Covid-19 and the worsening of inequalities in the Metropolitan Region of Rio de Janeiro

A Covid-19 e o agravamento das desigualdades na Região Metropolitana do Rio de Janeiro

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Abstract

This article deals with the impacts of Covid-19 on the income of the population living in the Metropolitan Region of Rio de Janeiro. The analysis of data from a web survey confirms the hypotheses pointed out in the international literature regarding the role of the Covid-19 pandemic in the worsening of pre-existing social inequalities. Also, the article shows that the inequalities occur in the peripheral areas of the Rio de Janeiro Metropolis, where the negative impacts are much greater compared to other areas. Economic security has become more unequal in the Covid-19 pandemic when we compare the inhabitants' dwelling place, skin color, and gender.

Keywords: inequalities; Covid-19; Rio de Janeiro; economic insecurity.

Resumo

Este artigo trata dos impactos da Covid-19 na renda da população da Região Metropolitana do Rio de Janeiro. A análise dos dados da aplicação de um web-survey confirma as hipóteses apontadas na literatura internacional no que diz respeito ao papel da pandemia de Covid-19 no agravamento de desigualdades sociais preexistentes. Além disso, o artigo informa que as desigualdades ocorrem nas áreas periféricas da metrópole fluminense, nas quais os impactos negativos são comparativamente muito superiores aos de outras áreas. A segurança econômica tornou-se mais desigual adiante da pandemia de Covid-19, quando comparados o lugar de moradia, a cor e o gênero dos habitantes.

Palavras-chave: *desigualdades; Covid-19; Rio de Janeiro; insegurança econômica.*

In addition to triggering an unprecedented health crisis, the Covid-19 pandemic has significantly affected the Brazilian economy. According to the National Household Sample Survey (Pnad-Covid19) carried out to measure the impacts of the new coronavirus, 77.8% of companies operating in Brazil have reported that Covid-19 had a negative impact on this economic branch – 13.5% of them had to reduce the number of employees and, of these, 10.5% have reduced this number by more than 50%. The impact of Covid-19 on the labor market was also significant. Unemployment rate, which recorded 10.5% in early May 2020, reached 13.3% in early August. Parallel to the increased unemployment rate of 2.8 percentage points recorded within three months, the worsening process observed in the labor market resulted in loss of earnings. According to Pnad-Covid19, 30.7% of employed individuals in July 2020 had lower income than the routine ones. These data have also indicated that black or brown individuals, as well as those with lower schooling, were the ones most negatively affected by the economic impacts caused by Covid-19.

The present article has shown that social inequalities, worsened by the Covid-19 pandemic, had highly negative impacts on peripheral zones, such as the Metropolitan Region of Rio de Janeiro City. Based on results of a web-survey carried out in early April 2020, the current article was an original contribution that joined the efforts of other researchers who aimed at better understanding the socio-spatial consequences of the Covid-19 pandemic to the country's second-largest metropolis (Britto et al., 2020). Before presenting the data analysis, the present study addresses some issues approached by the international literature about the association between Covid-19 and socioeconomic inequalities. It also highlights two important features of the metropolitan socio-spatial context, namely: the spatial inequality in income distribution and the crisis in the labor market.

Covid-19 and the risks of worsening inequalities in Brazil

The pandemic caused by the new coronavirus is the greatest challenge faced by mankind since the end of World War II. Covid-19 is seen as a major global systemic shock that has achieved impressive numbers in several fronts, such as infected and dead patients, children and young students forbidden to go to school, bankrupted firms and unemployed individuals, among others. The great lockdown (a term coined by the International Monetary Fund – IMF to define the set of measures taken to stop the economy due to social exclusion) is a challenge of unprecedented magnitude, since the economic crisis generated by it did not derive from macroeconomic fundamentals, as seen in previous crises, but rather from sanitary health issues.

The economic and social impacts caused by the Covid-19 pandemic are massive and the recovery efforts to be taken will have unprecedented magnitude and require some time for the economy to reach the pre-crisis indicators. According to estimates by IMF (2020), the global economy will shrink by approximately 5.1% in 2020, in comparison

to the 3.0% growth recorded in 2019. These figures result from the isolation and social distancing measures put in place by almost all countries in order to control the pandemic.

Although the effects of the pandemic can be felt in several countries worldwide, it is clear that the poorest countries, as well as those classified as developing countries, are the ones mostly affected by the crisis, mainly due to structural weaknesses observed both in the offer of public goods and productive structure, as well as to fiscal and financial limitations. Brazil, for instance, is expected to present a decrease by 8.1% in its gross domestic product in 2020, whereas the number of unemployed citizens can exceed 20 million individuals, based on estimates (Pnad-Covid19).

