SUPTM 2026: 3rd Conference on Future Challenges in Sustainable Urban Planning & Territorial Management

Universidad Politécnica de Cartagena

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Proceedings

Cycling perception in urban mobility: how low bicycle infrastructure contributes to reducing sustainable transport use

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Abstract: Active and sustainable transport modes are discouraged due to unsafe infrastructure. With the purpose of investigate the reasons why this phenomenon occurs, we applied a questionnaire asking cyclists how they feel regarding safety during urban cycling. Our study was developed in the city of Suzano, Brazil. The results reveal that only one-fourth of respondents use bicycles for urban mobility. Moreover, there is a significant difference between gender and bicycle usage (X^2 = 7.55, $p < 0.05$). Most participants reported travel time above 60 minutes, and a significant difference was observed among transport ways (X^2 = 28.45, $p < 0.05$). Participants who did not report cycling argue that they do not feel safe and/or dislike cycling activity.

Keywords: cycling; active mobility; public transport; infrastructure issues.

Citation: Santos, L.; Santos, A.; Reis, J.G.; Silva, A.; Oliveira, R.; Machado, S.T. Cycling perception in urban mobility: how low bicycle infrastructure contributes to reducing sustainable transport use. *SUPTM 2026 conference proceedings* xx. https://doi.org/ 10.31428/xxxxx

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1. Introduction

Inefficient infrastructure to ride bicycles is by far the most important issue to promote active mobility in cities due to provoke traffic unsafety. Data from the World Health Organization shows that 1.2 million people die in traffic accidents annually and between 20 and 50 million suffer some type of injury, as well as, about 90% of traffic fatalities occur in developing countries, which have only 48% of the world's vehicle fleet (1). A healthy and sustainable solution to traffic unsafety is to promote the use of active mobility and public transportation because the individual motorized vehicles is the main cause of accidents in roads. In the specific case of bicycle riding, it is hard to implement and motiving people to use it, in a short distance, when city infrastructure does not provide safety or does not exist.

On the other hand, bike-friendly cities such as Santos, Brazil, the adoption of active mobility is a reality for population that include bicycles in their daily routine travels. According to the Santos government, its citizens have 58 km of bike paths connecting the different regions of the city. In addition, there is sharing biking stations, resting areas and places to repairs (fixed tool kits). People who do not have an own bicycle could use the sharing program for free for 45 minutes or could (2; 3).

This paper aims to investigate the perception of Suzano/SP urban community about using bicycle as a transport mode and city infrastructure to cycling.

2. Area of study

Inefficient planning and management in cities promote hard competition among drivers on road and does not favor public transport or active mobility modes. According

to Stevenson et al. (4) the expansion of metropolitan area is one the major international challenge due the consequences of changing population demographics and inefficient policies to deal with management of land use, mobility and population health.

Public transport and active modes are established as complementary structures for those who cannot afford their own car or for some reason decide not to have one. The governments tried to encourage practice of active mobility for short distance (until 8 km) or as a way of to complete commute travels using public transportation. The Stevenson et al. (4) study shows health gains for a modal shift from private motor vehicles to walking, cycling, and public transport in compact cities. An interesting point of view is defended by Pucher et al (5) that demonstrate health benefits of cycling. Using previous scientific studies the authors show that the benefits exceed the risks from traffic, contradicting the perception, that bicycling is a dangerous activity (5). Ride a bicycle in metropolitan area without a dedicated infrastructure to practice cycling put cyclists in a danger condition. According to Departamento Estadual de Trânsito de São Paulo, from January up to March/2025 was accounted for 1,416 death in traffic (4.3%) upper the last year, and this total 288 were pedestrian, 100 cyclists, 625 motocyclits, and 293 drivers (6).

This paper defends that people need change the way to move in metropolitan areas, but it is necessary an infrastructure to promote the traffic safety of different transport modes and connect transport systems to favor the active mobility and public transport use. Previous studies show a positive and statistically significant relationship between bicycle infrastructure and levels of bicycling (5).

3. Methodology

Active modes suffer from the infrastructure quality – irregular and short pavements, and a lack of dedicated bike lanes. To expose this situation and to investigate how cyclists feel regarding safety during urban cycling, we analyze the situation of Suzano city, in the metropolitan area of São Paulo. The research project was submitted and evaluated prior to conducting the survey by Research Ethics Committee of Federal Institute of São Paulo (number: 83988324.3.0000.5473).

3.1. Case-study and data collection

Suzano city has approximately 307,429 inhabitants and the population density of 1,490.67 inhabitants km² (7). Territorial area of Suzano city 206.236 km², and an urbanized area of 56.12 km² (7), which may impact the infrastructure for active mobility, such as the use of bicycles. With 89.7% of the sewage system considered adequate and 75.2% of public roads having trees (7), there is a favorable basis for the implementation of cycle paths and spaces for bicycles. So, to investigate the perception of the Suzano urban community about using bicycles as a transport mode and city infrastructure to cycling, we carried out a structure questionnaire with 20 questions that was planned to collect information about socioeconomic characteristics, transport systems preference and cycling perception in Suzano city infrastructure during December 2024 and January 2025.

3.2. Variables and Data Analysis

Twente variables were analyzed considering the participants group "No cycling" and "Cycling". The socioeconomics characteristics variables were investigated such as gender, age, education level, family income, and city of residence. To investigate the preference for transport systems, the variables were the purpose of using transportation, frequency, main transport mode, travel time, and bicycle usage. Finally, the variables about perception of bicycle usage considered were: the main reason for bicycle adoption or not; frequency; purpose of use of the cycle path; bicycle travel time - the most important factors in the use of the cycle path; physical integration between cycling infrastructure and the transport system; evaluation of the experience of using the cycle path; safety when using

the cycle path; cycle path encourage; and perception of cycling a sustainable mode of transport.

