(77.8)	9.4	
Yes	251	(22.2)	15.5	
Risk behaviors–Group 3 ^{***}				0.452 ^a
No	340	(30.0)	9.7	
Yes	793	(70.0)	11.2	
Presence of rear reflector				0.554 ^a
No	848	(74.9)	11.1	
Yes	285	(25.1)	9.8	
Working brakes				0.572 ^a
No	319	(28.2)	11.6	
Yes	814	(71.8)	10.4	
Fear of accidents				0.290 ^a
No	335	(29.6)	9.3	
Yes	798	(70.4)	11.4	
Respect for traffic rules				0.648 ^a
No	46	(4.1)	8.7	
Yes	1087	(95.9)	10.9	

^a Test for heterogeneity of proportions.

^{*} Running red lights; not using bicycle lane when available; stopping over pedestrian crossings.

^{**} Zigzagging through traffic; riding after ingestion of alcohol; riding rapidly.

^{***} Riding the wrong way on one-way streets; riding on left side of street; riding side-by-side with another cyclist; riding on sidewalk; crossing streets with right-of-way without stopping.

Table 4

Variables associated with traffic accidents among workers who used a bicycle as mode of transportation, after adjusted analysis. Pelotas, Brazil (2006).

Variables	Adjusted analysis ¹	
	RR (95%CI)	p-Value
Days of use/week		0.013 ^a
5 days	1.00	
6 days	1.00 (0.67–1.50)	
7 days	1.93 (1.25–2.99)	
Riding side-by-side with another cyclist		0.043 ^b
No	1.00	
Yes	0.82 (0.68–0.99)	
Risk behaviors—Group 2 ^{**}		0.024 ^b
No	1.00	
Yes	1.53 (1.06–2.21)	

¹ Adjusted for all variables that in crude analysis showed association with $p \leq 0.400$.

^a Test for linear trend.

^b Test for heterogeneity of proportions.

^{**} Zigzagging through traffic; riding after ingestion of alcohol; riding rapidly.

merchandise salesmen), whereas the remainder were distributed among other occupations such as automobile mechanics, electricians, and others. There was no statistically significant association between demographic and socioeconomic variables and the occurrence of traffic accidents.

As seen in Table 2, the majority of bicycle commuters used a bicycle for commuting purposes 5 or 6 days per week, for 30–60 min per day. Median and mean daily use were 60 and 74 min, respectively. Approximately 25% of subjects had extensive traffic experience, having used a bicycle for commuting for over 20 years. The wide majority of subjects reported cycling also during the night and under rainy weather, indicating that the bicycle commuters included in the sample used bicycles not sporadically or only under favorable conditions, but rather as their major and oftentimes only mode of transportation to work. Number of cycling days per week and mean daily use time, which are directly related to the duration of exposure to traffic, were significantly associated with occurrence of accidents. On the other hand, there was no significant association between accidents and greater traffic experience or using a bicycle at night or under rainy weather.

Table 3 shows that a substantial fraction of bicycle commuters did not obey basic traffic safety rules, with, in some cases, over one-third of the sample admitting to a given risk behavior. Running red lights, riding the wrong way on one-way streets, and riding side-by-side with other cyclists were the most frequently reported risk behaviors. In contrast to these results, over 95% of subjects were of the opinion that cyclists should respect traffic rules, and 70% reported being afraid of traffic accidents.

The wide majority of risk behaviors were not significantly associated with occurrence of accidents. Only zigzagging through traffic and the set of risk behaviors termed “Group 2” (zigzagging through traffic, riding after ingestion of alcohol, and riding rapidly) were associated with traffic accidents in the 12 months preceding the interview. Having working brakes or rear reflectors was not associated with the outcome.

Only one of the 1133 bicycles studied had all the safety equipment required by the Brazilian Traffic Code, whereas 12% did not have any. Slightly over one-half (58%) of bicycles had only one piece of required equipment. Working brakes were absent from 28% of bicycles. Pedal reflectors were the mandatory safety equipment most frequently used. The proportion of use of mandatory and other safety equipment is presented in Fig. 1.

Table 4 presents variables that, after adjustment, remained or became significantly associated with the outcome. Bicycle commuters who used a bicycle 7 days per week were almost two times

more likely to have suffered an accident when compared to those who cycled 5 or 6 days. Riding side-by-side with another cyclist was found to have a protective effect against accidents, with subjects who reported this behavior showing 18% lower risk of having suffered an accident. Cyclists who reported following the set of risk behaviors included in “Group 2” (zigzagging through traffic, riding after ingestion of alcohol, and riding rapidly) were more than 50% more likely to have suffered a traffic accident when compared to those who did not.

4. Discussion

Every day, in the city of Pelotas, about 18 thousand workers that use a bicycle as mode of transport, the majority of which are males aged 20 years or older (Bacchieri et al., 2005). The sampling strategy utilized in the present survey was designed for an intervention study, and thus did not attempt to ensure populational representativeness. Notwithstanding, the subjects surveyed show many of the characteristics of the typical bicycle commuter, as evidenced by the similarity between our present results and those of a previous, population-based survey carried out in 2005 in the same city (Bacchieri et al., 2005). The similarity between Pelotas and other medium-sized Brazilian cities in terms of geography, socioeconomic settings, and bicycle use for commute among working classes allows our results to be extended also to these cities.

