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Racial inequality related to transportation means in Brazil

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ABSTRACT
Brazil is a country with great cultural diversity. Most of the population, represented by black and brown people, has suffered from social and racial inequality due to their skin colour. Considering that transportation means interfering with access to education, employment opportunities and health services, it is necessary to identify how they can mitigate inequality. This work aims to assess racial inequality related to transportation means in Brazil. The differences between white and black/brown people were compared considering population rate, municipal human development, schooling rate index, and gross domestic product. The promotion of improvements and access to means of transportation should prioritize the least privileged population, which is the one that uses them the most. As a conclusion, the conditions of transportation offered by a country to the population can reduce the racial disparity and discrimination in the country.
Keywords **-** racial inequality; transportation means; skim colour; discrimination

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I. INTRODUCTION

Brazil is a country with continental dimensions and great cultural diversity. However, there is still social and racial inequality, a consequence of the slavery of African people in the past, from 1535 to 1888.

In 1500, when discovered by Portugal, Brazil became a Portuguese colony, whose colonizers used slavery, already practiced in Africa and the Arab world. At the year 1535 the first ship with enslaved Africans arrived in Brazil, captured in Portuguese colonies such as Angola and Mozambique, in Africa. Such slaves produced all wealth in Brazil, from the planting and harvesting sugar cane and coffee to building houses, mills, and churches. Slavery conditions in Brazil were the worst possible, and, after adulthood, the slave not lived more than ten years [1]. Slaves worked from sun to sun, received poor food, wore rags, and lived in slave quarters (*senzalas*), a dark, damp and unhygienic place. In addition to painful punishments, they were forbidden to profess faith or to perform rituals. Besides, women slaves were sexually abused by their owners. This shadowy period in Brazilian history lasted 353 years [1, 2].

The campaign that resulted in the slavery abolition on May 13, 1888 (*Áurea* Law) was the first collective demonstration to mobilize people and find supporters in all Brazilian social strata. However, after the signing of *Áurea* Law, no orientations were established to integrate slaves into a society's new rules based on wage labor [2].

In Brazil, without access to land or any type of compensation for forced labor, usually illiterate, victims of all kinds of prejudice, many former slaves remained on the farms where previously they were slaves, selling their work in exchange for survival [3]. The newly freed people also faced challenges as unemployment, homelessness, and lack of access to health, education, and other public policies [4].

In addition to suffering skin-colour discrimination, the ex-slaves joined the poor population and formed the group of unwanted people, called the Republic's disinherited. Since that time, the rise in unemployed, temporary workers, beggars, and abandoned children increased violence and discrimination [2]. In the rural area, ex-slaves were replaced by immigrants and migrated to the Brazilian urban area, performing subordinate functions, without access to education or the possibility of ascending socially [5].

Geographically excluded, ex-slaves started to inhabit peripheral urban areas forming slums (*favelas*) and tenements in the cities. Prejudice, discrimination and the permanent idea that blacks were only used for hard work left sequels since the end of slavery to the present days [3].

Zhao and Gustafson [6] also confirmed the spatial inconsistency of jobs and residences for low-income families related to transportation means. Glaeser et al. [7] complemented that the offer of different transportation means and transport

technologies determines cities' spatial structure. In 2020, Valente and Berry [8] evidenced that grave disparity in income, educational achievement, labour force participation, and political representation between blacks and whites remain prevalent in Brazilian society.

Salon and Gulyani [9] evaluated the transportation accessibility of slum people in Nairobi, Kenya. The findings demonstrate that most slum people cannot afford motorized transport, so they walk. Besides, women and children are disproportionately affected. Unfortunately, in Brazil, black or brown people also represent the population parcel with a lack of adequate transportation means access.

Gwilliam [10] complements that developing country cities have a different degree of transport developments. When the cities have developed, poor people have tended to be marginalized in peripheral locations with inadequate access. Transportation inequities are typically evaluated from social and spatial equity. Social equity in social scenery represents the vulnerable or disadvantaged populations, which in transportation is usually evaluated along socio-demographic lines, such as income, race, gender, or age [12, 13].

The Brazilian Applied Economic Research Institute conducted a diagnosis in twenty main Brazilian cities about the inequality of accessibility in the country. It was verified that black and low-income populations have less access to work, health, and education opportunities. As for means of transportation, the research has shown that these directly interfere in accessing job opportunities, health services, and education, which contributes to inequality [13].

Transportation is essential for people lives, improving participation in daily activities and opportunities. A deficiency of personal mobility or access to transportation will affect people economic and social development. From this point of view, transportation can be considered as a fundamental civil right. Nevertheless, travel costs and differing levels of accessibility lead to an imbalance in transportation costs and benefits across population groups (Lee et al. 2017).

Sánchez et al. [11] affirm that transportation policies have not only inequitable effects on the ability of low-income individuals and minorities to access places, but also have serious indirect effects such as encouraging and reinforcing residential segregation; restricting access to employment and other economic opportunities, housing, and education; and causing health disparities.

In this scenario, this study aims to assess racial inequality related to transportation in Brazil. The panorama of racial inequality in Brazil was outlined through official data and a survey of injustice and unequal treatment cases. A set of suggestions were proposed to reverse this situation.

II. METHODOLOGY

In this study, a survey about how African descendant's inequality in Brazil is related to transportation was carried out. Initially, it was important to comprehend the Brazilian peculiarities about the population and then relate the racial inequality in the country.

Five Brazilian capitals were selected to compare the differences among them. The data were collected from Brazilian studies and census. Based on the data obtained, it was possible to provide proposals to reduce racial inequality in Brazil and indicate measures to be adopted to improve people's living conditions who suffer from racial injustice. The methodology is shown in Fig.1 and follows described.

Phase 1. Percentage of population according to skin colour in Brazilian regions

A data survey about the population's percentage according to skin colour in the Brazilian regions was performed. The data were collected from the Brazilian Institute of Geography and Statistics (2019 reports projected from 2010 census). From such data, it was possible to select capital cities from different Brazil regions to perform the study. In this study, only white and African-descendants people were considered.

