REVISTA DA FACULDADE DE ODONTOLOGIA DE PORTO ALEGRE
V. 64 (jan./dez. 2023) - ARTIGOS ORIGINAIS
DOI: 10.22456/2177-0018.124883

EVALUATION OF DENTAL TRAUMA ASSOCIATED WITH CYCLING ACCIDENTS IN A CITY IN THE SOUTH OF BRAZIL: AN OBSERVATIONAL STUDY

Avaliação de traumatismos dentários associados a acidentes com bicicletas em uma cidade do sul do Brasil: um estudo observacional

Vinícius Furlan[a]
Matheus Luis Reolon[b]
Gabriela Oltramari Nery[c]
Thalia Tessaro Torresan[c]
Luciana Batista Luz[d]
Karen Barea de Paula Duarte[d]
Regis Burmeister dos Santos[e]
Francisco Montagner[f]

[a]DDS, Private Practice, Porto Alegre, RS, Brazil.
[b]DDS, MSc, PhD candidate, Dental post-graduation program, Department of Conservative Dentistry, School of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, RS, Brazil.
[c]DDS, MSc candidate, Dental post-graduation program, Department of Conservative Dentistry, School of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, RS, Brazil.
[d]DDS, MSc, PhD, Department of Conservative Dentistry, School of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, RS, Brazil.
[e]DDS, MD, MSc, PhD. Professor, Department of Conservative Dentistry, School of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, RS, Brazil.
[f]DDS, MSc, PhD. Associate Professor, Dental post-graduation program, Department of Conservative Dentistry, School of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, RS, Brazil.
Corresponding author: Francisco Montagner - E-mail: francisco.montagner@ufrgs.br
Data de envio: 30/05/2022 **Data de aceite:** 22/11/2022

ABSTRACT

Aim: to evaluate the cyclists' profile and the frequency of dental trauma associated with cycling in a southern city in Brazil. **Materials and Methods:** a questionnaire was applied to 234 cyclists with at least 18 years old. The variables of interests were: sociodemographic data, data related to the profile of users, and data on the occurrence of all traumas and dental traumas. Descriptive and inferential statistical analyses were carried out (α=5%). **Results:** The mean age of participants was 31.38 ± 11.6 years, ranging from 14 to 67 years. The majority of the participants were male (62.8%), had attended higher education (45.7%), and had incomes equivalent to 1 to 3 times the minimum wage (39.3%). The main reason given for riding a bicycle was leisure (35.9%). Users of their own bicycles had fewer items of mandatory safety equipment fitted to their bicycles than users of rented bicycles (Student's *t* test, P<0.0001). However, study participants riding their own bicycles wore personal protective equipment more frequently than renters (Student's *t* test, P<0.0001). Moreover, 33.7% of the respondents reported having suffered an accident, and 25% had traumatized some part of the body. Among those who reported traumas, 20% (4/20) had suffered traumas to hard dental tissues and supporting structures. **Discussion:** Dental trauma was not frequent in a population predominantly from an urban area that uses bicycles, especially for leisure, despite the prevalence of accidents involving bicycle use. **Conclusion:** Health education campaigns should emphasize the importance of personal protective equipment for cyclists and of safety items fitted to bicycles, whether cyclists' own or rented.

Keywords: Bicycling. Wounds and injuries. Tooth injuries. Dentistry.

RESUMO

Objetivo: avaliar o perfil dos ciclistas e a frequência de traumatismo dentário associado ao ciclismo em uma cidade do sul do Brasil. **Materiais e Métodos**: aplicou-se um questionário a 234 ciclistas com idade mínima de 18 anos. As variáveis de interesse foram: dados sociodemográficos, dados relacionados ao perfil dos usuários e dados sobre a ocorrência de todos os traumatismos e traumas dentários. Foram realizadas análises estatísticas descritivas e inferenciais (α=5%). **Resultados:** A idade média dos participantes era de 31,38 ±11,6 anos, variando de 14 a 67 anos. A maioria dos participantes era do sexo masculino (62,8%), tinha curso superior (45,7%) e renda equivalente a 1 a 3 salários mínimos (39,3%). O principal motivo para andar de bicicleta foi lazer (35,9%). Usuários de suas próprias bicicletas tinham menos itens de equipamentos de segurança obrigatórios instalados do que os usuários de bicicletas alugadas (teste t de Student, P<0,0001). Porém, participantes do estudo que andavam em sua própria bicicleta usavam equipamentos de proteção individual mais frequentemente do que os locatários (teste t de Student, P<0,0001). Ainda, 33,7% dos entrevistados relataram ter sofrido algum acidente e 25% traumatizado alguma parte do corpo. Entre os que relataram traumatismos, 20% (4/20) sofreram traumas em tecidos duros dentais e estruturas de suporte. **Discussão:** O traumatismo dentário não foi frequente em uma população predominantemente de área urbana que utiliza bicicletas, principalmente para lazer, apesar da prevalência de acidentes envolvendo o uso de bicicletas. **Conclusão:** As campanhas de educação em saúde devem enfatizar a importância dos equipamentos de proteção individual dos ciclistas e dos itens de segurança instalados nas bicicletas, sejam elas próprias ou alugadas.

Palavras-chave: Ciclismo. Ferimentos e lesões. Traumatismos dentários. Odontologia.

INTRODUCTION

Use of bicycles as a means of public transport has increased. Brazil is one of the countries with the largest fleets of bicycles. This fact may be related to the significant advantages of using this means of transport, since it offers health benefits through physical activity and the cost of acquisition is low. However, bicycle accidents have increasingly become a cause of injuries and deaths, especially in children and young adults[1,2].

The infrastructure necessary for safe use of bicycles is still lacking in many places in Brazil. This is the main contributing factor to the occurrence of accidents. The lack of bicycle paths or lanes, for example, forces bicycle users to share traffic with motor vehicles[3], increasing competition for space on public roads and exposing cyclists to accidents[4].

Another critical factor associated with the severity of bicycle accidents is failure to use safety equipment. Bacchieri et al.[1] reported that 55% of bicycles had only one of the items of safety equipment required by the Brazilian Traffic Code, while just 0.3% had all items. Castañon et al.[5] revealed that most bicycles did not have any safety equipment, and about 67% of users did not wear any personal protective equipment, such as helmets, for example. Cycling is convenient for children and adolescents and riding a bicycle is not seen as a dangerous practice, with the result that wearing a helmet is atypical[4].