This is an innovative study in Brazil, and uses an approach that differs from those used in studies from other countries. Thus, any comparison with the results of other studies would not be adequate, especially given the specificity of our sample and of the safety equipment investigated. Helmet use, frequently discussed by North-American and European researchers, was not addressed due to the complete absence of this item among bicycle commuters in Pelotas.

The major limitation of the present study is its reliance on self-reported information. The 12-month recall period could potentially generate recall bias, possibly underestimating the number of non-severe accidents taken place close to the limit of the period. When compared to data obtained from the intervention study (longitudinal follow-up), we found that 8.3% of subjects reported at least one accident (data from the author) among those with complete follow-up, suggesting that any potential underestimation would not be of substantial magnitude. On the other hand, the accuracy of risk behavior reports may have been influenced by a process of self-censorship among subjects, probably in the direction of under-reporting. Such bias would lead to reduction in the magnitude of effect estimates. In order to minimize this problem, we assured participants during the interview as to the confidentiality of the information provided, and also as to the lack of any connection between the survey and public law enforcement agencies, which made subjects more comfortable to answer questions related to risk behaviors.

Prevalence of traffic accidents in the 12 months preceding the survey was 10.8%. Taking into account the estimate that there are currently 18 thousand cyclists in Pelotas, each year roughly 1900 cyclists suffer at least one accident when commuting to and from work.

The profile obtained from sociodemographic variables described the bicycle commuter as a worker coming from less favored social classes, who uses the bicycle especially as a means to save money that would otherwise be spent on motorized transportation. With regard to traffic accidents, our results show that the sociodemographic factors studied do not significantly influence the occurrence of the outcome.

Among bicycle use characteristics, the higher risk accidents found among workers who cycled to work seven days per week

is due mainly to their greater exposure to traffic. These workers used bicycles an average of 100 min per day, in contrast to 65 and 74 min per day among workers who used a bicycle 5 and 6 days per week, respectively. Daily usage corroborates this hypothesis: in crude analysis, subjects who used a bicycle for two hours or more per day were 2.6 times more likely to have suffered an accident than those who used it for 30 min per day. In addition to greater exposure to traffic, another hypothesis for the higher risk among workers who use a bicycle seven days per week is the significant increase in accidents seen in Pelotas during weekends, and especially on Sundays (Barros et al., 2003).

The intense use of bicycles during the night is due to the fact that during certain times of year commute takes place before dawn on the way to work, and after dusk on the way home. Although Rodgers (1995) found bicycle use at night to be associated with greater risk of accidents, bicycle commuters who cycled also at night (the great majority) showed practically the same risk of accidents as those who cycled only during the day. A similar scenario was found among subjects who cycled under rainy weather when compared to those who cycled only under favorable conditions.

The low prevalence of safety equipment use is similar to that found in the population-based study carried out in Pelotas (Bacchieri et al., 2005). The socioeconomic characteristics of the studied population imply a lack of resources to purchase safety equipment or of knowledge of regulations requiring the use of certain safety equipment, or the need to maintain the bicycle as free as possible of any accessory in order to minimize risk of theft.

Although use of rear or pedal reflectors was not protective against occurrence of accidents, these results should not in any way justify their absence. A systematic review carried out by Kwan and Mapstone (2004), based on 25 trials, found that use of this equipment makes cyclists more visible during the night, allowing drivers to detect and recognize those who use them.

The absence of working brakes in almost 30% of bicycles in the sample did not emerge as a significant risk factor for accidents also, leading to conclusions similar to those relative to other safety equipments. Moreover, the longitudinal study implementing an educational intervention, mentioned in the beginning of this article, led the researchers into direct contact with subjects and their bicycles, revealing the precarious conditions of these vehicles. Most bicycles were poorly lubricated, lacked gears, were poorly maintained, and were unlikely to reach high speeds. Under such conditions, cyclists may not perceive the need for brakes. Thus, in addition to the aforementioned socioeconomic factors, poor overall maintenance may have led to lack of maintenance, and consequent loss, of brakes.

We investigated a series of behaviors and markers of risk that we believed would have a marked influence on the outcome. Our results indicated that occurrence of traffic accidents involving bicycle commuters bore little relationship with the manner in which they rode their bicycles or with presence of safety equipment. The lack of association could be interpreted as inadequate cyclist behavior not leading to increased risk of accidents. In epidemiological terms, the fact is that we could not detect this association. The most likely reason, though, is not that inadequate behavior bears no link with safety, but that in our traffic context other factors have much greater importance. Etiologic fraction calculations showed that only 29% of accidents are due to risk behaviors adopted by cyclists, the remaining 71% being due to other factors. Within the complexity of urban traffic, motor vehicle drivers and the deficient

bicycle lane network share a substantial proportion of responsibility for accidents involving cyclists. Also, the traffic is poorly organized. Data obtained in a study carried out in Pelotas in 2003 showed that one third of accidents involving cyclists were not registered with the police and 47% of those registered did not include identification of the motor vehicle involved. Hit-and-run incidents accounted for 26% of accidents (Barros et al., 2003).

Based on the results obtained, changes in cyclist behavior are not likely to have substantial impact on the occurrence of accidents in our context and at this point in time. First, the local traffic authority should invest in the improvement of road conditions and signaling, prioritizing the expansion of the existing bicycle lane infrastructure. The wide majority of medium-sized and large cyclable Brazilian cities, including Pelotas, rely on a bicycle lane network that is vastly inferior to that required to ensure safe transit of cyclists. Repression of traffic law infringement is another priority that should be achieved through more intensive policing.

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