Worsened inequality at a global scale is one of the expected effects of the pandemic, which confirmed and strengthened a phenomenon that had previously stood out in the international debate. At the time rumors about the current pandemic started, there was a strong idea that everyone was in the same boat, i.e., that this crisis would equally affect all social classes, in different countries, worldwide. It may be the reason why the narrative that this virus would make us equal, regardless of the social class we belonged to, has gained some echo at the beginning of the Covid-19 pandemic.

However, the opposite has proved to be the case and Covid-19 became the factor capable of reinforcing pre-existing inequalities, since it reached the poorest social strata or groups, due to their highly vulnerable condition. On the one hand, black, indigenous and elderly individuals form the groups most susceptible to the incidence of severe disease cases and death. Women and children, in their turn, are strongly affected by the consequences of the pandemic due to factors such as work overload and higher exposure to domestic violence, learning deprivation and lack of interaction with other children due to school closing, and the risk of having their psychical health compromised, among others.

Thus, according to Milanovic (2016), two main forces are acting to reduce inequality. "Benign forces" would encompass all political and economic actions whose main goal would be to reduce inequalities; among them, one finds governmental transfers, investments in education and progressive income taxation. On the other hand, "malignant forces" would be those over which there would be no control, such as wars, epidemics and natural disasters. These forces would be malignant because, although they could reduce inequality, they could also reduce economic wealth in a given country.

However, the idea suggested by Milanovic (ibid.) about the expected effects of "malignant forces" on inequality appears to be only partly valid. Although the aforementioned author was right about income reduction for all, his proposition disregards the fact that such a loss is greater for strata where labor (wages) is the only source of income and assets.

Brazil is a continental country historically acknowledged as one of the most unequal nations in the group of developing countries. Inequalities in the Brazilian economy can be seen at different scales (regional, gender, skin color, functional); they are historically identified as the matrix of the main economic and social issues in the country. Piketty (2014) has emphasized that Brazil is the country where the richest 1% of the population holds

the highest wealth concentration. In 2015 - the most recent year presenting data on Brazil -, 27.8% of national income was in the hands of the richest 1%; this value is even higher than the income rate held by the richest 1% in the Middle East. The survey has also shown that the richest 10% in Brazil held 55% of the total income – only lost the first position in this ranking to the Middle East (61%). With respect to Europe, 37% of the national income is held by the richest 10%.

Thus, the fear that the pandemic would worsen inequalities in the country, which would suffer a major setback, is not unreasonable; it became the main concern among several scholars and public managers. The international and national literature on the risks of increasing inequalities due to Covid-19 has highlighted the main transmission channels capable of further worsening the income distribution issue in the medium and long-terms.

These studies (Blundell et al., 2020; Neidhöfer, 2020; Nyqvist et al., 2020) are based on data and scenarios observed in other pandemics (Ebola, in Africa; and H1N1, in Asia), as well as on studies conducted in different regions of the United Kingdom, during the current pandemic context. Results have pointed out an important way to think about the Brazilian reality, mainly because all the addressed transmission channels are also observed nowadays as effects of the Covid-19 on the country's economy and daily life. These channels would have immediate effects, but mainly intergenerational effects capable of affecting the quality of life and economic conditions of low-income social strata.

Education is the first transmission channel. Isolation or social distancing policies resulted in closed schools and educational institutions, a fact that kept a large number of children and young students away from the classrooms; some of them did not have access to any type of formal educational activity. Data provided by the United Nations have indicated that 189 countries experienced some degree of closure of educational institutions, which kept approximately 1.5 billion students away from schools.

Children and young individuals belonging to the most vulnerable social strata are clearly at disadvantage in comparison to the ones belonging to wealthier social groups. Homeschooling brings along a set of physical and cultural demands that are not always met in the poorest homes, such as regular access to the internet, computers and other computer equipment, as well as individualized family and professional support. The great risk expected from this scenario lies on the extension of the qualification and knowledge acquisition gap between the richest and the poorest, a fact that may condemn an entire generation to have lesser qualified jobs in the future. Since education is the main factor determining the occupation of more qualified, safe and better-paid job positions, the effects of the pandemic on the education of the poorest population have great potential to reinforce the existing inequalities, mainly in countries with large educational deficit, such as Brazil.