The low adherence to use of safety equipment by Brazilian cyclists[3] is reflected in the rates of head traumas in this population group. Cyclists who wear a helmet are 40% less likely to suffer maxillofacial injury than those who do not. The severity of injuries depends on the area of the face affected, since cycling helmets do not have visors[6,7].

In cases of dental trauma, the time elapsed between the accident and treatment has a significant impact on treatment prognosis[8]. Color changes, sensitivity, painful symptoms, necrosis, and tooth loss can result from delayed or no dental treatment in cases of dental trauma[8,9]. Tooth avulsion is one of the most severe dental injuries. Prognosis depends on first aid procedures and the time elapsed between the trauma and provision of dental care[10]. A study conducted at a public dental trauma service found that bicycle accidents were the leading cause of dental avulsion, accounting for

31.2% of cases[4]. These results confirm previous studies that have demonstrated that victims of bicycle accidents are more likely to suffer tooth avulsion[7,11].

The few studies of traffic accidents involving bicycles that have been conducted in Brazil focus on more severe accidents[12]. Consequently, data referring to minor accidents are underreported[13]. Since more specific data are lacking, dental trauma prevention measures cannot be targeted at this group. The present study aimed to evaluate the profile of cyclists and the occurrence of dental trauma associated with cycling accidents in a city located in southern Brazil.

MATERIALS AND METHODS

The research protocol was approved by the Research Board (COMPESQ-ODO, Faculdade de Odontologia, UFRGS) and by the Research Ethics Committee at the Universidade Federal do Rio Grande do Sul (Protocol CAAE 04447318.0.0000.5347). The research design is an observational study using quantitative methodology, conducted from March 2019 to September 2019.

Cyclists over the age of 18 who frequented public parks in a single city in southern Brazil were invited to participate in the study at locations close to bicycle rental stations. A total of nine locations were used for data collection. According to data from the region studied, there are 210,000 bike-sharing app users in the vicinity. Ferreira et al.[14] demonstrated that the rate of dental trauma associated with cycling accidents is 11%, with a 95% confidence interval and a 5% margin of error. A total sample size of 230 participants was estimated using these data to perform the sample calculation in WinPepi® version 10.5 (JD Abrahamson, 2010). Therefore, 26 bicycle users at each location were invited to join the study at each location, comprising 234 participants.

Participation in the research was voluntary. Participants were informed about the research objectives in advance. They were given opportunities to request clarification about the methodology employed before, during, and after the research. Participants were approached directly and invited verbally at predetermined locations. They provided informed consent prior to study participation.

A questionnaire comprising 21 questions covering sociodemographic data, the profile of bicycle use, and occurrence of traumas in general and of dental traumas specifically was developed for the study based on previous studies[1,5,12].

The variables of interest were: sociodemographic data (gender; age; profession; education; and income), data related to the cyclist's profile (reason for use, frequency of use, distances covered, times of day cycling, effect on use of weather conditions, place of use, origin of the bicycle [rental or own], safety equipment fitted to the bicycle, and personal protective equipment worn), and data on the occurrence of traumas and dental traumas (occurrence of a bicycle accident, its possible causes, location and when the accident occurred, parts of the body affected, occurrence of facial trauma, occurrence of dental trauma, use of protective equipment in the accident, type of care provided). Safety items fitted to the bicycle that were analyzed in the study were presence of a bell, reflectors on the pedals, left rearview mirror, rear reflector or light, front reflector or light, and side reflectors. The personal protective equipment (PPE) analyzed were helmet, glasses, reflective/high visibility clothing, and flashlight/headlamp.

Data were input to an electronic spreadsheet (Microsoft Excel, Microsoft Corp, Redmond, Washington, USA). Descriptive and inferential statistics were calculated using a statistical software package (SPSS for Windows v18, Statistical Package for the Social Sciences, New York, USA). Student's *t* test was applied and the level of significance adopted was 5%.

RESULTS

Table 1 shows the results for the demographic data of the study population. Regarding gender, there were more males, accounting for 62.8% (147/234) of the sample; 48.3% of participants did not inform their profession (103/234); a majority of the participants had completed a Higher Education degree (45.7%; 107/234); and 39.3% (92/234) stated an income equivalent to 1 to 3 times the Brazilian minimum wage.

Table 1 – Demographic data of the population participating in the research, considering the type of origin of the bicycle.

	Bicycle Origin			
	Own	Rent	Both	Total
Age				
Mean (sd)	31.5 (±11.6)	31.0 (±11.2)	33.7 (±11.8)	31.38 (±11.6)
Min	14	18	18	14
Max	63	67	66	67
Gender				
Male	83 (56.46%)	49 (33.33%)	15 (10.2%)	147 (100%)
Female	34 (39.08%)	46 (52.87%)	7 (8.05%)	87 (100%)
Educational status				
Elementary School Incomplete	1 (100%)	0 (0%)	0 (0%)	1 (100%)
Elementary School Complete	2 (100%)	0 (0%)	0 (0%)	2 (100%)
High School Incomplete	4 (57.14%)	2 (28.57%)	1 (14.29%)	7 (100%)
High School Complete	24 (55.81%)	15 (34.88%)	4 (9.3%)	43 (100%)
Higher Education Incomplete	39 (52.7%)	31 (41.89%)	4 (5.41%)	74 (100%)
Higher Education Complete	47 (43.93%)	47 (43.93%)	13 (12.15%)	107 (100%)
BMW*				
Has no own income	17 (62.96%)	9 (33.33%)	1 (3.7%)	27 (100%)
Up to 1 BMW	18 (72%)	6 (24%)	1 (4%)	25 (100%)
From 1 to 3 BMW	42 (45.65%)	41 (44.57%)	9 (9.78%)	92 (100%)
From 3 to 6 BMW	25 (43.1%)	24 (41.38%)	9 (15.52%)	58 (100%)
From 6 to 9 BMW	9 (52.94%)	7 (41.18%)	1 (5.88%)	17 (100%)
From 9 to 12 BMW	1 (25%)	3 (75%)	0 (0%)	4 (100%)
>12 BMW	3 (33.33%)	5 (55.56%)	1 (11.11%)	9 (100%)
Did not inform	2 (100%)	0 (0%)	0 (0%)	2 (100%)

*BMW: Brazilian Minimum Wage

With regard to the profile of cycling, 50% of the cyclists reported owning their own bicycles; 38.5% (90/234) of the participants use their bicycles for more than one reason; and the most prevalent single use was for leisure and sport 17.5% (41/234). Only 14.5% (34/234) of respondents ride a bicycle every day; 50.8% cycle 1-3 days per week; and 34.6% ride 4-6 days per week. This use frequently occurs both on weekdays and at weekends (67.5%; 158/234). Use of a rental bicycle is more associated with shorter destinations (1-5 km) (32/49) than longer destinations (16-20 km and > 20 km). A total of 90.05% (212/234) of the participants stated that weather conditions influence their bicycle use, especially rain (67.4%; 143/212). Concerning the region of the city where participants typically use a bicycle, 90.2% (211/234) responded that they only ride in the urban area of the municipality (Table 2).

