

CYCLOMOBILITY DEVELOPMENT IN SÃO PAULO CITY: A COMPARISON WITH THE TEN MOST BIKE-FRIENDLY CITIES WORLDWIDE

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Resumo

O uso da bicicleta tem sido incentivado como alternativa sustentável, rápida e barata para a mobilidade das pessoas nos centros urbanos. Porém, sua adoção depende diretamente da infraestrutura disponível, do clima, da segurança, da disponibilidade de equipamentos compartilhados e do incentivo dos governos e da sociedade. Este artigo analisa como São Paulo, a maior cidade da América do Sul com mais de 12 milhões de habitantes, se posiciona em relação às 10 cidades mais cicláveis do mundo. Para tanto, foi realizada uma pesquisa bibliográfica utilizando dados do Índice Global de Cidades para Bicicleta (GBCI) de 2022. Comparamos os 16 indicadores do índice organizados em 6 categorias por meio de estatística descritiva. Os resultados mostram que São Paulo possui clima adequado para o uso da bicicleta como mobilidade urbana, mas apresenta baixo percentual de utilização devido aos maiores riscos de roubos e furtos, infraestrutura precária e falta de estrutura de compartilhamento.

Porém, foram realizados investimentos recentes em infraestrutura e eventos para incentivar a adoção da bicicleta o que está posicionando a cidade na classificação do GBCI, mesmo ainda estando longe do patamar das cidades mais cicláveis do mundo.

Palavras chave: Urban mobility. Active Mobility. Bicycle.

Abstract

Bicycle usage has been encouraged as a sustainable, fast, and cheap alternative for people's mobility in urban centers. However, its adoption depends directly on the available infrastructure, climate, security, availability of sharing equipment, and the incentive of governments and society. This paper analyzes how São Paulo, the largest city in South America with more than 12 million inhabitants, is in relation to the 10 most cyclable cities in the world. To this end, literature research was conducted using data from the 2022 Global Bicycle Cities Index (GBCI). We compared the 16 indicators of the index organized into 6 categories using descriptive statistics. The results show that São Paulo has suitable weather for the use of bicycles as urban mobility, but it has a low percentage of usage due to the higher risks of robberies and thefts, poor infrastructure, and lack of sharing structure. However, recent investments in infrastructure and events to encourage bicycle adoption have been carried out which is positioning the city in the GBCI classification, even though it is still far from the level of the most cyclable cities in the world.

Keywords: Urban mobility. Active Mobility. Bicycle.

1. INTRODUCTION

Economic development is the goal of countries worldwide. However, it provokes the population growth in large urban centers which is a concern in modern society. The reason for this concern is that the concentration reduces the quality of life of the population due to the excess noise, congestion, poor air quality, and high carbon dioxide (CO₂) emissions caused by displacements using engine vehicles, mostly individual use [1]. So how is it possible to find ways to mitigate these effects?

Air quality and mobility in cities have been widely discussed by the United Nations (UN) investigating actions and efforts to mitigate greenhouse gas emissions

(GHC) [1]. Thus, the use of electric vehicles, the adoption of telework, the incentive to public transport, and the use of active mobility have been suggested in order to reduce the effects caused by pollution in the urban population due to daily basis's mobility [2,3,4].

Urban mobility means the way people and goods move in cities comprising public, individual, motorized, or non-motorized transport [5]. By promoting the connection of people, relating cities to their interests and opportunities, such as work, school, entertainment, and health, among others, urban mobility is a fundamental factor for social and economic development [6].

To be considered sustainable, urban mobility needs to happen rationally with minimal impact on the environment. In 2015, the UN Member States published the 2030 Agenda, which included the 17 Sustainable Development Goals – SDDS, which led several member countries to rethink their actions to achieve these objectives, including the reduction in the mortality rate from respiratory diseases caused by CO2 emissions and traffic accidents [2].

In addition to the sustainability issue, the recently faced pandemic by COVID-19 [7] drew attention to cycling as a cheap alternative to promote social distancing and well-being. However, this increase in bicycle use contrasted with a difficult reality of cities, the lack of safe road infrastructure for its use [8].

Despite these developments, there are many complaints about the quality and security of these infrastructures. São Paulo, for example, which has been taking initiatives for almost a decade, has many bike paths on damaged sidewalks, endangering cyclists who may suffer accidents holes in cycle tracks, and lack of respect for the bike path space by pedestrians and motor vehicles, lack of connection between the bike paths, etc. Having precarious oversight and without adequate maintenance, it is difficult to educate pedestrians and drivers [9]. However, initiatives such as the leisure cycle lane and the bike paths established in important regions of the city have had relative success and an increase in users in the city. Shared bikes installed at location points also increase this adoption [10].

The adoption of the bicycle as an expression of a way of life, representing environmental awareness and a great concern for health and quality of life, caused a new term to emerge to evaluate its use: "bicycleability". The term consists of indexes capable of measuring how comfortable a city or urban region is for the cyclist or for the

movement of bicycles, that is, indexes that measure the adequacy and safety offered to bicycle users on their routes/destinations [11].

This idea is not something relatively new. Since 2000, several tools have emerged to evaluate the actions that defend, enable, and praise the use of bicycles as a viable form of transportation, such as the Global Bicycle Cities Index (GBCI) and the Copenhagenize Index [12]. These tools aim to evaluate the various criteria related to the adoption of bicycle use in urban centers.

In this context, the aim of this article is to use one of these tools, the Global Bicycle Cities Index to compare the situation of São Paulo in relation to the 10 most cycling cities in the world. Thus, the results presented by this index are analyzed and discussed considering the current situation of the state capital.

2. METHODOLOGY

To carry out the present study, exploratory bibliographic research was conducted in order to understand the Global Bicycle Cities Index (GBCI) [12] in its parameters, analyzing certain evaluation patterns of the cities that make up the top 10 positions in the ranking comparing with the city of São Paulo, which occupies the 76th position.

From the GBCI, a descriptive statistic was established comparing the indexes presented by the city of São Paulo and the 10 most 'bike-friendly' cities to the use of the bicycle according to the classification given. The GBCI deals with an annual report prepared by the French insurance company LUKO, which ranks the 90 cities with the highest rate of bikeability calculated by a score that is based on statistics presented by the world's cities, that is, that are more bike-friendly in the world [12]. These data are divided into 6 criteria that are presented below:

1. **Weather score:** in this criterion, climatic and meteorological conditions were analyzed using an aggregate score, considering the annual total of hours of sunshine, temperatures below 0° c, or above 30°C;
2. **Percentage of bicycle usage:** percentage of people who use the bicycle in everyday life in each city;
3. **Crime and safety:**
 - a. **Fatalities:** deaths in bicycle accidents (including deaths related to bicycle theft) per 100,000 cyclists in cities, starting from bicycle use rates;

- b. **Accidents:** this is an estimate of accidents involving bicycles that result, at least in minor injuries per 100,000 cyclists;
- c. **Bicycle theft score:** this is the estimated rate of stolen bicycles per 100,000 cyclists, starting from the rate of use or ownership of bicycles;

4. Infrastructure:

- a. **Number of bicycle shops in the city:** the total number of shops in cities per 100,000 cyclists;
- b. **specialized routes and quality of these routes:** route quality score;
- c. **Investment and infrastructure quality:** infrastructure score of the Logistics Performance Index (LPI); and the Economic Forum's Global Competitiveness Index;

5. Sharing

- a. **Sharing stations:** index that considers the number of bike rental and sharing stations per 100,000 inhabitants;
- b. **Shared bikes:** this is an estimate of the fleet of bicycles shared by 100,000 cyclists;
- c. **Sharing score:** indicates the level of bike sharing of each city;

6. Events

- a. **Day without car:** indicates whether the city holds events that encourage the non-use of the individual car;
- b. **Critical mass score:** this is a celebration of cyclists that takes place in more than 300 cities around the world, considering the number of participants of events in the cities;
- c. **Event score:** indicator that scores the capacity of each city to hold events for the adoption of active mobility;

3. RESULTS AND DISCUSSION

Table 1 shows the 10 most 'friendly' cities for the use of bicycles according to GBCI and São Paulo, which occupies the position of number 76 in the same classification. They are classified as small (S) when they have up to 500,000 inhabitants, average (M) when the number of inhabitants is between 500,000 and 999,999, and large (L) when the number of inhabitants is more than 1 million inhabitants.