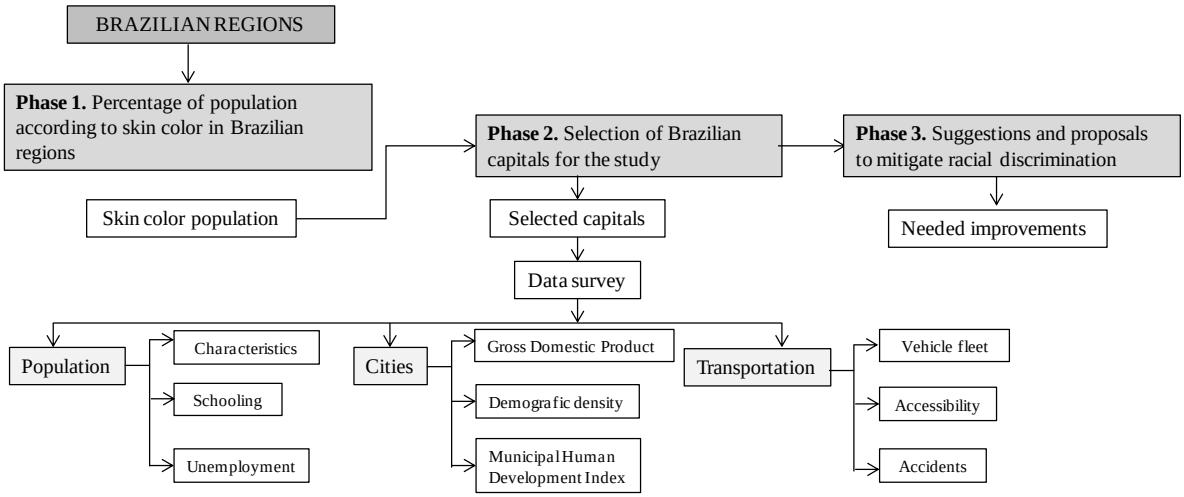


Fig. 1. Flowchart of the methodology.

The yellow and indigenous populations were not accounted for because, in general, they live in isolated areas. According to race and colour, the rate of illiteracy and students' number at a higher level were also evaluated.

Phase 2. Selection of capital cities

For selecting capital cities, some criteria based on Brazilian regions situation, number of population, and percentage of skin colour were established. Firstly, cities with 360,000 to 505,000 inhabitants were selected.

Based on this criterion, Florianópolis (Santa Catarina State, located in the South region), Macapá (Amapá State, located in the Northeast region) and Vitória (Espírito Santo State, Southeast region) were selected.

After that, capital cities located in different Brazilian regions, but where the percentage of the population according to skin colour was representative, were chosen. From this criterion, Maceió (Alagoas State, located in the Northeast region) was included. Finally, it was necessary to include a capital city in which there are many means of transportation. From this criterion, Rio de Janeiro city (Rio de Janeiro State, located in the Southeast region) was chosen.

The primary data related to population characteristics, social development, and access to transportation means were evaluated in each city. The differences and similarities were analyzed to establish why racial inequality is still a challenge to be faced. For each capital city, the vehicle fleet was assessed.

The motorization rate was related to car occupant, motorcycle, and cyclist mortality indicators to verify the percentage between white and black and brown population involved.

Phase 3. Suggestions and proposals to mitigate racial discrimination

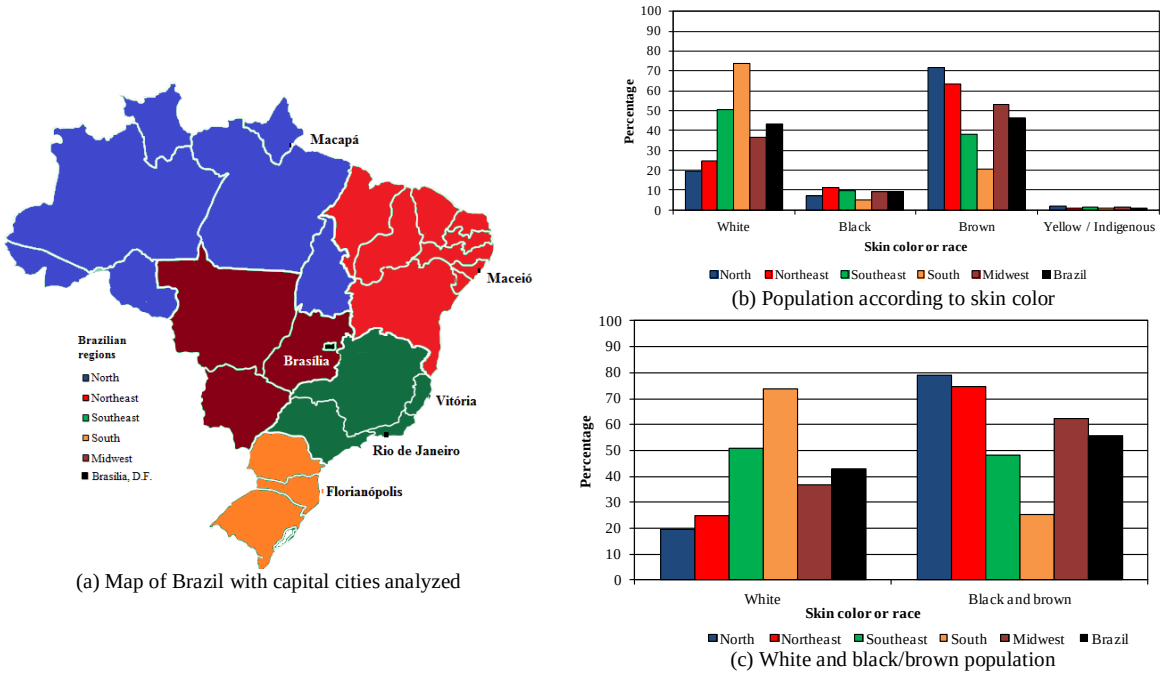
Based on Brazilian data and reports, one assessed how the improvements in transportation infrastructure could improve access to public transport and quality of life for the less favoured population (poor, black and brown) and minimize inequality in the country.

Racial inequality problems due to transportation accessibility were also reported. Some suggestions and actions were indicated to minimize and reduce problems. Ways of participation and inclusion of African descendants in society, considering transportation to promote the changes were discussed. It was also examined how transportation means and their improvements can contribute and affect change conditions like housing, violence, and employment opportunities for the least favoured population, i.e., blacks and browns.