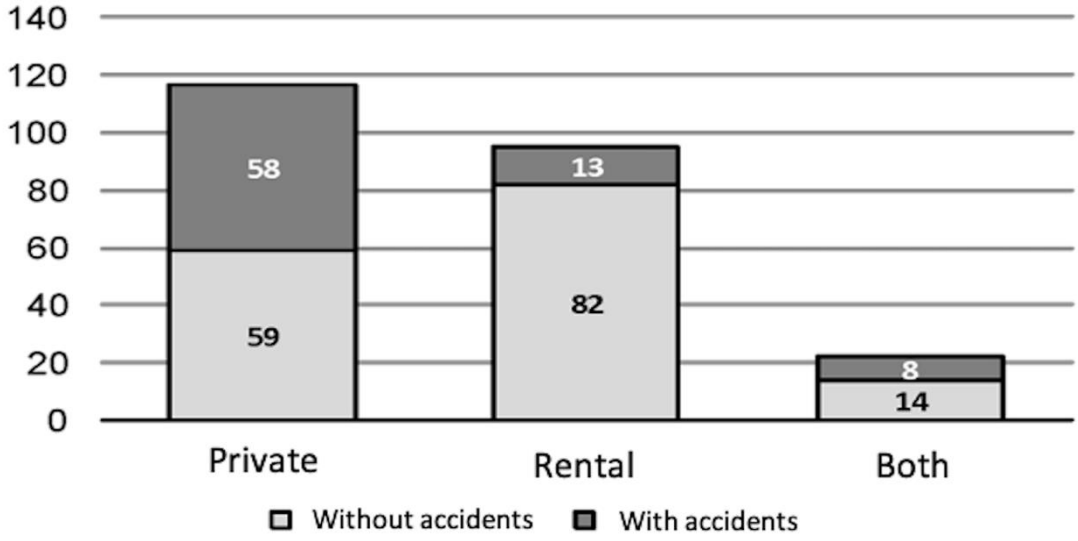
Table 2 – Data regarding the use of bicycles by research participants, considering the type of origin of the bicycle.

	Bicycle Origin			
	Own (n=117)	Rent (n=95)	Both (n=22)	Total (n=234)
Reason for using the bicycle				
Only for recreation	30 (25.64%)	50 (52.63%)	4 (18.18%)	84 (35.9%)
Only for sport	4 (3.42%)	4 (3.16%)	2 (9.09%)	9 (3.85%)
Only as a means of transportation	17 (14.53%)	9 (9.47%)	1 (4.55%)	27 (11.54%)
Only for work	1 (0.85%)	2 (2.11%)	0 (0%)	3 (1.28%)
Two of the reasons mentioned	38 (32.48%)	25 (26.32%)	9 (40.91%)	72 (30.77%)
Three of the reasons mentioned	18 (15.38%)	5 (5.26%)	5 (22.73%)	28 (11.97%)
All reasons	9 (7.69%)	0 (0%)	1 (4.55%)	10 (4.27%)
Number of days used per week				
1 to 3 days	45 (38.46%)	64 (67.37%)	10 (45.45%)	119 (50.85%)
4 to 6 days	46 (39.32%)	26 (27.37%)	9 (40.91%)	81 (34.62%)
Everyday	26 (22.22%)	5 (5.26%)	3 (13.64%)	34 (14.53%)
Time of the week				
Only during the week	12 (10.26%)	20 (21.05%)	3 (13.64%)	35 (14.96%)
Only during the weekend	10 (8.55%)	28 (29.47%)	2 (9.09%)	40 (17.09%)
During the week and the weekend	95 (81.20%)	46 (48.42%)	17 (77.27%)	158 (67.52%)
Did not inform	0 (0%)	1 (1.05%)	0 (0%)	1 (0.43%)
Travelled distance				
1-5 km	13 (11.11%)	32 (33.68%)	4 (18.18%)	49 (20.94%)
6-10 km	21 (17.95%)	31 (32.63%)	7 (31.82%)	59 (25.21%)
11-15km	16 (13.68%)	21 (22.11%)	1 (4.55%)	38 (16.24%)
16-20 km	20 (17.09%)	4 (4.21%)	6 (27.27%)	30 (12.82%)
>20 km	34 (29.06%)	0 (0%)	4 (18.18%)	38 (16.24%)
Did not inform	13 (11.11%)	7 (7.37%)	0 (0%)	20 (8.55%)
Shift you use				
Morning	2 (1.71%)	5 (5.26%)	0 (0%)	7 (2.99%)
Evening	30 (25.64%)	37 (38.95%)	3 (13.64%)	70 (29.91%)
Night	3 (2.56%)	4 (4.21%)	1 (4.55%)	8 (3.42%)
In two shifts	47 (40.17%)	41 (43.16%)	17 (77.27%)	105 (44.87%)
In all shifts	35 (29.91%)	8 (8.42%)	1(4.55%)	44 (18.8%)
Influence of weather condition				
Yes	101 (86.32%)	90 (94.74%)	21 (95.45%)	212 (90.6%)
Rain	71 (60.68%)	59 (62.11%)	13 (59.09%)	143 (61.11%)
Cold	0 (0%)	1 (1.05%)	0 (0%)	1 (0.43%)
Heat	3 (2.56%)	3 (3.16%)	0 (0%)	6 (2.56%)
More than one	20 (17.09%)	18 (18.95%)	5 (22.73%)	43 (18.38%)
All	7 (5.98%)	9 (9.47%)	3 (13.64%)	19 (8.12%)
No	16 (13.68%)	5 (5.26%)	1 (4.55%)	22 (9.40%)
In which region of the city do you use it?				
Urban area	98 (83.76%)	93 (97.89%)	20 (90.91%)	211 (90.17%)
Periurban area	1 (0.85%)	0 (0%)	0 (0%)	1 (0.43%)
Rural area	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Urban area + Periurban area	7 (5.98%)	2 (2.11%)	0 (0%)	9 (3.85%)
Urban area + Rural area	5 (4.27%)	0 (0%)	1 (4.55%)	6 (2.56%)
All	6 (5.13%)	0 (0%)	1 (4.55%)	7 (2.99%)