The GBCI score for the 10 cities was between 46.70 and 77.84 points, a variation of approximately 67%. São Paulo scored 26.81 with a percentage change of approximately 214% in relation to Utrecht and approximately 88% in relation to Hannover. Considering Hangzhou in China, which has a population similar to São Paulo, this variation was approximately 112%. Thus, we can conclude that the city of São Paulo is far from establishing itself as a city friendly to the use of bicycles, even with the investments made in infrastructure over the last decade. However, these advances cannot be discarded.

Table 1. The 10 most bike-friendly cities and the city of São Paulo

Pos	City	Country	Size	Area (km ²)	Population	Score
1 ^o	Utrecht	Holland	P	99.21	330,000	77.84
2 ^o	Munster	Germany	P	302.9	314,319	65.93
3 ^o	Antwerp	Belgium	P	204.51	472,071	60.51
4 ^o	Copenhagen	Denamak	M	179.8	794,000	60.46
5 ^o	Amsterdam	Holland	M	219.3	825,000	60.24
6 ^o	Malmo	Sweedeen	P	76.81	339,313	55.88
7 ^o	Hangzhou	China	G	16,847	10,360,000	52.55
8 ^o	Bern	Suisse	P	51.6	113,115	48.76
9 ^o	Bremen	Germany	M	326.7	569,352	47.81
10 ^o	Hannover	Germany	M	204	535,932	46.70
76 ^o	São Paulo	Germany	G	1,521	12,250,000	24.81

Data adapted from LUKO (2022)

Benedini et al. [13] conducted a survey exploring the profile of cyclists in São Paulo before and after the expansion of the infrastructure dedicated to cycling and their results indicated that this expansion allowed segments of the population, previously underrepresented, to adopt the bicycle as women and individuals from more disadvantaged economic classes.

The cities with the highest score have a planned infrastructure for cycling that ensures support to cyclists, safety, and incentive for daily use of the bike through events and routes according to the needs of users. As highlighted in Table 1, most of the cities

that occupy the top 10 positions are considered small (S) and medium (M) size, with the exception of Hangzhou – in China, which is classified as a large city (L), as well as São Paulo, but has a smaller population per square kilometer.

The fact that São Paulo has a higher population density makes it more challenging to apply a public policy that favors the use of bicycles as a transport modal. At the same time, it becomes a necessary action since the bicycle occupies much less space when compared to motor vehicles that circulate only with the driver in the city of São Paulo. Benedini et al. [13] indicate that travel time and the use of shared bicycles are predictors of the adoption of the mode of transport that can be an alternative to cars and traffic in large and highly congested cities.

The following analyzes the situation of São Paulo in relation to the 10 cities best ranked in the GBCI based on the six aspects measured and presented in the methodology section.

3.1 Climate

Both, climate and geography of the region are preponderant factors to make the user adopt the bicycle as a transport system to carry out their daily activities. Figure 1 presents the GBCI index for climate in selected cities.

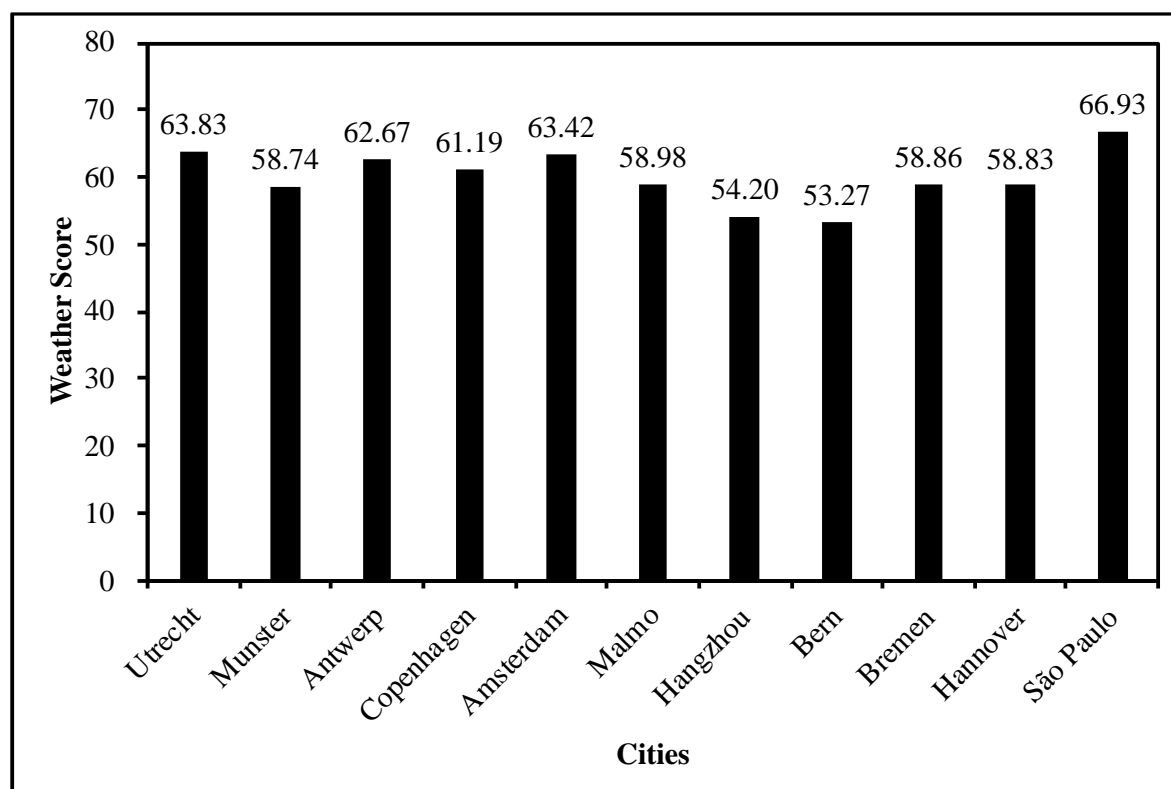


Fig. 1 Weather score for the study cities. Source: Adapt from [12]

It is observed by the figure that São Paulo has the best index among the best-ranked cities. This denotes a possibility of increasing the adoption of bikes for travel. The warm climate allows the use of the bike to be done all year round. Countries with cold weather have travel problems due to the harsh winter.

Spencer et al. [14] studied the effect of climate on cycling trips in the city of Vermont located United States and concluded that precipitation, low temperatures, inclement road conditions, limited daylight schedule, and wind are uncontrollable impediments to cycling throughout the year, which has put metaphorical brakes on many potential bike trips. This is not the case in São Paulo, which keeps temperatures much warmer.

3.2 Percentage of Bike Usage

The percentage of bicycle usage in the selected cities can be seen in Figure 2.