III. RESULTS AND DISCUSSIONS

3.1. Brazilian population characteristics

Brazil is a very large country with 8,516,000 km², divided into twenty seven States, grouped into five regions (Fig. 2a). Brasília, the Federal District, is an autonomous unit composed of administrative regions and the federal government's seat.



(a) Map of Brazil with capital cities analyzed

(b) Population according to skin color

(c) White and black/brown population

Fig. 2. Brazilian regions and population according to skin colour or race (Based on [14]).).

In 2019, the estimated population in Brazil was 210,147,125 in which the percentage according to skin colour was 43.1% white, 9.3% black, 46.5% brown, and 1.1% yellow or indigenous. Fig. 2b shows the skin colour distribution among the Brazilian regions [14, 15]. It is important to note that in Brazil, citizens themselves declare their skin colour. In this study, references to African descendants include self-declared brown and black (Fig. 2c). Fig. 2c shows the contrast of African descendant's percentage among regions, i.e., 78.8% in the North, 74.5% in the Northeast, and 25.4% in the South. The South region was mainly colonized and populated by Portuguese, Italians, and Germans.

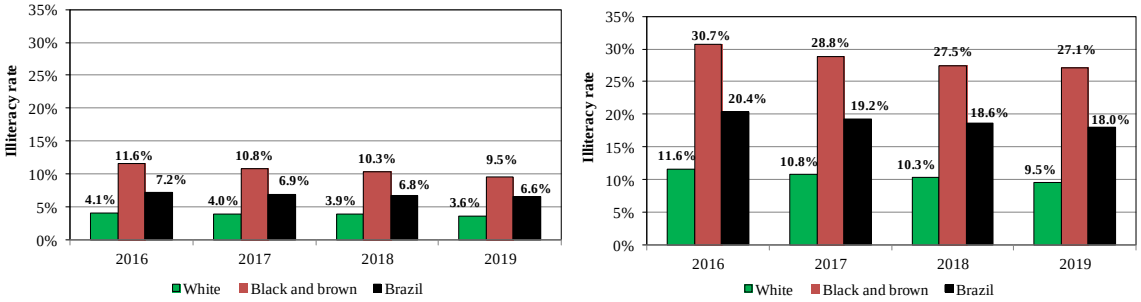
Through the Continuous National Household Sample Survey, conducted by the Brazilian Institute of Geography and Statistics, it was possible to establish the rate of illiteracy and students' number at a higher level according to race and colour [16].

Fig. 3a shows the illiteracy rate in Brazil as a function of race and colour for the population 15−59 years old, while in Fig. 3b, the data correspond to the population aged 60 years or older. It can be noted that, in Brazil, illiteracy is directly associated with age, which means that the older the population, the higher the number of illiterates; and with skin colour, i.e., there are many more illiterate black and brown than white people. However, a small decrease in the illiteracy rate can be observed for all people over time.

As for Brazilian regions, the illiteracy rate from 2016 to 2019 is shown in Fig. 4a for population 15−59 years old and in Fig. 4b for population aged 60 years or older. In Brazilian regions, it was verified that the rate of illiteracy reflects regional inequalities. In 2019 the Northeast region presented the highest illiteracy rates among people 15−59 years old, i.e., 13.9%.

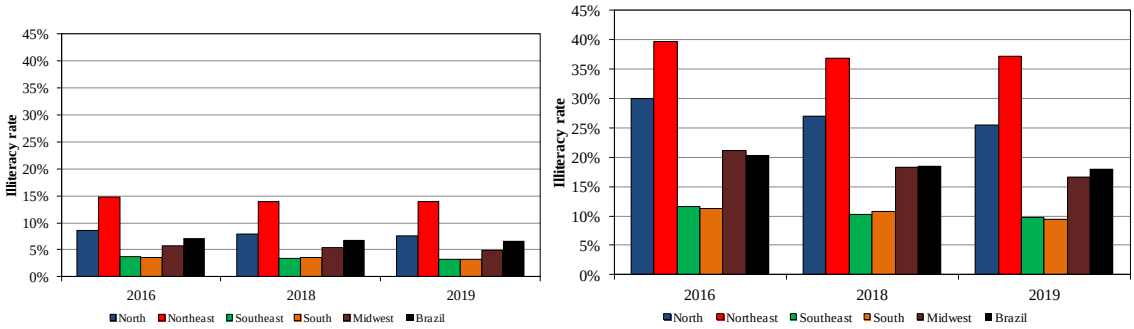
Results also showed that for the population aged 60 and over, in 2019, the rate in the Northeast region reached 37.2% and in the North region, 25.5%. On the other hand, it was below 10% in the Southeast and South.

In 2019 there were 4,035,000 white students and 4,018,000 black and brown students attending universities and colleges in Brazil. According to race and colour, Fig. 5 shows the number of students who attended universities and colleges from 2016 to 2019. In the North, Northeast, and Midwest regions, the number of black and brown students is higher than white students. On the other hand, in the South region, the inequality is noticeable.



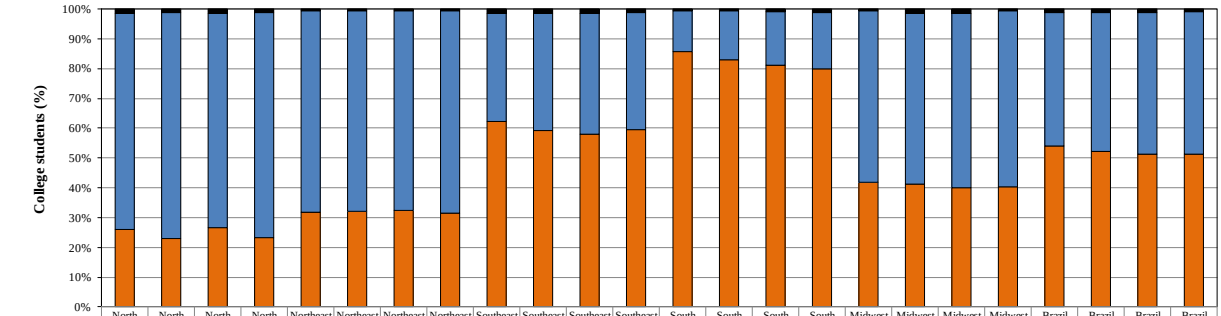
(a) Population 15−59 years old (b) Population aged 60 years or older

Fig. 3. Brazilian population illiteracy rate over 2016−2019 (Based on [14]).