When the occurrence of accidents associated with bicycles was evaluated, 33.7% (79/234) of users stated that they had already suffered some type of accident. Most of the accidents involved cyclists riding their own bicycles (73.4%; 58/79).

Accidents with app/rental bicycles accounted for 16.4% (13/79) of the accidents reported. (Figure 1).

Figure 1 – Self-report of the occurrence of accidents associated with the use of bicycles and the search for medical and dental care in a subpopulation of the city of Porto Alegre (RS).



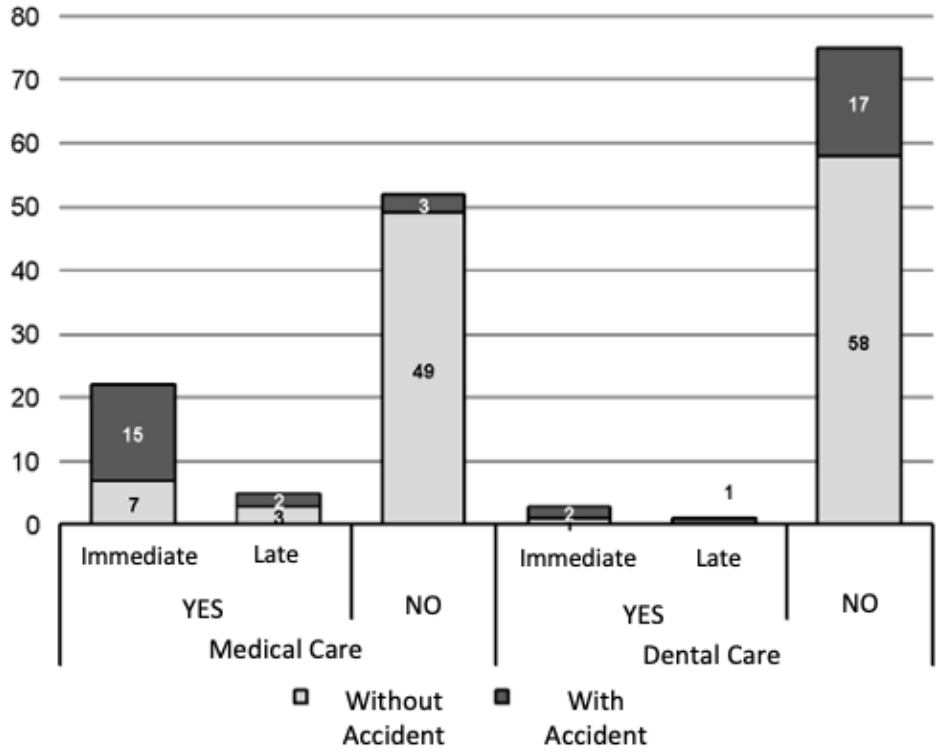
The most frequent type of bicycle accidents was being hit by a vehicle (35.5%; 28/79), followed by 26.6% of accidents caused by losing balance (21/79). In 22.7% of the cases, the cyclist was wearing earphones at the time of the accident (18/79). Of the total number of participants who had had accidents, 25.3% (20/79) had suffered an injury of any part of the body. The body regions most affected we upper and lower limbs (8/20). Trauma/fractures were in a single (10/20) or combined (9/20) location in the body. There were 4/20 reports for dental trauma. These data are shown in Table 3.

Table 3 – Characteristics of the event reported by study participants who had an accident while using a bicycle (n=79).

	No Injury (n=59)	Injury (n=20)	Total (n=79)
Alcohol intake			
Yes	4 (6.78%)	1 (5%)	5 (6.33%)
No	55 (93.22%)	19 (95%)	74 (93.67%)
Using cell phone			
Yes	2 (3.39%)	0 (0%)	2 (2.53%)
No	57 (96.61%)	20 (100%)	77 (97.47%)
Using earphone			
Yes	15 (25.42%)	3 (15%)	18 (22.78%)
No	43 (72.88%)	16 (80%)	59 (74.68%)
Did not inform	1 (1.69%)	1 (5%)	2 (2.53%)
How long?			
Up to 6 months	16 (27.12%)	2 (10%)	18 (22.78%)
From 7 months to 1 year	9 (15.25%)	2 (10%)	11 (13.92%)
More than 1 year ago	17 (28.81%)	14 (70%)	31 (39.24%)
Did not inform	16 (27.12%)	3 (15%)	19 (24.05%)
Affected body region			
Head	3 (5.08%)	2 (10%)	5 (6.33%)
Face	1 (1.69%)	0 (0%)	1 (1.27%)
Mouth	0 (0%)	2 (10%)	2 (2.53%)
Upper limbs	9 (15.25%)	4 (20%)	13 (16.46%)
Lower limbs	21 (35.59%)	4 (20%)	25 (31.65%)
Head + face	1 (1.69%)	0 (0%)	1 (1.27%)
Head + upper limbs	1 (1.69%)	0 (0%)	1 (1.27%)
Head + lower limbs	3 (5.08%)	0 (0%)	3 (3.8%)
Face + mouth	1 (1.69%)	0 (0%)	1 (1.27%)
Upper and lower limbs	10 (16.95%)	3 (15%)	13 (16.46%)
Head + face + mouth	0 (0%)	1 (5%)	1 (1.27%)
Head + upper limbs + lower limbs	4 (6.78%)	1 (5%)	5 (6.33%)
Face + upper and lower limbs	1 (1.69%)	0 (0%)	1 (1.27%)
Head + face + mouth + upper limbs	0 (0%)	1 (5%)	1 (1.27%)
All	0 (0%)	1 (5%)	1 (1.27%)
Other	2 (3.39%)	1 5%)	3 (3.8%)
Did not inform	2 (3.39%)	0 (0%)	2 (12.53%)
There was trauma/fractures?			
Yes	-	20 (100%)	
Face	-	1 (5%)	-
Teeth	-	3 (15%)	-
Arm	-	2 (10%)	-
Leg	-	4 (20%)	-
Face + Arm	-	7 (35%)	-
Teeth + Arm	-	1 (5%)	-
Arm + Leg	-	1 (5%)	-
Other	-	1 (5%)	-
No	59 (100%)	-	-

A total of 27/79 of the participants reported attending medical services seeking care and 22/27 received care immediately. Only 4/79 users reported receiving dental treatment. Three out of four had received dental treatment immediately and the same respondents also suffered tooth traumas/fractures. (Figure 2).