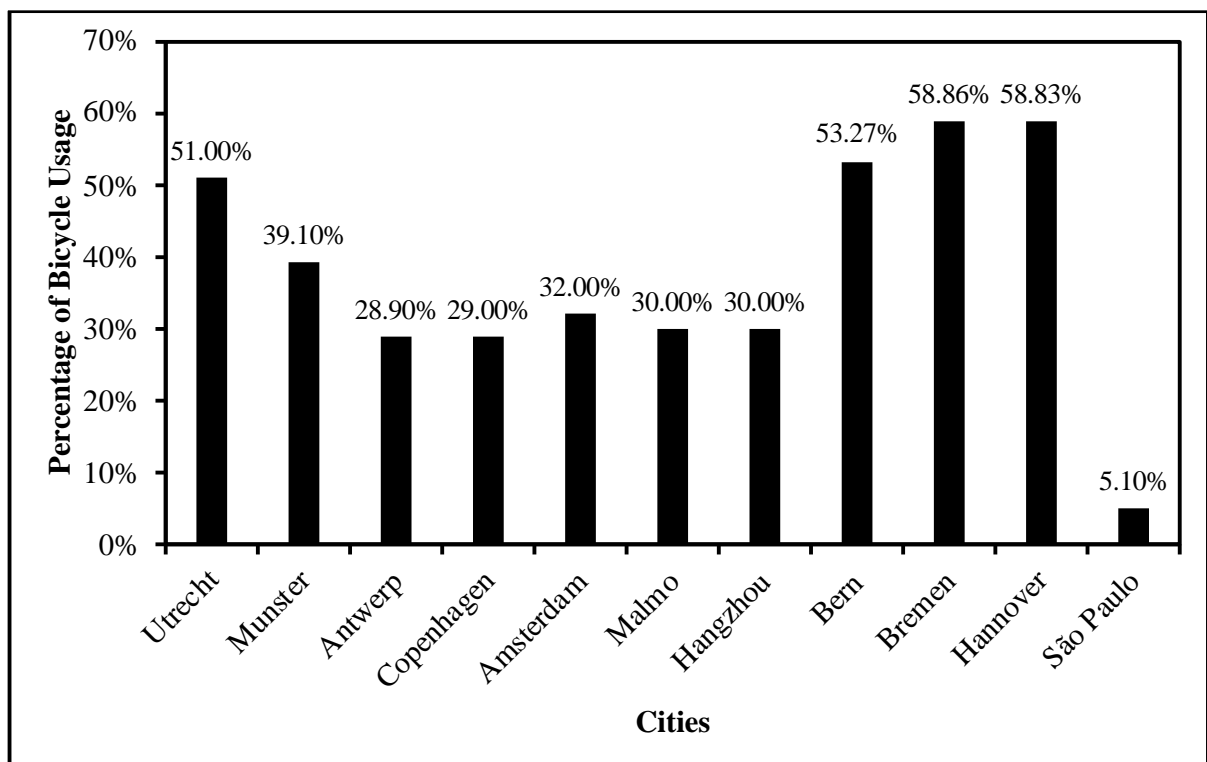


Fig. 2 Percentage of bicycle usage for the study cities. Source: Adapt from [12]

The percentage of bicycle use in São Paulo is very low. Factors that influence beyond the infrastructure are big distances needed to go from dormitory neighborhoods to centers of interest, non-flat geography, and lack of adequate places for hygiene after travel. It should also be considered the increase in bicycle prices caused by the devaluation of the REAL, the lack of raw materials caused by the restrictions of COVID-19, and the increased sudden demand due to restrictions of social isolation and use for sports practices.

To increase the number of bicycle users on the streets, considering the human dimension, it is necessary that there are public policies, campaigns, projects, incentives, measures, goals, and intersectoral actions. In addition, indicators are needed to evaluate the actions and evolutions of these processes over time [15].

3.3 Crime and Safety

The crime and safety rates in bicycle use are important factors for the adoption of the system as a mode of transport. In GBCI they are composed of three indexes. Figure 3 shows the first of these which refers to the number of fatalities per 100,000 cyclists.

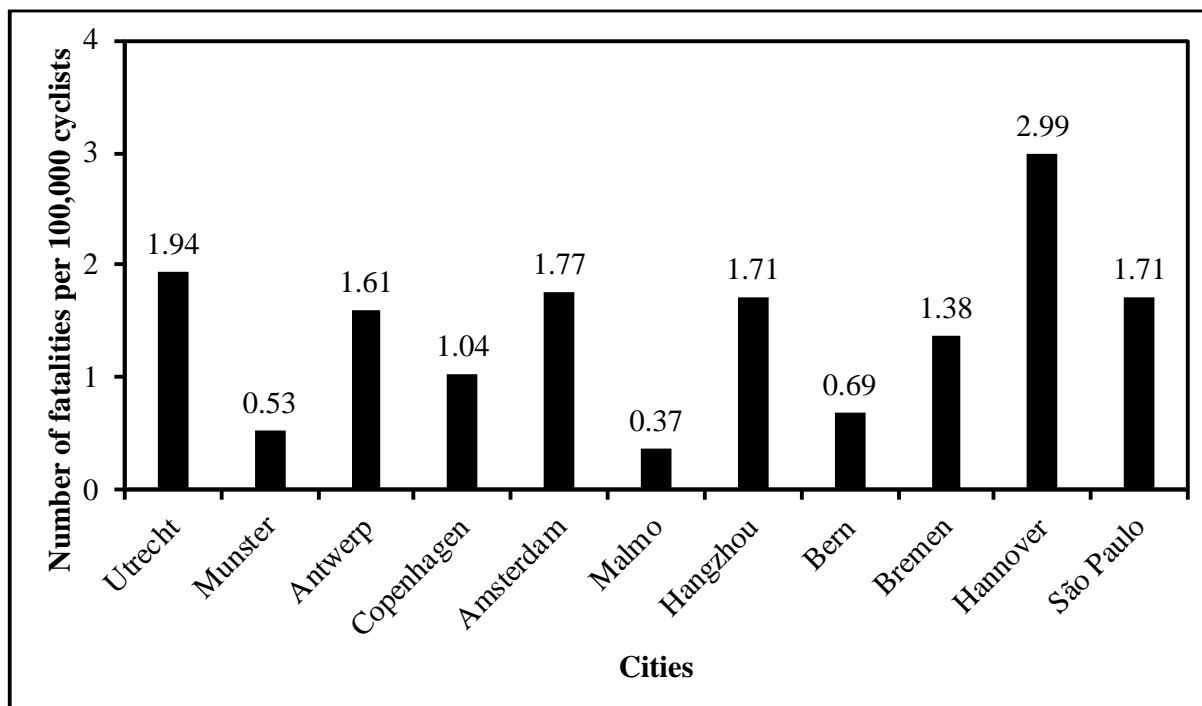


Fig. 3 Number of fatalities per 100,000 cyclists for the study cities. Source: Adapt from [12]

Observing Figure 3, São Paulo presents several fatalities according to most cities, with 1.71 fatalities per 100,000 cyclists as well as Hangzhou. These are lower than Amsterdam which has 1.77 fatalities, Utrecht with 1.94, and Hannover with almost 3 fatalities per 100,000 cyclists. However, it is necessary to analyze this number in relation to the number of accidents recorded. Figure 4 shows the number of accidents involving cyclists per 100,000.

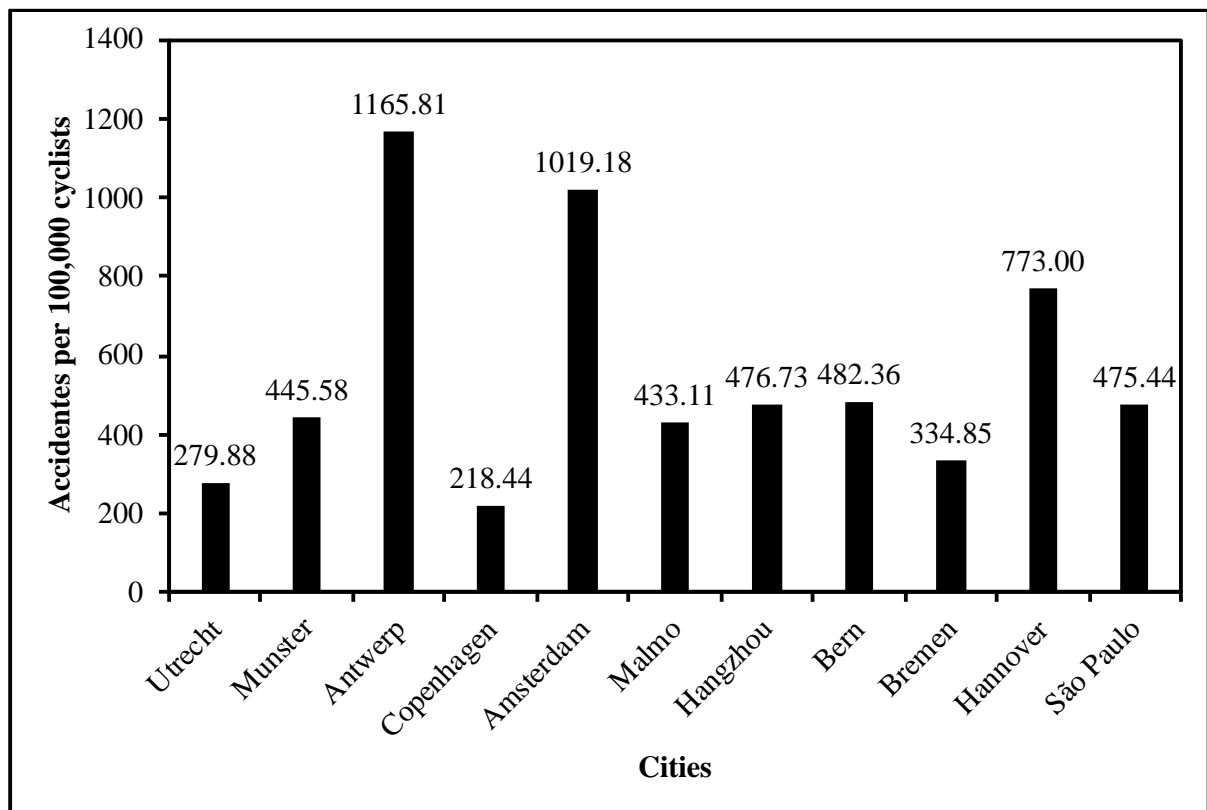


Fig. 4 Number of accidents per 100,000 cyclists for the study cities. Source: Adapt from [12]