(a) Population 15−59 years old (b) Population aged 60 years or older

Fig. 4. Illiteracy rate in the Brazilian regions over 2016−2019 (Based on [14]).



	North (2016)	North (2017)	North (2018)	North (2019)	Northeast (2016)	Northeast (2017)	Northeast (2018)	Northeast (2019)	Southeast (2016)	Southeast (2017)	Southeast (2018)	Southeast (2019)	South (2016)	South (2017)	South (2018)	South (2019)	Midwest (2016)	Midwest (2017)	Midwest (2018)	Midwest (2019)	Brazil (2016)	Brazil (2017)	Brazil (2018)	Brazil (2019)
Yellow/Indigenous	1.4%	1.2%	1.5%	1.1%	0.7%	0.4%	0.6%	0.7%	1.5%	1.4%	1.5%	1.1%	0.5%	0.7%	0.8%	1.0%	0.7%	1.5%	1.4%	0.6%	1.1%	1.1%	1.2%	1.0%
Black/Brown	72.6%	75.9%	71.9%	75.5%	67.6%	67.6%	67.0%	67.9%	36.3%	39.5%	40.5%	39.5%	13.7%	16.5%	18.1%	19.0%	57.3%	57.2%	58.6%	59.0%	44.8%	46.8%	47.6%	47.8%
White	26.0%	22.9%	26.6%	23.4%	31.7%	32.0%	32.3%	31.4%	62.2%	59.1%	58.0%	59.4%	85.9%	82.9%	81.1%	79.9%	42.0%	41.4%	40.1%	40.4%	54.1%	52.2%	51.2%	51.2%

Fig. 5. Number of university and college students according to skin color over 2016−2019 (Based on [14]).

In Brazil, federal and state universities are for free, and private ones are paid. To minimize inequality and increase the black population's access to higher education, the federal government signed the Racial Quotas Law in 2012 (Brazil 2012). This law is part of the Affirmatives Actions Policy for higher education and was established to help comply with and fulfil the rights of traditionally marginalized or excluded groups in Brazil.

According to the law, 50% of the university's total places are reserved for students from public schools with low income and self-declared blacks, browns and indigenous people and people with disabilities. The proportion of blacks, browns, and indigenous people is established from the Brazilian Institute of Geography and Statistic.

3.2. Results for the city capitals selected for analysis

Five cities such as Florianópolis, Maceió, Macapá, Vitória, and Rio de Janeiro were selected to perform the study (Fig. 2a). The North region has the highest population of African descendants, while the South has the lowest. Florianópolis and Vitória are islands, and Florianópolis and Macapá have a similar population. Rio de Janeiro city was included because it is one of the major Brazilian cities; it has transportation like subway, trains, and ferries. The difference between African descendants and white people is low (around 7%).

Concerning this study, the yellow and indigenous populations were not considered. Fig. 6 shows the percentage between white and

black/brown population for the five cities and Brazil. In Florianópolis, in the South, the white population is the majority (84.6%), while in Macapá, in the North, most of the population is black/brown people (73.5%).

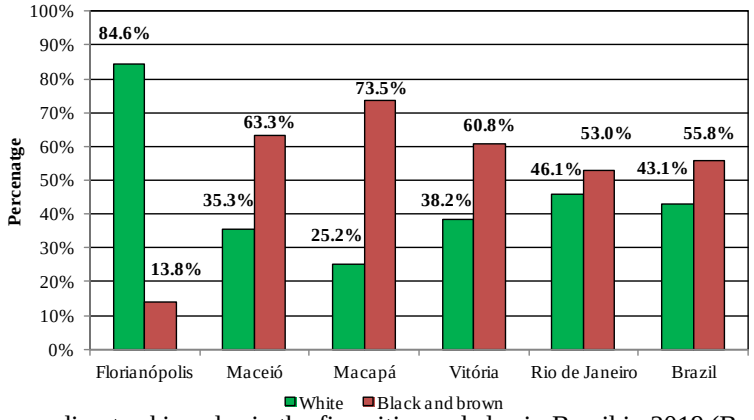


Fig. 6. Population according to skin color in the five cities and also in Brazil in 2019 (Based on [14]).

Maceió (Northeast) and Vitória (Southeast) present similar results, and in Rio de Janeiro (Southeast), black and brown people represent 53.0% of the population, which is similar to Brazil (55.8%). Table 1 shows some characteristics of the five cities.

Unfortunately, the differences go beyond skin colour. Florianópolis has the highest MHDI, i.e., almost 15% major than Maceió's. In Florianópolis, the average monthly wage corresponds to 4.8 minimum wages; while in Maceió are 2.8, almost 60% lower. The average is 4.1 minimum wages in the three other cities. The schooling rate (from 6 to 14 years old) was considered high in all cities (more than 94.8%). Vitória and Rio de Janeiro presented the highest Gross Domestic Product (GDP) while Maceió and Macapá, the lowest.

The unemployment rate is higher for the black and brown population than for the white. The lowest variation was observed in Florianópolis (1.3%) and the highest in Maceió (7.6%). A similar pattern occurred concerning underutilization (persons aged 14 and over), in which the lowest rate was in Florianópolis (2.1%) and the highest in Maceió (9.6%). Based on such data, it is possible to confirm racial inequality, in which the black and brown population is more sensitive to social differences. Underutilization refers to people who went to school or had a profession but are not inserted in the employment market.

In theory, the offer and the number of public vehicles could indicate that transportation means are largely accessible for all populations. Table 2 shows the vehicle fleet of each city. Fig. 7 presents the relationship between car occupants' motorization rate and mortality, motorcycle drivers, and cyclists for each city. Motorization rate measures the relationship between the number of light vehicles (automobiles, pickup trucks, motorcycles) and the city's population, per thousand inhabitants.

The first analysis was performed for Florianópolis (Fig. 7a), Maceió (Fig. 7b), Macapá (Fig. 7c) and Vitória (Fig. 7d) because the public means of transportation in these cities are bus, taxi, and app car only. Florianópolis has the highest number of cars (Table 2) and the other cities' motorization rate. Vitória (Fig. 7d) has the highest mortality rate (car, motorcycle, and bicycle) compared to the other cities. The motorization rate in Maceió (Fig. 7c) and Macapá (Fig. 7e) is similar. However, the car occupant mortality is higher in Macapá, although the number of cars in Maceió is higher than in Macapá (Table 2). Maceió has more motorcycles than Florianópolis (Table 2); nevertheless, the motorcycle occupant mortality in Florianópolis (Fig. 7a) is higher than in Maceió (Fig. 7b).