Figure 2 – Medical and dental care after trauma situations associated with bicycle use.



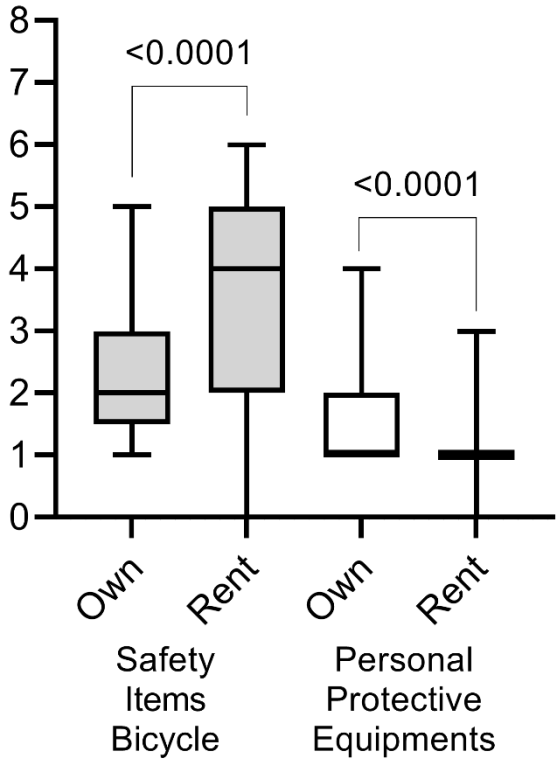
The interviewer observed which safety items were fitted to the bicycles and worn by the participants, as shown in Table 4. App/rental bikes had more items of safety equipment fitted than bikes ridden by their owners.

Table 4 – Mandatory safety equipment present on the bicycle and used by the driver.

	Bicycle Origin			
	Own	Rent	Both	Total
Bicycle				
Bell	45 (28.84%)	80 (51.28%)	31 (19.87%)	156 (100%)
Pedal signaling	71 (43.03%)	62 (37.57%)	32 (19.39%)	165 (100%)
Left rearview mirror	8 (9.41%)	58 (68.23%)	19 (22.35%)	85 (100%)
Rear night signaling	86 (48.86%)	60 (34.09%)	30 (17.04%)	176 (100%)
Front night signaling	63 (39.87%)	66 (41.77%)	29 (18.35%)	158 (100%)
Side night signaling	2 (13.33%)	11 (73.33%)	2 (13.33%)	15 (100%)
None	12 (70.58%)	3 (17.64%)	2 (11.76%)	17 (100%)
Did not inform	0 (0%)	1 (100%)	0 (0%)	1 (100%)
Participant				
Yes	73 (73.73%)	14 (14.14%)	12 (12.12%)	99 (100%)
Only Helmet	27 (79.41%)	5 (14.7%)	2 (5.88%)	34 (100%)
Only Glasses	2 (28.57%)	4 (57.14%)	1 (14.28%)	7 (100%)
Only clothing with signage	0	0	0	0
Only flashlight/headlight	1 (33.33%)	1 (33.33%)	1 (33.33%)	3 (100%)
Helmet + glasses	9 (81.81%)	1 (9.09%)	1 (9.09%)	11 (100%)
Helmet + clothing with signage	2 (100%)	0 (0%)	0 (0%)	2 (100%)
Helmet + flashlight/headlight	6 (66.66%)	1 (11.11%)	2 (22.22%)	9 (100%)
Glasses + flashlight/headlight	1 (50%)	1 (50%)	0 (0%)	2 (100%)
Clothing with signage + flashlight	0 (0%)	0 (0%)	1 (100%)	1 (100%)
Helmet + glasses + clothing with signage	4 (80%)	1 (20%)	0 (0%)	5 (100%)
Helmet + glasses + flashlight	9 (90%)	0 (0%)	1 (10%)	10 (100%)
Helmet + clothing with signage + flashlight	5 (100%)	0 (0%)	0 (0%)	5 (100%)
Helmet + glasses + clothing with signage + flashlight	5 (71.42%)	0 (0%)	2 (28.57%)	7 (100%)
No	44 (32.59%)	81 (60%)	10 (7.4%)	135 (100%)

The median for the number of safety devices for groups “own” and “rent” are 2 (min=1; max=5) and 4 (min=0; max=6). The median for the number of personal protective equipment in the group “own” and “rent” are 1 (min=1; max=4) and 4 (min=0; max=3). More safety items were observed on rented bicycles than on owned bikes (Student's *t* test, P <0.0001). Participants who owned a bicycle tended to wear more personal protective equipment than those riding rented bicycles (Student's *t* test, P <0.0001). (Figure 3)

Figure 3 – Median and quartiles for the number of safety devices and personal protective equipment between the groups (Own *vs*. Rent). (Student's *t* test, P<.0001)



DISCUSSION

Few studies in Brazil address traffic accidents involving bicycles and their orofacial repercussions. Additionally, there is also a tendency to underreport data referring to accidents involving cyclists, especially those in where they did not attend emergency services[13]. The present study assessed the profile and the occurrence of accidents and dental trauma involving bicycles in a city located in southern Brazil. The source of the bicycle (cyclist's own or rented) and presence or absence of safety devices and personal protective equipment were considered in the analysis.