In the case of accidents involving bicycles, São Paulo has a total of 475.44 accidents per 100,000 cyclists, a result lower than those presented by 5 of the 10 cities with the best overall rating. Antwerp in Belgium and Amsterdam which are cities with high use of people using bicycles for urban mobility had the highest number of accidents recorded, above 1,000 per 100,000 cyclists. The figures show that São Paulo has a death rate of 0.36% while Antwerp with almost three times as many accidents has a 0.14% rate.

The third factor analyzed in this item is bicycle theft/theft, this risk is measured by the GBCI and can be seen in Figure 5.

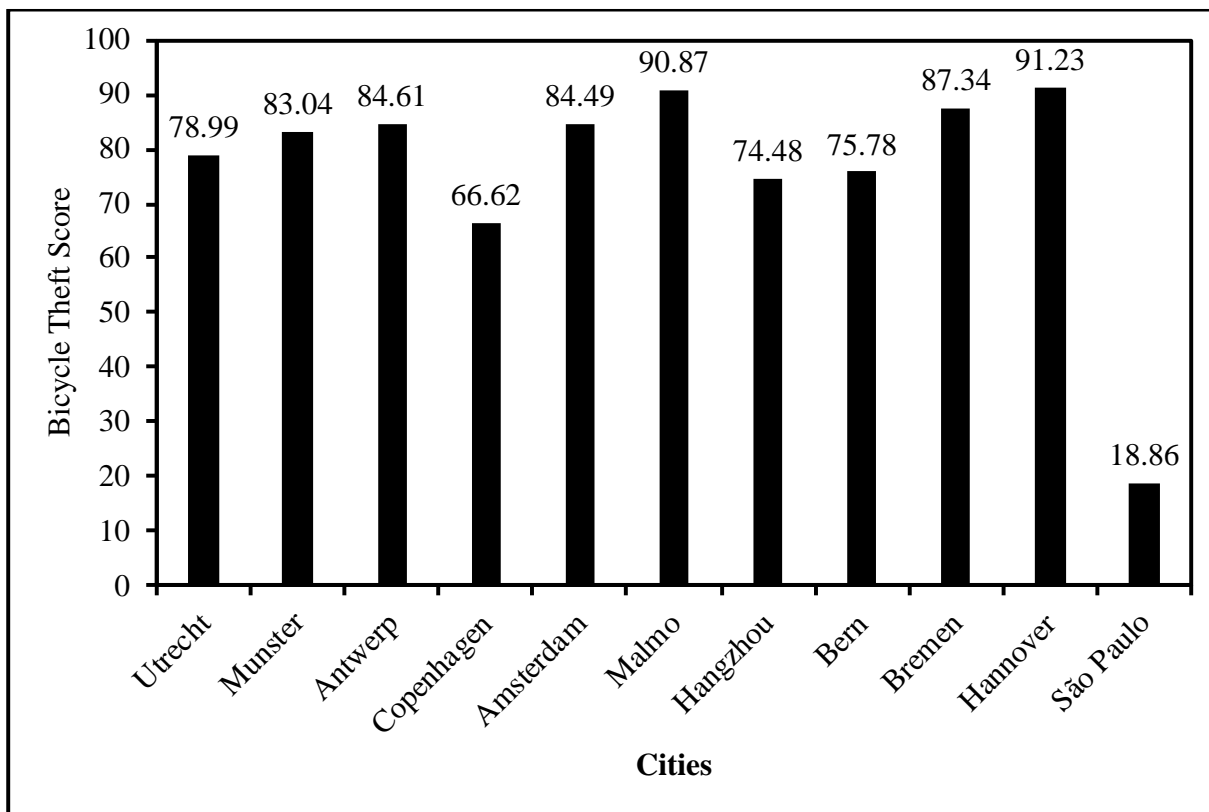


Fig. 5 Bicycle theft score for the cities of the study

São Paulo has a low score regarding safety against bicycle thefts (18.86), as opposed to the leaders of the classification who are very safe, and Copenhagen presented the lowest value among them with 66.62 points.

Márquez and Soto [16] while analyzing the infrastructure of Bogotá, Colombia, considered a bike-friendly city, identified that safety concerns are a significant impediment to the use of bike lanes in the city, while perceptions of risk of theft affect the value or importance that cyclists attribute to travel time.

3.4 Infrastructure

In the infrastructure, three aspects are analyzed, the number of stores (the bike shops), the quality and availability of the routes for bicycle use, the investments, and the quality of the available infrastructure. Figure 6 shows the number of bike shops per 100,000 cyclists.

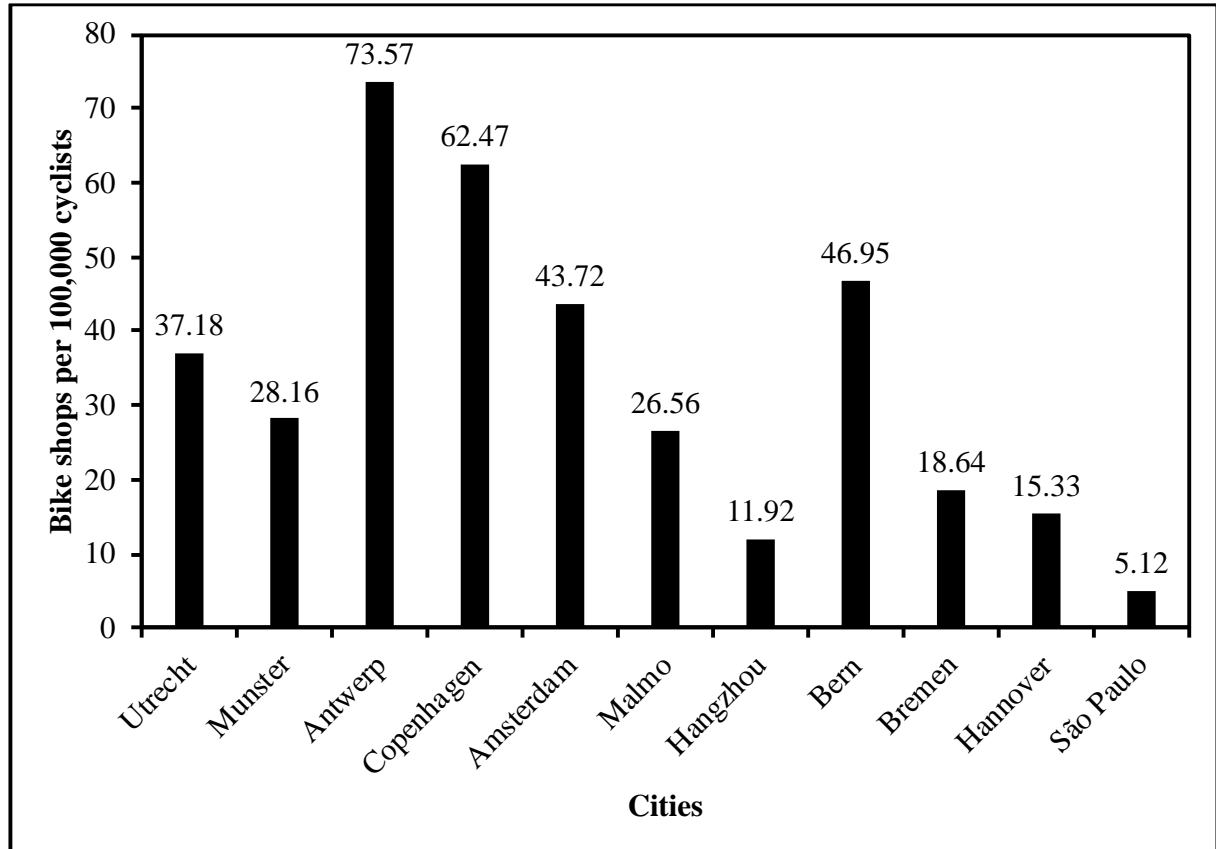


Fig. 6 Infrastructure indices of bicycle shops (bike shops) for the study cities. Source: Adapt from [12]