Concerning bike lanes, according to city halls, Florianópolis has 41.0 km, Maceió 42.0 km, Macapá 3.1 km and Vitória 47.0 km. However, none have interconnection with other means of transportation [19, 20, 21, 22]. On average, Vitória (Fig. 7d) and Florianópolis (Fig. 7a) have higher mortality of cyclists from 2006 to 2017, and from 2014 the rate increased in Macapá (Fig. 7c).

Public transportation means in Rio de Janeiro are composed of the bus, subway, light rail, urban train, rapid bus, ferry, taxi, and app car. There is 450.0 km of bike lanes [23], but only 36% of transport network stations are close (around 300 meters) to the bicycle infrastructure (stations and bike lanes) [24]).

Its motorization rate is not high when compared with Florianópolis, for example. In Rio de

Janeiro, mortality is predominant with cars and motorcycles (Figure 7e).

Figure 8 shows the average travel time to go from home to work and the share of total household income spent on public transportation for each city. It is possible to observe that in Rio de Janeiro, the average travel time is higher than in other cities despite various means of transportation. The share of total household income spent on public transportation is high in all cities.

The selected capitals are metropolitan areas. Other nearby cities is dependent and generates pendulum movement: daily movements to go to and from work, school, leisure services, health, and commerce. A Brazilian study found that metropolitan commuting movements are carried out by people whose income varies significantly. The majority's average income was up to two minimum wages, while the minority had income above twenty minimum wages [26]. In Brazil, the pendular movements allow researchers to know the population movements related to the metropolises' outskirts.

The number of public vehicles and motorization rates does not result in mobility and accessibility to the population. In general, low-income people live in the outskirts, are Afro-descendants, and are the population who suffer more due to lack of adequate transportation.

Bastiaanssen et al. [27] conducted an exhaustive literature review study and concluded that job seekers might benefit from public transport strategies targeted at improving their access to jobs. However, bringing new employment opportunities closer to unemployed people can help even though it is difficult to perform.

In Rio de Janeiro, 15.4% of the black or brown students in the 9th grade of elementary school did not attend school due to lack of security on the way home-school or at the school itself. Among the whites, the rate was 13.1% [28].

Figure 9 shows the number of deaths of black and brown people due to transportation accidents. It can be observed that Macapá and Maceió have a higher number of black and brown people deaths, Rio de Janeiro and Vitória the percentage was similar while in Florianópolis, the percentage was higher for the white population.

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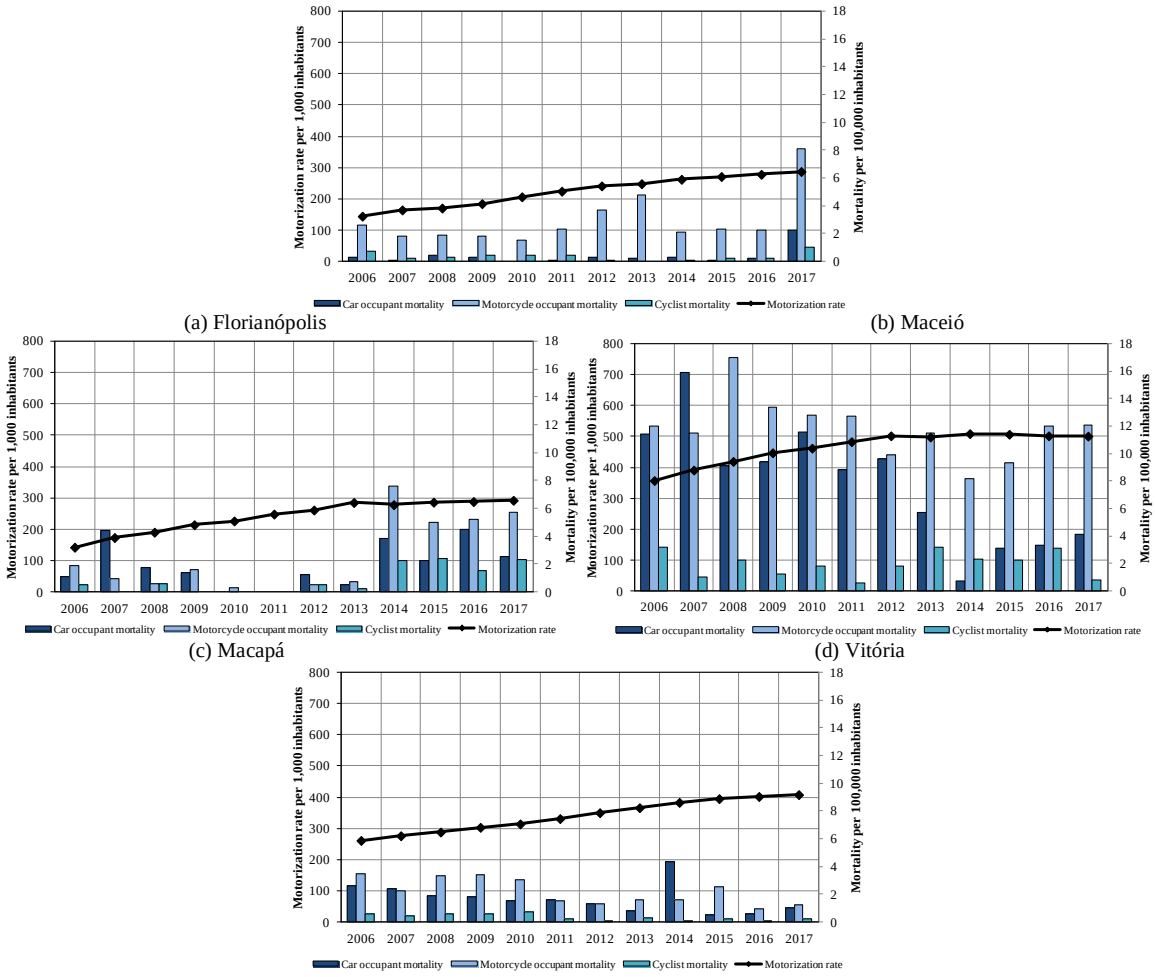
Table 1. Characteristics of the five cities (Based on [16]).