The methodology used was a quantitative analysis based on a survey conducted with a questionnaire with closed questions. It is assumed that this methodology facilitates capture and tabulation of data and the speed with which results are obtained. It is initiated by a direct approach to the participant, making participation in the survey easier. However, it can also be subject to limitations, such as difficulty with interpretation of questions, respondents who are in a hurry, or even dishonesty when answering the questionnaire, which can be detrimental to the results.

Sometimes, a participant may not understand the question and feel embarrassed to ask the researcher to explain. Additionally, it is also subject to recall bias, which is when participants forget essential information about events that have happened after a certain period has elapsed.

Regarding the profile of cyclists in the city where the study was carried out, most were male (62.8%), had a higher education level (45.7%), and reported incomes equivalent to 1 to times the 3 minimum wage (39.3%). This information is in agreement with the findings of other studies available in the literature. One study reports that 85% of bicycle users are male and a large part of its sample had similar incomes to the present study[5]. In another study, the bicycle was the most used means of transport by men (27%), followed by automobiles (24%) and busses (19.9%). Women were more likely to use a bus (49%) or walk (21%) than to cycle (6%)[1]. It should be noted that the present study was conducted with an urban population that uses bicycles more for leisure than for work. In Sweden, on average, 11% of trips are made by bicycle. Trips for work or school make up a higher percentage, between 14 and 15%. The frequency of cycling in Sweden is also high, compared, for example, to the United States, the UK, or France, but it is lower than in Denmark or the Netherlands[15].

Brazil's Institute for Applied Economic Research (IPEA)[16] has reported that there are nearly 50 million bicycles in Brazil, surpassing cars. However, when calculated as a proportion of means of transportation, bicycles only account for 7%. In early 2019, an average of 6.5 trips per day were made per bicycle rented via app in the city where this study was conducted. The number of shared bicycle users has been growing every year. According to data from the manager of the rental service in the city studied, the number of new users grew by 48% from 2013 to 2018. This figure is higher than the average for European cities such as Barcelona and Paris[17].

Wearing personal protective equipment and having safety devices fitted to the bicycle can reduce the severity of bicycle-related accidents[18]. In the literature, some studies show low adherence to personal protective equipment by cyclists and a lack of mandatory equipment on bicycles. Sousa et al.[19] reported that only 0.3% of bicycles inspected in Brazilian capitals had all items of mandatory safety equipment, while 14% had none at all. Bacchieri et al.[1] evaluated the determinants and patterns of bicycle use and of traffic accidents suffered by working cyclists. One of its results was that the researchers found that less than 1% of bicycles had mandatory safety equipment and about 15% did not even have brakes. In the present study, data were similar to those

reported in previous studies. Bicycles rented through apps seemed safer for users because they had a significantly higher number of safety items fitted, preventing accidents. However, users who own their bicycles are better protected when accidents do occur because they tend to wear significantly more personal protective items than those who rent bicycles. Thus, users of shared bicycles should be encouraged to wear more personal protective equipment and owners of private bicycles should be encouraged to fit more mandatory safety items.

Adherence to use of personal protective equipment is also low in other countries. A retrospective study in Poland indicated that 71.3% of respondents did not always wear a helmet. Women stated that they did not always wear headgear. According to the study, one of the risk factors for bicycle-related accidents was the frequency of use of personal protective equipment[20]. Ding et al.[21] indicated that bicycle crash frequency is positively correlated to road density, commercial area, the proportion of elderly, male, and Caucasian cyclists, and the cyclists' median household income. These authors suggested that development of bicycle infrastructures, traffic management, control, education, and enforcement strategies can enhance the safety awareness of cyclists and reduce their crash risk in the long run.

According to the Brazilian Transport Planning Company (GEIPOT)[22], the increase in the number of accidents in Brazilian cities may be related to insufficient cycling infrastructure and the low awareness of motor vehicle drivers regarding the presence of cyclists on public roads. Bicycle accidents are also reported in European countries. Meredith et al.[23] analyzed cycling accidents that led to fractures through a detailed evaluation of data on the accident scenario and the outcome in Sweden. From 1960 fractured people, 15.4% were cyclists. Collisions with a car were the most common cause of impact (58.5%) and occurred in urban environments (88.9%) and on urban roads (62.6%). Incidents with a single bicycle and collisions with another bicycle were significantly less likely to result in a high-impact fracture than a collision with a car. These results may offer insights for prioritizing new campaigns or regulations for cyclist safety.

According to the literature, bicycle accidents are among the main etiological factor in dental trauma. Mesquita et al.[4] evaluated cases of dental avulsion at a public dental trauma service and found that the causes of 32% of avulsions were related to cycling accidents. Amadori et al.[24] indicated that bicycle accidents accounted for approximately 37% of trauma cases in patients aged 0 to 18 years old. Besides dental

trauma, the most affected facial regions were the mandible, the maxilla, and the zygomatic bone. Additionally, the prognosis of traumatic injuries to teeth depends on first aid and the time elapsed between the accident and dental care[10]. In situations of dental avulsion, only 8% of cases had their teeth correctly stored until the time at which dental care was provided. It is crucial to implement public policies to publicize the issue and raise awareness among the population about the specific causes of dental trauma events[5].

With regard to the number of dental injuries associated with cycling accidents, it was found that 20% of the participants who reported having suffered a trauma to some region of the body had suffered injuries involving dental and supporting structures (4/20). These data are very similar to those of other studies =found in the literature. Makara et al.[25] observed the characteristics of injuries sustained in cycling accidents in Ohio (United States of America) using police accident reports and hospital databases. Six thousand, four-hundred and fifty-one cyclists were involved in accidents between 2013 and 2017, with 26.8% sustaining injuries to the head, face, and neck region. Lima Júnior et al.[7] evaluated the prevalence of facial trauma in accidents between cyclists and motorcyclists in Piracicaba (Brazil) at a university Oral and Maxillofacial Surgery service. Dental trauma was present in 50/556 patients, equating to approximately 10% of the total number of accidents and 20% of facial trauma cases. In the present study, dental trauma associated with cycling was reported by 0.17% of the participants. The low frequency of dental injuries associated with cycling in the present study may be due to the age of the participants, since the inclusion criteria included participant age over 18 years. Gulinelli et al.[26] indicated that 48.1% of patients who suffered dental traumas were 1-15 years old. Moreover, Díaz et al.[27] reported that 43% of patients treated at an emergency service in Chile who had suffered dental trauma were aged 1-15 years. Traumas associated with bicycles accounted for 15.6% of the cases.