São Paulo presented 5.12 stores of bicycle items for every 100,000 cyclists, a much lower value than those presented by the city best evaluated in this item, Antwerp, with 73.57 service points. However, some observations need to be made about this result. São Paulo is a city with very large social differences. The stores of specialized brands are in noble areas with a high service value that mainly serves the user of competition and leisure. On the outskirts of the city are several small workshops to serve the majority of users and often with a very high informality index that cannot be reflected in the numbers of the GBCI.

The index of Specialized Roads & Road Quality is shown in Figure 7.

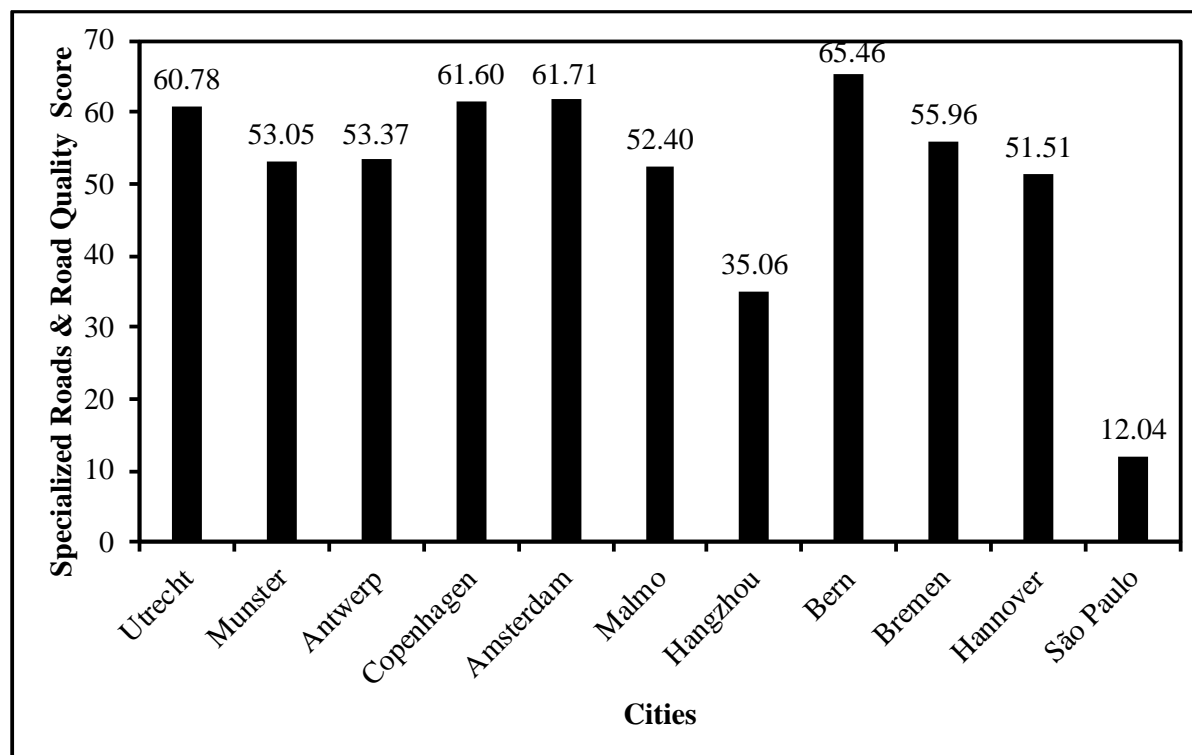


Fig. 7 Specialized roads & road quality score for the cities in the study. Source: Adapt from [12]

For quality and availability of roads intended for cycling use, the state capital scored 12.04, while Utrecht, in turn, was evaluated with 60.78 points. A percentage difference of more than 400%. In other words, São Paulo still needs many effective measures and actions to increase and improve the city's cycling infrastructure. These investments in infrastructure improvement are evaluated in the next item, Figure 8.

For investments and quality of infrastructure it is noteworthy that the three cities at the top of the list obtained almost the same scores – Utrecht, Amsterdam, and Bern with just over 98 points, while São Paulo was evaluated with 21.97 points, a percentage difference of 346%. Finally, the overall evaluation for infrastructure can be seen in Figure 9.

In the general evaluation for São Paulo infrastructure, it was classified with 9.84 points, obtaining a score much lower than the cities considered exemplary which scored between 59.78 and 32.92. Schwarz et al. [17] studying the cycle infrastructure of Munich, Germany, concluded that the improvement of this has the potential to generate more travel and consequently allow the face of environmental or health-related challenges in urban areas, such as climate change or the spread of infectious diseases such as COVID-19.

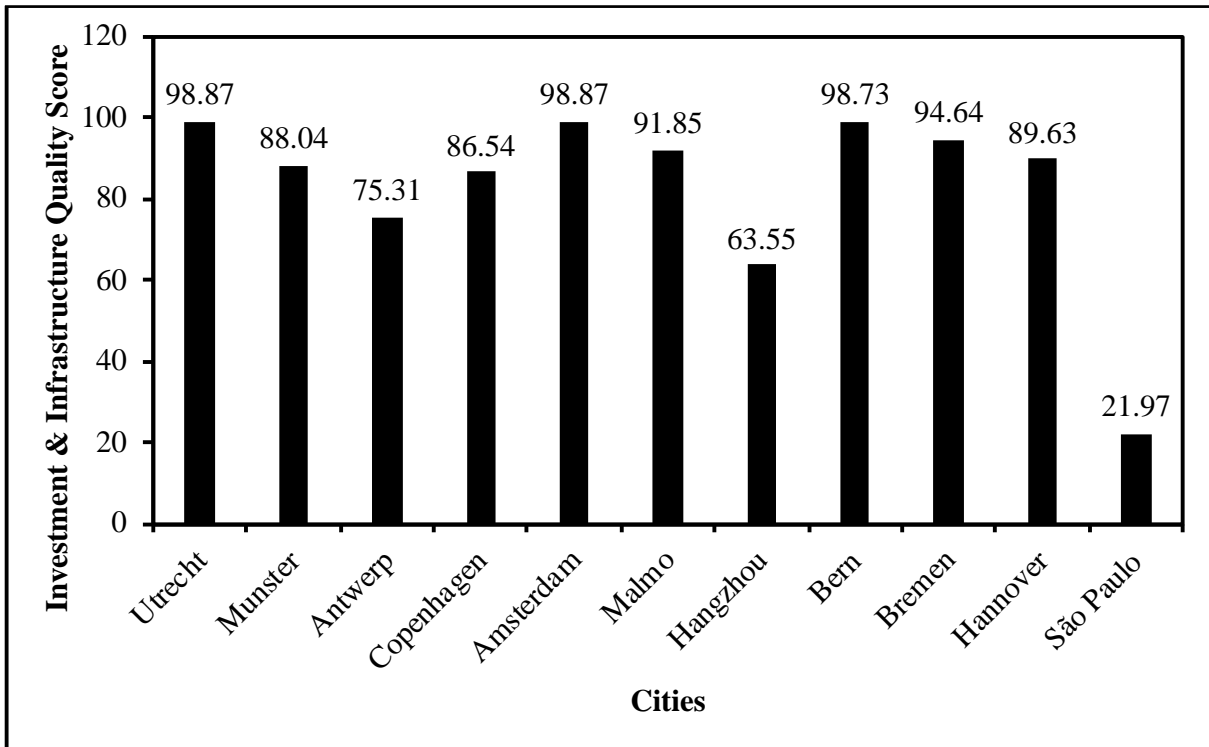


Fig. 8 Investment & Infrastructure Quality Score for the cities in the study. Source: Adapt from [12]