Characteristics	**Cities**				
	Florianópolis	**Maceió**	**Macapá**	**Vitória**	**Rio de Janeiro**
Region	South	Northeast	North	Southeast	Southeast
Estimated population (2019) inhab.	500,973	1,018,948	503,327	362,097	6,718,903
Population in the last census (2010) inhab.	421,240	923,748	398,204	327,801	6,320,446
Demographic density (2010) inh/km^2	623.68	1,854.10	62.14	3,338,30	5,265.82
Municipal Human Development Index (MHDI)	0.847	0.721	0.733	0.845	0.799
Average monthly wage of formal workers (2018) (Brazilian minimum wage)	4.8	2.8	4.3	4.0	4.2
Schooling rate from 6 to 14 years old (2010) (%)	98.4	95.0	94.8	97.6	96.9
Gross Domestic Product (GDP) (2017) US$	8,032.52	4,242,02	4,210.98	11,155.84	10,355.24
Afforestation of public roads (2010) (%)	32.0	47.1	66.0	65.4	70.5
Urbanization of public roads (2010) (%)	54.4	57.1	8.8	78.7	78.4
Unemployment rate (persons aged 14 and over)					
White population (%)	6.1	11.5	17.3	8.4	11.9
Black or brown population (%)	7.4	19.1	20.7	15.4	17.0
Rate of underutilization (persons aged 14 and over)					
White population (%)	12.2	17.1	27.0	14.5	16.8
Black or brown population (%)	14.3	26.7	36.1	21.4	22.4

Table 2. Fleet of vehicles in each city (Based on [14, 17, 18]).

Vehicles	**City**				
	Florianópolis	**Maceió**	**Macapá**	**Vitória**	**Rio de Janeiro**
Car	226,784	190,194	65,206	125,370	4,511,484
Micro bus	917	1,179	346	1,019	38,671

Motorcycle	48,703	72,556	48,160	22,413	950,025
Scooter	9,695	4,713	9,006	4,048	169,95
Bus	1,901	2,173	900	945	44,803



(a) Florianópolis (b) Maceió

(c) Macapá (d) Vitória

(e) Rio de Janeiro

Fig. 7. Relationship between motorization rate and mortality in accidents (Based on [25]).

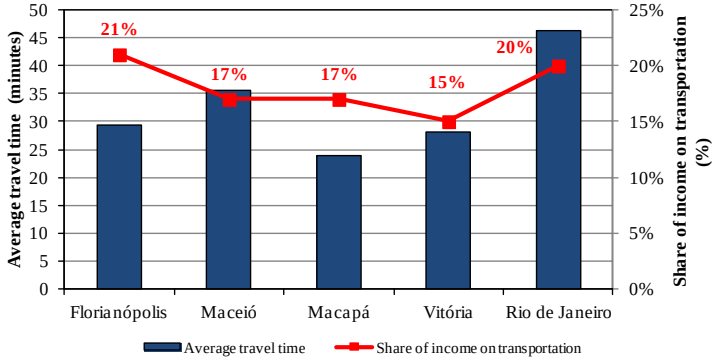


Fig. 8. Travel time average (Based on [25]).

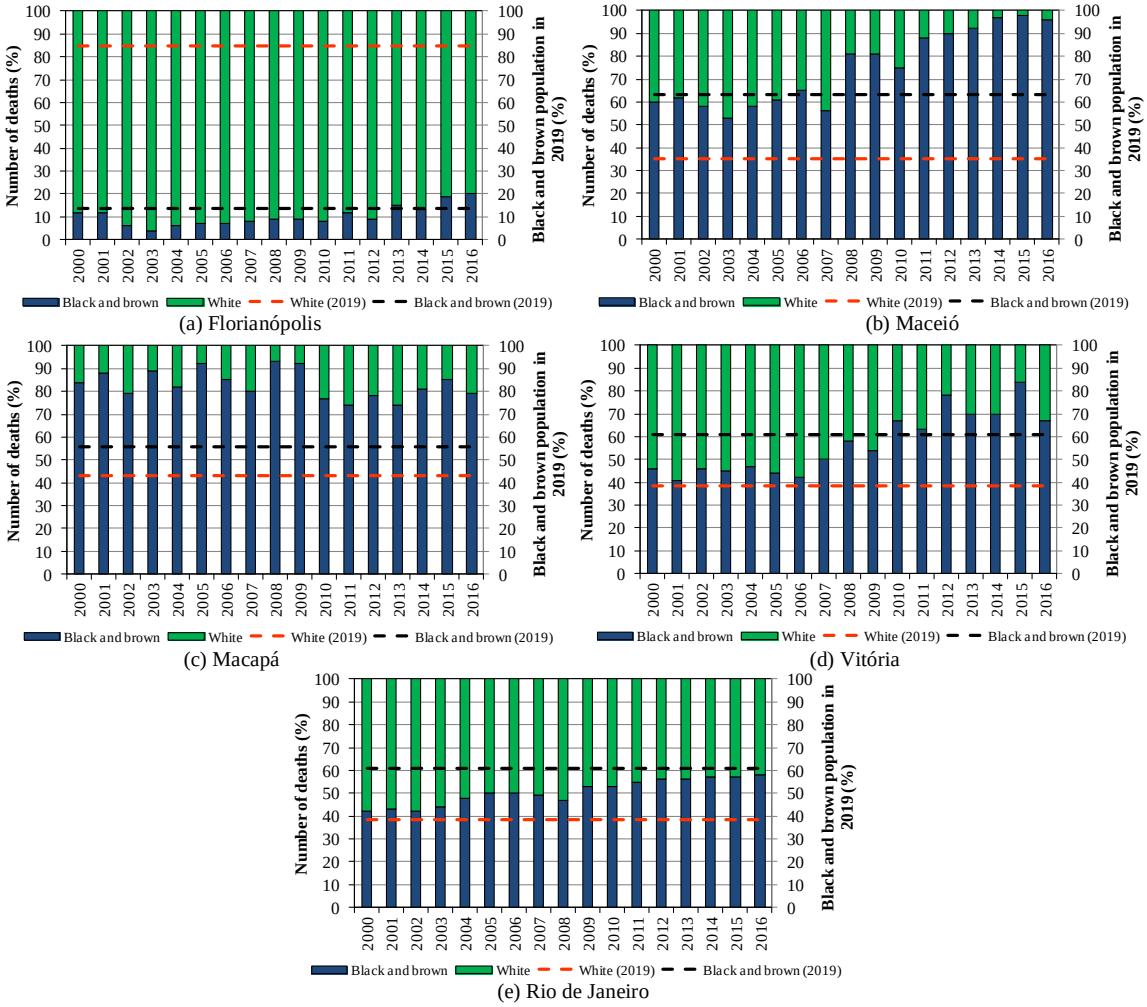


Fig. 9. Number of deaths due to transportation accidents according to skin color (Based on [25]).