The literature also describes other factors involved in cycling accidents. Carvajal et al.[28] evaluated bicycle safety in Bogotá and their results showed that roads with poor traffic conditions were associated with a higher risk of fatal accidents involving cyclists. Hosseinpour et al.[29] evaluated self-reported injuries in Denmark, comparing single and multiparty bicycle crashes. A total of 81% of single bicycle crashes and 83.1% of multiparty accidents involved cyclists commuting from/to work/education because they are exposed daily and cycle frequently. A study in the United Kingdom also found that

cycling to work was associated with a higher risk of accidents than commuting by a non-active mode (car or public transport). However, individuals who cycled to work had lower risk of cardiovascular disease, cancer, and death. For the authors, the risks must be considered in favor of the health benefits of active commuting by bicycle, emphasizing the need for safer infrastructure for cycling[30].

Some measures can be employed to increase prevention and reduce the risks and severity of accidents involving cyclists. In Canada and the US, helmet use among bicycle users averages 60%. In some European countries, wearing a helmet is mandatory by law[24]. This safety measure helps to reduce the risk of facial injuries by 65%. Hwang et al.[31] indicated that wearing helmets reduced the risk of facial injuries among cyclists by 40%. However, it does not significantly reduce the risk of dental trauma due to the lack of protection for the lower part of the face, which could be achieved with mouth-guards or face protection[24].

Investment in urban mobility with expansion of cycling infrastructure could reduce the number of accidents. Construction of new bicycle lanes would reduce competition for space between cars and bicycles, consequently reducing users' exposure to accidents[32]. Reynolds et al.[33] reviewed literature on how different types of transport infrastructure affected cyclists' safety and concluded that bicycle lanes reduce the risk of accidents and injuries compared to using bicycles on the road with traffic or off-road with pedestrians. The main advantage of investing in infrastructure modifications is that it achieves injury prevention for the entire population, without depending only on the behavior of users. Additionally, strategies must focus on education. The São Paulo Transit Engineering Company created a booklet for bicycle users, presenting rules and good practices to achieve healthy, harmonious, and safe coexistence in cycling[34]. Government, universities, and civil society should all contribute to informative content for cyclists. Producing and publicizing guidelines on correct conduct and first aid in dental trauma events should positively help patient prognosis and reduce healthcare expenditure.

CONCLUSION

Dental trauma was not frequent in a population predominantly from an urban area that uses bicycles, especially for leisure, despite the prevalence of accidents involving bicycles. Health education campaigns must emphasize the importance of

personal protective equipment for cyclists and of safety items fitted to bicycles, whether they are the cyclists' own or rented.

ACKNOWLEDGMENT

The authors would like to thank all the voluntary participants. The authors have no affiliations or sources of financial support to declare.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

REFERENCES

1. Bacchieri G, Gigante DP, Assunção MC. Determinants and patterns of bicycle use and traffic accidents among bicycling workers in Pelotas, Rio Grande do Sul, Brazil. Cad Saúde Pública. 2005 out;21(5):1499-508. doi: 10.1590/S0102-311X2005000500023.

2. Bacchieri G, Barros AJD, Santos JV dos, Gonçalves H, Gigante DP. A community intervention to prevent traffic accidents among bicycle commuters. Rev Saude Publica. 2010 Oct;44(5):867–75. doi: 10.1590/s0034-89102010000500012.

3. Garcia LP, Freitas LRS de, Duarte EC, Garcia LP, Freitas LRS de, Duarte EC. Deaths of bicycle riders in Brazil: characteristics and trends during the period of 2000-2010. Revista Brasileira de Epidemiologia. 2013 Dec;16(4):918–29. doi: 10.1590/s1415-790x2013000400012.

4. Mesquita GC, Soares PBF, Moura CCG, Roscoe MG, Paiva SM, Soares CJ. A 12-year retrospective study of avulsion cases in a public brazilian dental trauma service. Braz Dent J. 2017 Dec;28(6):749–56. doi: 10.1590/0103-6440201701610.

5. Castañon U, Castañon JAB, Santos MPS. The profile of cyclists in the city of Juiz de Fora. Work. 2012;41 Suppl 1:5866–70. doi: 10.3233/WOR-2012-0977-5866.

6. Hwang MJ, Dillon JK, Dodson TB. Helmets decrease risk of bicyclist-related maxillofacial injuries but not severity. J Oral Maxillofac Surg. 2019 Oct;77(10):2055–63. doi: 10.1016/j.joms.2019.04.018.

7. Lima Júnior SM, Santos SE, Kluppel LE, Asprino L, Moreira RWF, de Moraes M. A comparison of motorcycle and bicycle accidents in oral and maxillofacial trauma. J Oral Maxillofac Surg. 2012 Mar;70(3):577–83. doi: 10.1016/j.joms.2011.03.035.

8. Andreasen JO, Andreasen FM, Andersson L. Textbook and color atlas of traumatic injuries to the teeth. 4th ed. Wiley-Blackwell; 2007.

9. Sanabe SM, Cavalcante LB, Coldebella CR, De Abreu e Lima FCB. Dental traumatism urgencies: classification, signs and procedures. Rev. Paul. Pediatr. 2009 Feb;27(4):447-51. doi: 10.1590/S0103-05822009000400015.

10. Andersson L, Andreasen JO, Day P, Heithersay G, Trope M, Diangelis AJ, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. Dent Traumatol. 2012 Apr;28(2):88–96. doi: 10.1111/j.1600-9657.2012.01125.x.

11. Marchiori EC, Santos SE, Asprino L, de Moraes M, Moreira RWF. Occurrence of dental avulsion and associated injuries in patients with facial trauma over a 9-year period. Oral Maxillofac Surg. 2013 June;17(2):119–26. doi: 10.1007/s10006-012-0354-5.

12. Sousa CAM de, Bahia CA, Constantino P. Analysis of factors associated with traffic accidents of cyclists attended in Brazilian state capitals. Ciência & Saúde Coletiva. 2016 Dec;21(12):3683–90. doi: 10.1590/1413-812320152112.24152016.

13. Barros AJD, Amaral RL, Oliveira MSB, Lima SC, Gonçalves EV. Acidentes de trânsito com vítimas: sub-registro, caracterização e letalidade. Cadernos de Saúde Pública. 2003 ago;19(4):979–86. doi: 10.1590/S0102-311X2003000400021.