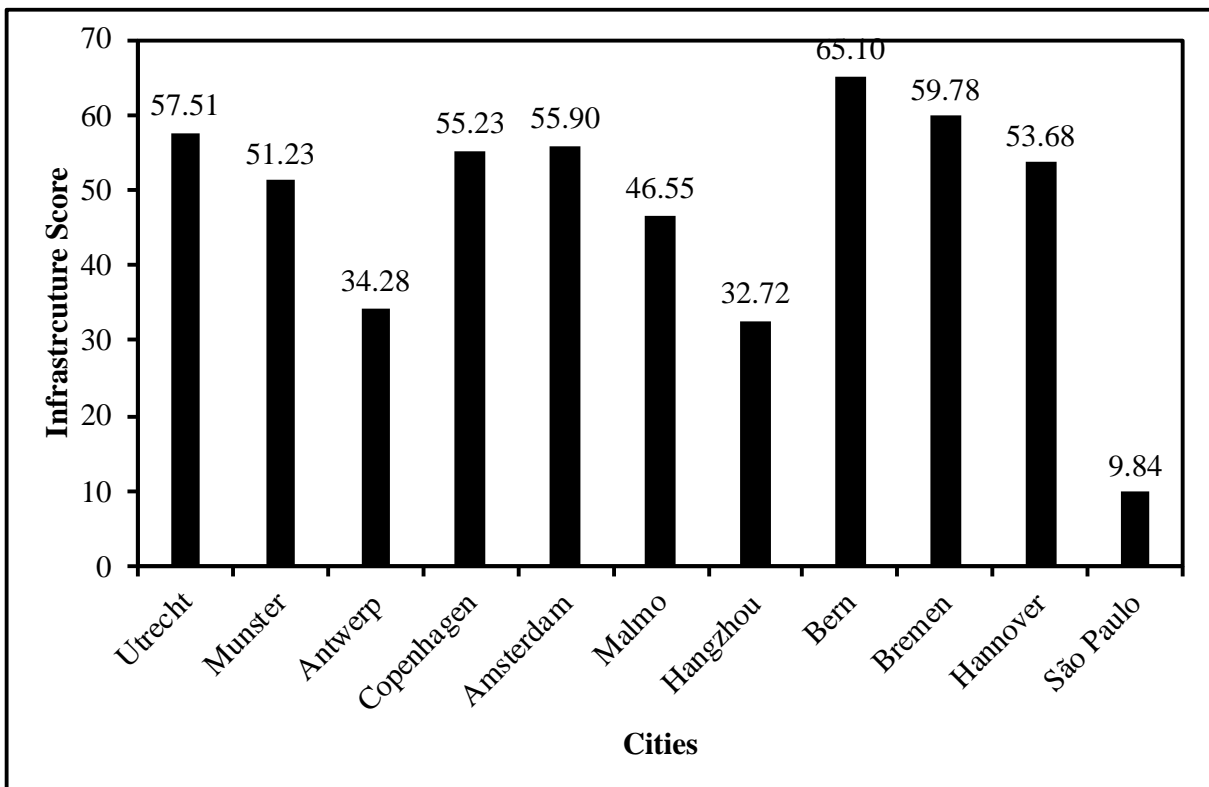


Fig. 9 – Index for general assessment of infrastructure for the cities in the study. Source: Adapt from [12]

3.5 Sharing

Bike sharing considers the number of sharing equipment and stations available, the number of bikes shared per 100,000 cyclists, and a sharing score. Figure 10 presents the first of these factors.

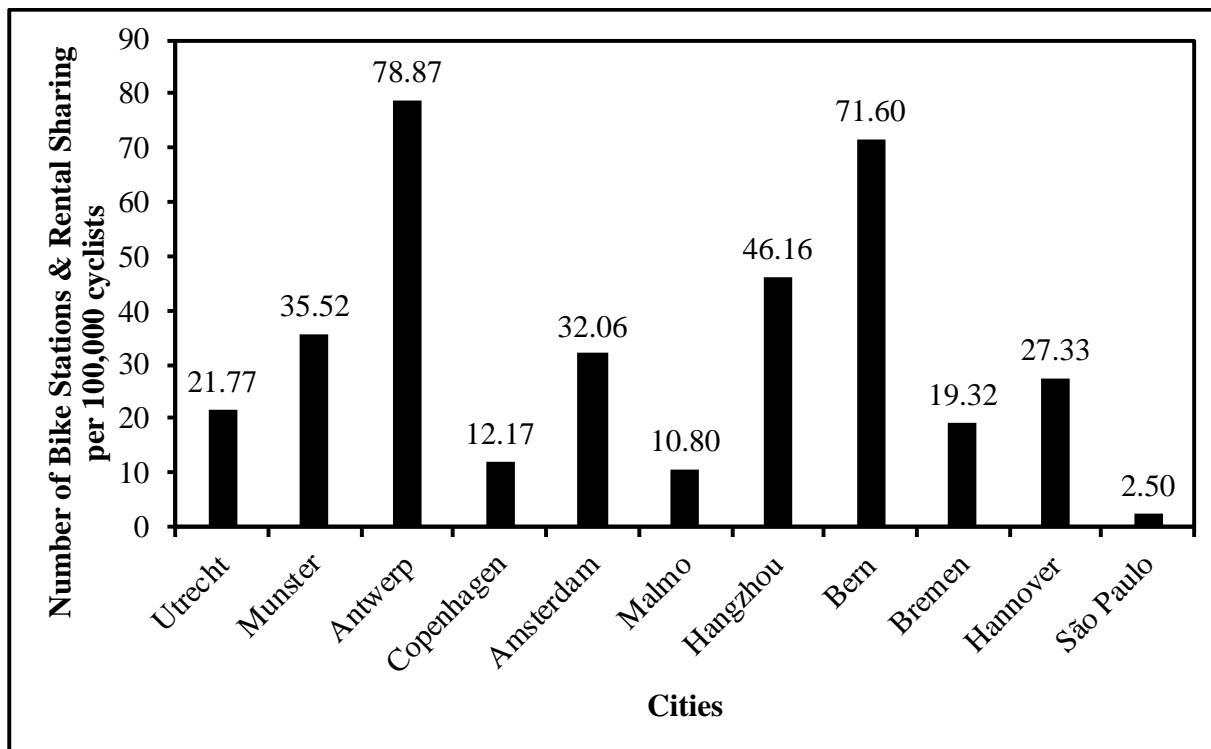


Fig. 10 Number of bikes and stations available for sharing for study cities per 100,000 cyclists for study cities. Source: Adapt from [12]

While Antwerp has 78.87 bicycles and sharing stations for every 100,000 inhabitants, São Paulo has 2.5, representing a percentage difference of more than 3,000%. The few stations available in São Paulo are in economically valued parts and the main parks near these areas. The number of bikes shared per 100,000 cyclists is shown in Figure 11.

Again, while Antwerp and Bern feature around 100 shared bikes per 100,000 cyclists, São Paulo only 1.90, which corresponds to a difference of more than 5,000%. Figure 12 shows the result of the bicycle sharing index in the cities surveyed (score).