It is important to assess racism concerning violence in Brazil, as well. The Brazilian Institute of Geography and Statistics reported that there was an increase in the homicide rate of the black and brown population from 2012 to 2017, i.e., from 37.2 to 43.4 per 100 thousand inhabitants, while such indicator remained constant for the white population, i.e., around 16.0 [14]. According to data from the Brazilian Mortality Information System, 255 thousand deaths of black people by murder were registered over that period. Among white youths aged 15 to 29, the rate was 34 deaths per 100,000 inhabitants in 2017. There were 98.5 murders per 100,000 inhabitants among the blacks and browns, but for black men in this age group, the homicide rate rises to 185. As for young women, the rate is 5.2 for the white and 10.1 for the black and brown [15].

Table 3 shows how black and brown people are inserted into the job market. In general, they occupy lower-paid positions, and they are less represented in managerial positions, especially those at higher levels. Besides, on a broader scale, the black and brown populations are below the poverty line, and they live in households with worse conditions and less access to goods and services than the white population [17, 18, 29].

Although most Brazil's population is black or brown, they are the most negatively affected in terms of housing conditions, health services, education, employment, leisure, and access to means of transportation. Regarding access to means of transportation, this is a parameter that is difficult to measure because it is not an isolated factor. In other words, to remodel transportation means and make them accessible to all, it is necessary to improve the infrastructure and the quality of life of the least favoured people. In general, this part of the population lives in the outskirts, in precarious houses, streets without a sewage system, without paving and often without access to drinking water.

Table 3. Comparative parameters of racial inequality in Brazil in 2019 (Based on [14]).

Comparative parameters	**Skin color**	
	White	**Black/brown**
Managerial positions (%)	66.6	29.9
Underutilization (%)	18.8	29.0
Political representation (%)	75.6	24.4
Income distribution and housing conditions		
Inferior to US$ 5.5/day (%)	15.4	32.9
Inferior to US$ 1.9/day (%)	3.6	8.8
Illiteracy rate		
Urban (%)	3.1	8.8
Rural (%)	11.0	20.7
Violence rate (per 100,000 people from 15 to 29 years old)		
Total	34.0	98.5
Men	63.5	185.0
Woman	5.2	10.1

The data collected from Brazilian Government Agencies were not enough to measure precarious access and the quality of means of transportation used by this population. However, considering that the poor and black people, in general, live in the outskirts of slums, need transportation to go to work or study, underline important governments' important actions.

Another point is related to racial insult, which goes unnoticed by society even though it is a crime. It is important to understand the point of view, the history, and the actions performed by other countries, where there is also racial inequality.

Equitable transportation systems are fundamental for building healthy communities [30]. However, transportation policies and regulations have not included guidelines or measures to prioritize and implement projects that improve equity. The main strategies to prioritize inclusion are:

- Reframe the transportation conversation;
- Allocate funding and resources equitably;
- Improve the quality and diversity of transportation leadership;
- Prioritize historically underrepresented communities in transportation decision making;
- Work in unison to provide people-focused infrastructure;
- Invest in communities to avoid displacement.

In Brazil, it is clear that the priority is to invest in education and increase access to African-descendant people's jobs and opportunities. However, these actions can only be implemented appropriately based on integrated transportation planning, including different transportation, to serve poor communities. Unlike developed countries, Brazilian metropolises have not invested adequately in subway systems, for example.

Considering that transportation means participate directly in access to job opportunities, health services, and education, transportation can contribute to minimizing inequality. In all cities evaluated, it was observed that the white and high-income populations have more access to opportunities than blacks and poor.

The concentration of activities in urban areas, associated with transport networks' performance, improves accessibility levels to the city centre (observed in Rio de Janeiro). At the same time, the lack of opportunities was evident in the outskirts.

Bastiaanssen et al. [27] affirmed that there are many other factors to consider outside of transport supply such as education and skills and employment opportunities, which must be considered in the analysis.

Concerning that problematic, the Brazilian Institute of Applied Economic Research presented a diagnosis of accessibility inequality. It concluded that the black/brown and low-income populations have less access to jobs, health, and education opportunities, regardless of the means of transportation [31].

The study added that nowadays, the conditions of accessibility in Brazilian cities reflect Brazil's historical urban development processes. However, the patterns of organization of urban space and transportation systems that determined inequalities may change. The levels of inequality in access to opportunities resulted largely from governance and public policy decisions adopted in cities.

The Brazilian Institute of Applied Economic Research considered an optimal scale of service for each public service according to the costs to achieve quality [31]. For example, in health care, for local health centres, geographic coverage will require greater physical proximity of the population

that lives in the neighbourhood. However, in highly complex health services, a greater physical distance from services would be more efficient.

On the other hand, as for the job market, the location of jobs would be influenced by agglomeration economies that will naturally cause some spatial inequality in access to jobs. Though, from distributive justice, the least expected is that these policies reduce inequalities in access to opportunities, prioritizing the improvement of working and transportation conditions of people in a vulnerable situation and that most depend on public and active transportation [31].

As for rail transportation, a study developed in China [32], recommended that, for developing countries, the rail transit expansions are likely to be cost-effective in cities with congested road traffic, with an enough number of high population density work locations and residential communities along rail lines.

In Rio de Janeiro, there is rail transportation, mainly in the suburbs. However, differently of Wu et al. [32] recommendations, even though the city presents congested road traffic and high-density population, along the rail lines have no residential communities or job. The poor population use this transportation means only to travel for work or school.

The Brazilian racial inequality scenario is described as a poor population. Most of them live in the outskirts, with infrastructure problems, lack of access to transportation, and basic rights. In all Brazilian regions, the black and brown population's socio-economic situation has disadvantages compared to other population groups [33].