The collected data were tabulated and analyzed through the presentation of graphs, cross-tabulations, and proportionality analysis, seeking to understand the data distribution and identify trends. In addition, the chi-square test was applied to investigate the existence of a significant association between the variables and the participants - who those use or not bicycles as a mode of transportation.

4. Results

Our sample (n = 114) reveals that only one-fourth of respondents use bicycles for urban mobility. Moreover, there is a significant difference between gender and bicycle usage in urban mobility ($X^2 = 7.55$, $p < 0.05$), and no significant difference was observed for age, education, and family income variables ($p > 0.05$), Table 1. These results are corroborated by Garrard et al. (8) that clarified about the differences in cycling by gender what contributes to low rate cycling. The "bicycle usage" group shows an age distribution concentrated in the older range (from 18 up to 35 years) than the "no bicycling usage" group (from 26 up to 45 years). However, when the distribution of the family income variable range, we noted that both groups had a concentration in ranges “up to 2” and “3 – 4", respectively.

Most participants reported that they make daily commutes (58%) to meet their needs for work, study, shopping, leisure, and access to essential services (hospitals, banks, post offices, among others). Therefore, the urban transport system infrastructure is fundamental to guaranteeing the quality of life for people in urban areas. Our results show a significant differences were observed between the main modes of transport indicated by the research participants ($X^2 = 28.45$, $p < 0.05$), with approximately 53.5% indicating the use of public transport as their main mode of transport, 38% car/motorcycle, 7% bicycle, and 1.5% walking.

From this point of view, Garrard et al. (8) investigated the male and female usage of bicycle infrastructure in Melbourne/Australia, and found that of 6,589 cyclists, 5,197 (almost 79%) used the cycling infrastructure, against 21% that not use the infrastructure. Similar results were observed in the female sample (8). Of the participants who use bicycles as a mode of transportation, approximately 28% use them to commute to work, 25% for leisure and various outings, from parks to visiting relatives and friends, 23.5% for shopping, 13.5% to access various services such as banks, post offices, and others, and 10% to travel to educational institutions. Considering this sample and the participants' profile, no significant differences were observed in the travel time reported by the participants, which may indicate that time did not interfere with the choice of transportation mode, with approximately 38.5% traveling in around 30 minutes, and 61.5% in more than 30 minutes.

Furthermore, participants who did report that not cycling argue that the main reasons were that they do not feel safe due to the existing infrastructure (28%), they dislike cycling because they get sweaty, sometimes dirty, or wet when it rains (28%), 16% economic reasons (currently bicycles are expensive), 15% declare that they do not know how to ride a bicycle, and 13% not specify.

Regarding the evaluation of Suzano's cycling system by people who do not use bicycles, it was noted that 33% rated it as "Regular," followed by 25% who rated it as "Poor," 21% as "Very Poor," among others. This result was similar to cycle path users. Although users stated that they do not use bicycles as a mode of transport, about 92% consider the bicycle to be a more sustainable mode of transport compared to others, and 93% consider it a healthy mode that contributes to the individual's health conditions.

Table 1. Participant characteristics by group "no bicycling usage" and "bicycling usage"

Variables	No bicycle usage (n=86)		95 % IC	Bicycle usage (n = 28)		95 % IC		
Sex	**n**	**%**	**Lower - Upper**	**n**	**%**	**Lower- Upper**	χ^2	p
Male	22	25.58	17.57 – 33.59	15	53.57	37.27 – 55.58	7.55	0.006
Female	64	74.42	66.41 – 82.43	13	46.43	44.42 – 62.73		
Age (years)								
18-25	26	30.23	21.81 – 38.66	6	21.43	13.89 – 28.96	3.62	0.46
26-35	33	38.37	29.45 – 47.30	8	28.57	20.28 – 36.86		
36-45	18	20.93	13.46 – 28.40	8	28.57	20.28 – 36.86		
46-55	6	6.98	2.30 – 11.65	4	14.29	7.86 – 20.71		
Above 56	3	3.48	0.12 – 6.86	2	7.14	2.42 – 11.87		
Education								
Less than high school	1	1.16	-0.805 – 3.14	-	-		0.48	0.924
High school	43	50.0	40.82 – 59.18	13	46.43	37.27 – 55.58		
College	31	36.05	27.23 – 44.86	11	39.29	30.32 – 48.25		
Posgraduated	11	12.79	6.66 – 18.92	4	14.29	7.86 – 20.71		
Family icome (6 miss.)								
Up to 2	23	28.39	20.12 – 36.67	6	22.22	14.59 – 29.85	6.65	0.156
3-4	37	45.68	36.53 – 54.82	10	37.04	28.17 – 45.90		
5-7	15	18.52	11.39 – 25.65	4	14.81	8.29 – 21.34		
8-9	3	3.70	0.236 – 7.17	3	11.11	5.34 – 16.88		
Above 10	3	3.70	0.236 – 7.17	4	14.81	8.29 – 21.33		

4. Conclusion

This study conclude that safe infrastructure is fundamental to promote cycling. Despite the fact of bicycles to be a mode of transport and cyclists have the right to use sharing roads, only experts' ones feel comfortable to make it in the middle of the traffic. Therefore, any attempt of a city to motivate their citizens to adopt active transportation modes pass for build a reliable and safety cycling infrastructure. The Suzano's study allow us to investigate this phenomenon in an empirical and small scale. However, this study was exploratory, and now, new studies are necessary to investigate how citizen's in other cities feel regarding the need of a safety bike infrastructure.

Conflicts of Interest: "The authors declare no conflict of interest."

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