14. Ferreira MC, Batista AM, Marques LS, Ferreira F de O, Medeiros-Filho JB, Ramos-Jorge ML. Retrospective evaluation of tooth injuries and associated factors at a hospital emergency ward. BMC Oral Health 2015;15:1-6. doi: 10.1186/s12903-015-0125-4.

15. Bergström A, Magnusson R. Potential of transferring car trips to bicycle during winter. Transp. Res. A 2003 Jan;37(8):649-66. doi: 10.1016/S0965-8564(03)00012-0.

16. Ipea. [Internet]. Brasil; 2017. Cidades cicláveis: avanços e desafios das políticas cicloviárias no Brasil [cited 2019 nov 21]. Available from: http://www.ipea.gov.br/portal/index.php?option=com_content&view=article&id=29531:td-2276-cidades-ciclaveis-avancos-e-desafios-das-politicas-cicloviarias-no-brasil&catid=397:2017&directory=1.

17. WRI Brasil [Internet]. Porto Alegre; 2019. A evolução das bicicletas compartilhadas e seus benefícios para a mobilidade. [cited 2019 nov 21]. Available from: https://wribrasil.org.br/pt/blog/2019/01/evolucao-das-bicicletas-compartilhadas-e-seus-beneficios-para-mobilidade.

18. Brasil. Lei no 9.503, de 23 de setembro de 1997. Institui o Código de Trânsito Brasileiro. [cited 2019 nov 21]. Available from: http://www.planalto.gov.br/ccivil_03/leis/l9503.htm.

19. Sousa CAM de, Bahia CA, Constantino P. Analysis of factors associated with traffic accidents of cyclists attended in Brazilian state capitals. Ciência & Saúde Coletiva. 2016 Dec;21(12):3683–90. doi: 10.1590/1413-812320152112.24152016.

20. Bogusiak K, Pyfel M, Puch A, Kopertowska M, Werfel D, Neskoromna-Jędrzejczak A. Characteristics and risk factors of bike-related accidents: Preliminary analysis. Adv Clin Exp Med. 2018 April;27(10):1403–9. doi: 10.17219/acem/70695.

21. Ding H, Sze NN, Li H, Guo Y. Roles of infrastructure and land use in bicycle crash exposure and frequency: a case study using greater London bike sharing data. Accid Anal Prev. 2020 Sep;144:105652. doi: 10.1016/j.aap.2020.105652.

22. Ciclocidade: Associação dos Ciclistas Urbanos de São Paulo[Internet]. São Paulo; 2014. Planejamento cicloviário: diagnóstico nacional: GEIPOT. [cited 2019 nov 21]. Available from: https://www.ciclocidade.org.br/biblioteca/file/47-planejamento-cicloviario-diagnostico-nacional-geipot.

23. Meredith L, Kovaceva J, Bálint A. Mapping fractures from traffic accidents in Sweden: how do cyclists compare to other road users? Traffic Inj Prev. 2020;21(3):209-14. doi: 10.1080/15389588.2020.1724979.

24. Amadori F, Bardellini E, Copeta A, Conti G, Villa V, Majorana A. Dental trauma and bicycle safety: a report in Italian children and adolescents. Acta Odontol Scand. 2017 Apr;75(3):227-31. doi: 10.1080/00016357.2017.1279345.

25. Makara J, Shen S, Nwosu A, Arnold W, Smith G, Zhu M. A cross-sectional study of characteristics of bicyclist upper and lower extremity injuries in bicycle-vehicle crashes in Ohio, United States, 2013-2017. BMC Public Health. 2021 Mar 2;21(1):428. doi: 10.1186/s12889-021-10452-1.

26. Gulinelli JL, Saito CTMH, Garcia-Júnior IR, Panzarini SR, Poi WR, Sonoda CK, et al. Occurrence of tooth injuries in patients treated in hospital environment in the region of Araçatuba, Brazil during a 6-year period. Dent Traumatol. 2008 Dec;24(6):640-4. doi: 10.1111/j.1600-9657.2008.00673.x.

27. Díaz JA, Bustos L, Brandt AC, Fernández BE. Dental injuries among children and adolescents aged 1-15 years attending to public hospital in Temuco, Chile. Dent Traumatol. 2010; June;26(3):254–61. doi: 10.1111/j.1600-9657.2010.00878.x.

28. Carvajal GA, Sarmiento OL, Medaglia AL, Cabrales S, Rodríguez DA, Quistberg DA, et al. Bicycle safety in Bogotá: a seven-year analysis of

bicyclists' collisions and fatalities. Accid Anal Prev. 2020 Sep;144:105596. doi: 10.1016/j.aap.2020.105596.

29. Hosseinpour M, Madsen TKO, Olesen AV, Lahrmann H. An in-depth analysis of self-reported cycling injuries in single and multiparty bicycle crashes in Denmark. J Safety Res. 2021 Jun;77:114-24. doi: 10.1016/j.jsr.2021.02.009.

30. Welsh C, Celis-Morales CA, Ho F, Lyall DM, Mackay D, Ferguson L, et al. Association of injury related hospital admissions with commuting by bicycle in the UK: prospective population based study. BMJ 2020 Jan;368:m336. doi: 10.1136/bmj.m336.

31. Hwang MJ, Dillon JK, Dodson TB. Helmets decrease risk of bicyclist-related maxillofacial injuries but not severity. J Oral Maxillofac Surg. 2019 Oct;77(10):2055-63. doi: 10.1016/j.joms.2019.04.018.

32. Benedini DJ. Bicicletas próprias e compartilhadas na cidade de São Paulo: perfil dos usuários e características das viagens. [tese]. São Paulo: Universidade de São Paulo; 2018.

33. Reynolds CC, Harris MA, Teschke K, Cripton PA, Winters M. The impact of transportation infrastructure on bicycling injuries and crashes: a review of the literature. Environ Health. 2009 Oct 21;8:47. doi: 10.1186/1476-069X-8-47.

34. CET [Internet]. São Paulo; 2019. Companhia de Engenharia de Trafego: Segurança e Mobilidade. [cited 2019 nov 21]. Available from: http://www.cetsp.com.br/consultas/seguranca-e-mobilidade/cartilha-do-pedestre.aspx.