Lucas et al. [34] evaluated the relationship between travel poverty and social disadvantage at the local geographical level. The authors assert the need for urban policymakers to accurately consider and target micro-scale factors as household income, age, gender, and employment status when to introduce transport means interventions in reducing social exclusion amongst low-income urban populations.

Moreover, the negative stereotype phenomenon of black and brown physical traits underlies the mechanism of "police suspicion". Because of this, blacks and browns are the preferred victims of police and security guards' arbitration on the streets, in public transportation, in department stores, banks, and supermarkets [35].

As described in this study, in Brazilian society and the main centres of development, discrimination, and inequality are present. They are centred on the spaces of housing, job market, and income. The black and brown population has been insulted with discriminatory and racist words/expressions over the years.

The transport policy has to ensure that all Brazilians can access good transportations, independent of social class, colour, and progeny. To change this scenario, firstly, initiatives outside the transport sector must be implemented. Also, actions to mitigate racial discrimination should be implemented. From this study, the following improvements are suggested:

- Federal Government must seek guarantees for freedoms and individual rights, regardless of sex, race, religion, ethnicity, colour, and social class. Although since 1989 the racial discrimination constitutes a crime in Brazil, blacks and browns have no guarantee of compliance with the law;
- Ensure education and equal opportunities for all citizens, regardless of colour or race;
- It is necessary to democratize the spaces of the cities, expanding mobility and decentralizing investments in infrastructure, which are currently present mainly in the noble and central spaces of large metropolises;
- Promotion of an investment policy for structuring public transportation services, assessing travel quality. In this way, inequalities would be minimized for the majority of the population who need these services and who travel daily through crowded buses, trains, and subways over long distances;
- Public investments in road infrastructure in segregated areas of cities. In many Brazilian cities, the public services and jobs are concentrated in selected neighbourhoods, and with the improvement of the road infrastructure, consequently, the provision of services would reduce the need for poor to travel for long distances;
- Intensify occupation and improve the quality of public spaces around transportation corridors;
- Improve conditions for the movement of pedestrians and the implementation of cycle paths, which will contribute to improving the health of the population and reducing emissions that cause air pollution and climate change;
- Increase equity of access to cities' opportunities and services through safe, accessible, sustainable transportation systems. This action will contribute to road safety, expansion of public transportation and conditions of accessibility to the vulnerable;
- Prioritize the use of roads by public transportation instead of private cars.

The poorest population in Brazil, predominantly blacks and browns, and racial inequality, face problems regarding public

transportation quality. A survey conducted by the National Confederation of Industry pointed out five measures that must be implemented to improve Brazil's public transportation, such as increasing the frequency, reducing fare, increasing security, guaranteeing punctuality, and decreasing travel time [36].

Despite the incentive to higher education for blacks and browns, dropout rates are not addressed. In other words, admission into universities and colleges was provided, but, on the other hand, there are no improvements in housing, urban infrastructure, and access to means of transportation.

The data also showed that racial inequality manifests in the dimension of violence. As in education, this scenario requires public policies focusing on the black and brown young population.

A research conducted by Bryceson et al. [37] in sub-Saharan Africa showed some similarities in Brazil. The authors concluded that reducing inequality in transportation means can be promoted through effective zoning and residential and transport planning. Government policies must include good access to work, educational and health services, recreation,

As for political representation, black and brown people are underrepresented in all levels of legislative power. In Brazil, overcoming racial inequalities, in all dimensions, remains a challenge [38].

Jacob [39] adds that in post-slavery Brazil, the Racism against Afro-descendants was different from the segregation practised in South Africa. In Brazil, Afro-descendants did not suffer legalized segregation under the spatial or institutional aspect.

In this case, as the blacks were and are the poorest, the agglomeration occurred in slums and neighbourhoods on the outskirts of cities, constituting segregation established in practice.

Even considering that there were no formal legal restrictions related to the choice of housing, access to public places or means of transportation, racism, and racial discrimination in Brazil are still evident. Since 1989 the Law No. 7716 defines crimes resulting from racial or colour prejudice established that Racism in Brazil is a crime whose prison sentence is up to five years [40].

Transport reality in developing countries has many contrasts, and because of this, it is not easy to promote comparison with developed countries. The lack of data is one of the problems in developing countries. Also, one of the main barriers to a better policy understanding of the problem of transport poverty is the level and sophistication of the available data that is needed to research the problem in any significant and geographically specific way [41].

Serulle and Cirillo [42] complement that, for extremely low-income households, the lack of transportation means hindering them from reaching job opportunities. Giuliano [43] asserts that it is not enough to offer only means of transport for the peripheral population, but this service must be satisfactory.

VI. CONCLUSIONS

In this study, racial inequality related to means of transportation in Brazil was assessed. Brazil is a country with great social differences and racial inequality.

Although most of the population is black or brown, this is the most excluded part of society and segregated in relation, for example, to transportation. This condition has resulted from more than three hundred years of slavery in Brazil. However, more than a hundred years after the end of slavery, Afro-descendants are still discriminated against their skin colour and represent the majority and the poorest population.

Population data and their conditions about transportation means were evaluated in five Brazilian capitals, for white and black and brown people. For all the parameters evaluated, it can be stated that, in Brazil, black and brown people have a lower level of education, live in worse conditions, need more public transportation, die in transportation accidents more often than the whites. Besides, they suffer discrimination through racist words. Also, it was observed that racial inequality had affected less the younger generation than to the older population (60 years or more).

Considering that means of transportation participate directly in access to job opportunities, health services and education, this system's improvement can contribute to minimizing inequality. In all cities evaluated, it was observed that the white and high-income population has more access to opportunities than blacks and the poor. Also, the concentration of activities in urban areas, associated with transportation networks' performance, improves accessibility levels to the city centre while the lack of opportunities in the outskirts was obvious.

Means of transportation, especially the public, must be understood as an essential service and a social right. The promotion of improvements and access to means of transportation should prioritize the least privileged population, which is the one that uses them the most. In Brazil's case, the least privileged population is composed of black, brown and poor people. Providing good-quality for transportation to these people is a way of improving

their quality of life. Beyond that, the conditions of transportation offered by a country to the population can reduce the racial disparity and discrimination that still exists in the country.

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