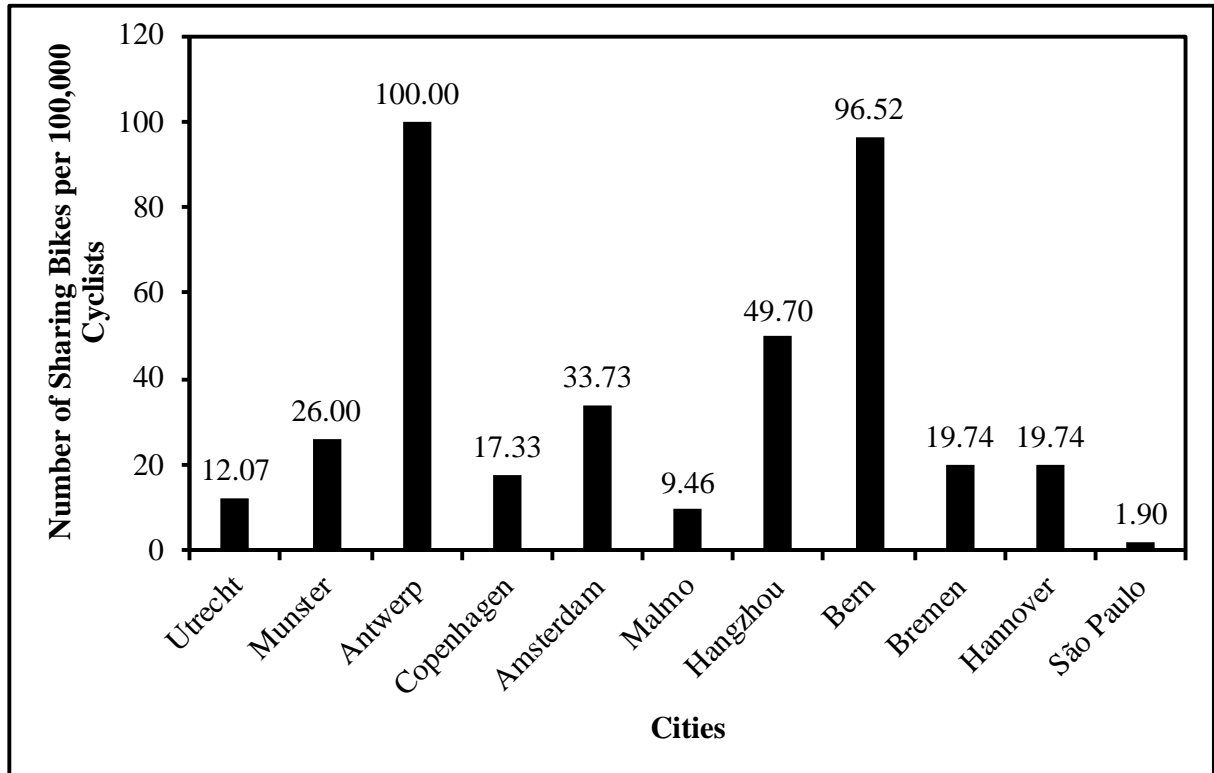


Fig. 11 Number of shared bikes per 100,000 cyclists for the study cities. Source: Adapt from [12]

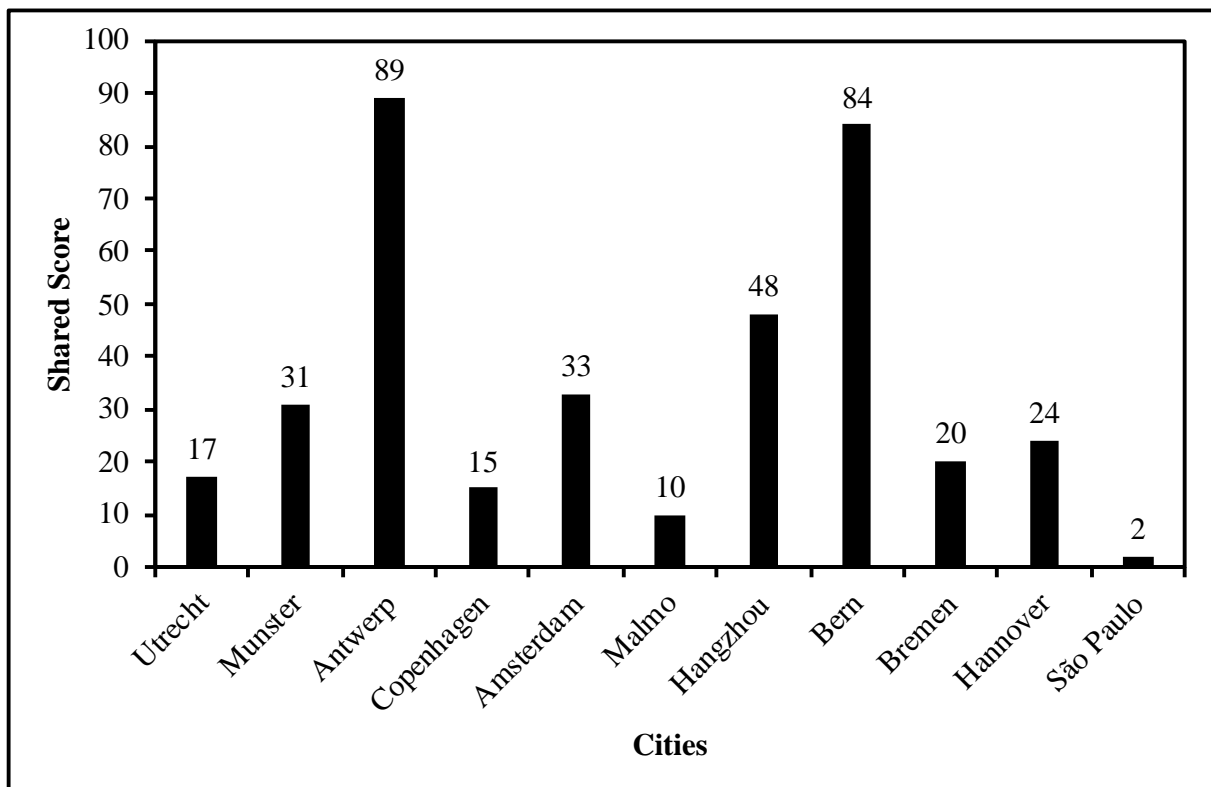


Fig. 12 Shared bike index for the study cities. Source: Adapt from [12]

São Paulo scored only 2 points, placing the Brazilian city far from the best-rated city with 89 points. Benedini et al. [13] studying the cycling system in São Paulo identified that shared bicycle systems play a fundamental role in multimodal travel and the introduction of bicycles to new users. They also noted that individuals making connections (using multiple modes for a single trip) tend to use shared bikes, and therefore bike sharing stations are, or at least should, be installed to allow not only first/last-kilometer trips, but also to allow connections between buses and subway/train stations.

3.6 Events

Events aim to encourage the adoption of the bicycle as a mode of transport. One of them is the adoption of the day without a car. Despite the low overall evaluation, São Paulo was classified as having at least one practice of culture entitled "day without a car", and only 4 of the 10 cities occupying the first positions used in this comparison also adopt this practice.

Attention is drawn to the importance of the item "events" among the criteria evaluated by the GBCI. This item is what makes possible a change of habit, a new experience that can lead people to realize that a bike trip to work, or to school can become a healthy, pleasurable, and sustainable habit. The second aspect of the item is "critical mass score", or critical mass event, which evaluates the movements that take place in various cities of the world in favor of active mobility, Figure 13. It is an event in which people adept at active mobility, such as users of skateboards, bicycles, scooters, skates, or who simply walk, occupy their space on the streets, usually on the last Friday of the month, with the sole and exclusive objective of making visible the possibility of a form of mobility different from cars and that can be healthy and sustainable.

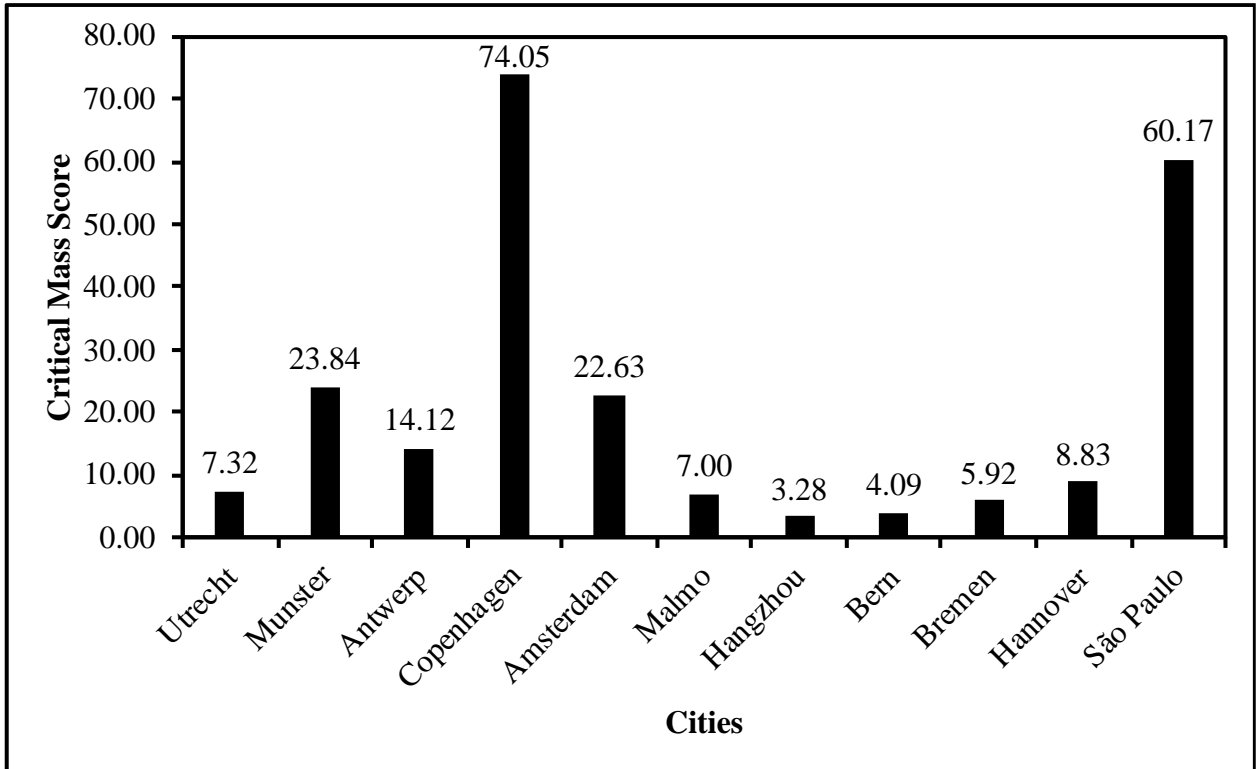


Fig. 13 Critical Mass Event Index for the study cities. Source: Adapt from [12]

These events are fundamental to show to people who believe that by owning a vehicle, they become a priority in public spaces. Everyone has the right to this space and must respect users of mobility alternatives. Political activism organized by cyclists has played an extremely important role in recent years in the city of São Paulo, fostering ideas, and participating in meetings that define public policies, in a real act of resistance [18]

The final index of events is given by a single score that can be seen in Figure 14.

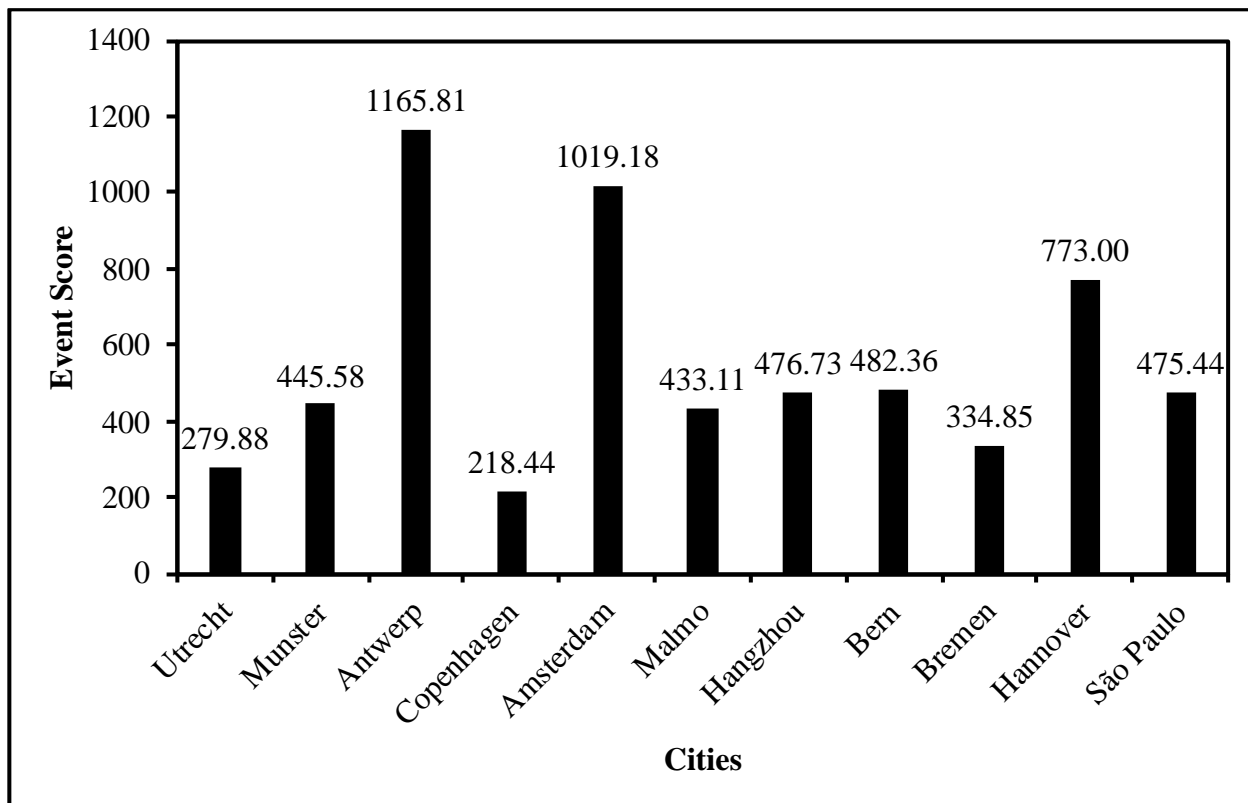


Fig. 14 Events index for the study cities. Source: Adapt from [12]

4. CONCLUSION

The aim of this article was to compare São Paulo with the 10 best-ranked cities in the Global Bicycle Cities Index, entitled as the 10 most cycling cities in the World. The results allowed for obtaining a clear view of the criteria in the evaluation of the bicycleability index of the cities. It is mainly noteworthy the actions carried out by the cities that occupy the first positions in order to encourage and favor the use of bicycles as a transport modal.

One of the most important aspects of achieving this classification is not to point out the flaws, or to define the best or worst city for the use of the bicycle. But to leave recorded the best actions for a change of culture, of habit that favors people who share urban spaces, improving the air quality and life of all people who share these spaces.

The city of São Paulo has several actions to improve mobility alternatives, although it is occupying a position far removed from the first classified. It is noted that the challenge of the city is quite large due to the number of people who move daily due to work, school, among others and the demographic density itself.

The restructuring of bike racks in bus, subway, and train terminals, in addition to the possibility of boarding the bicycle on trains, buses and subways, denotes a major advance in favor of bicycle users who need to travel great distances and depend on intramodality.

The increase in the use of bicycles as a transport modal should not be recognized only as a fun instrument, classified as a toy or as an exclusive item for sports, it is essential to achieve some points established as a goal among the Sustainable Development Goals – SDGs of the United Nations. Among them, the reduction in the number of deaths in traffic and cardiorespiratory diseases and the reduction of carbon dioxide emissions.

Motor vehicles that use fossil fuels as an energy source are the main emitters of carbon dioxide (CO₂), which is one of the main gases responsible for strong climate change, promoting the greenhouse effect and promoting a major negative impact on people's health and quality of life.

Analyzing this whole scenario, we can see the degree of importance that has the creation of a classification that evaluates the conditions and structures of cities for bicycle use as urban mobility. So more and more, more people can be safe and comfortable using the bike as a means of transport. The improvement of cycling conditions is a matter of sustainability, therefore, a matter of survival.

Finally, this research also allowed another look at the city of São Paulo in order to understand the challenges to be faced by public policies so that there is a greater number of cyclists on the streets. In a general scenario, considering that São Paulo is the largest city in South America and that it is a city that has the use of the car ingrained, with deep roots in the culture of mobility, many actions are necessary to change this scenario.

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