Health is the second transmission channel reinforcing inequalities in pandemic times. If the number of infected and dead individuals gets concentrated among the

poorest, there would be greater family destabilization and loss of income among them. In addition, Covid-19's poorly-known side effects could lead to a larger number of disabled or work-limited individuals among the lower-income classes, as well as affect the social condition of entire family groups. Similar to what was observed in previous health crises, the risk of orphanhood is also higher among the poorest, a fact that may lead children and young individuals to interrupt their studies and join the labor market early in life, mainly in job positions that require low qualification and offer low income and safety conditions.

Finally, income is the third transmission channel; it is associated with the labor market and with accumulated personal wealth. Local labor markets are abruptly and quickly affected in pandemic times when measures are taken to restrict urban mobility. Individuals with higher schooling and, consequently, with the best-paid workers account for almost 100% of the group for whom home office has become a real option during the Covid-19 pandemic. Thus, despite the losses associated with their workload and emotional burden, these individuals achieved greater stability in terms of occupation and, mainly, income. Low schooling workers were the most affected by the great lockdown, many of them almost right after the announcement of social isolation measures. Income loss was almost immediate, mainly in the service labor market, which naturally depends on commuting to and from cities, notably among workers at the most fragile conditions, such as those employed in informal sectors, who had to fully stop their activity due to mobility restriction measures.

It is worth emphasizing that these three transmission channels are interconnected and that their effects interact with each other. For example, income decrease caused by higher unemployment rates leads to greater food insecurity and to inability to provide the material conditions necessary to enable remote school education; consequently, it affects the education and health fields. The most disadvantaged groups, mainly populations living in urban peripheries of large national metropolises and rural areas with large deficit of basic social infrastructure, would be severely affected by Covid-19 based on these channels.

The following section analyzes the impact of the pandemic on economic insecurity in the Metropolitan Region of Rio de Janeiro City, which is featured by intense social, economic and spatial inequalities. It was affected, more than any other large Brazilian city, by the impacts of the economic crisis that has been plaguing the country since late 2014.

The Metropolitan Region of Rio de Janeiro – Brief history

The Metropolitan Region of Rio de Janeiro (RMRJ)[1] was created in 1974 to institutionalize the urban sprawl from the former federal capital towards its immediate periphery, which was then known as "Grande Rio" (Great Rio). The period when Rio de Janeiro City played the role of federal capital enabled regular and stable resource flow due to the centralization of the managerial functions of the Federal Government. Despite the low dynamism of
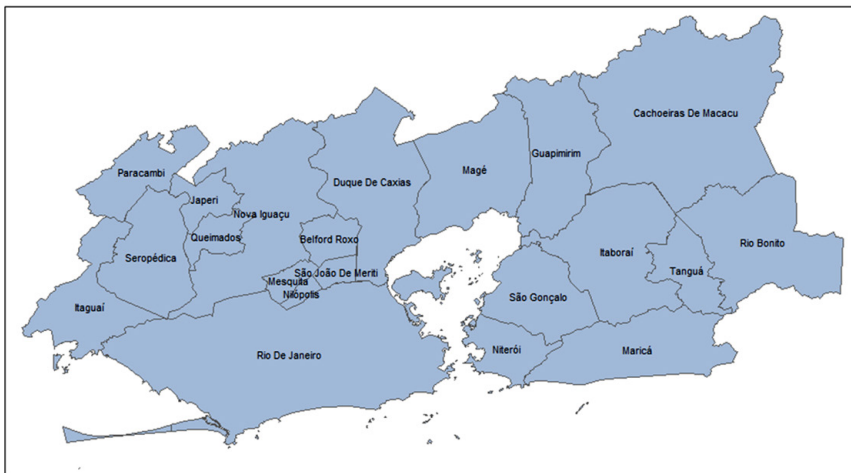
Rio de Janeiro's economy at that time, these resources (much of the collected taxes) should, by legal definition, be applied within the limits of Rio de Janeiro City's territory; consequently, areas such as Baixada Fluminense were defined as dorm space of the working mass.

These metropolitan regions were created within the same context of the urbanization process faced by the country and, consequently, it suffered with all its contradictions. The design applied to such metropolitan regions aimed at integrating the municipalities forming them in order to easily implement policies common to them. However, the centralizing and authoritarian bias of the law that has created the RMRJ intensified jurisdictional conflicts among entities involved in the process, and it ended up disrupting the provision of basic urban infrastructure, transportation and sustainable water resources management services.

According to the Metropolitan Chamber of Rio de Janeiro, such a fact has led "to a process of urbanization of our metropolis that generated fragmented spaces and brought along functioning issues and environmental inadequacy" (Câmara Metropolitana, 2016).

RMRJ was recently redefined by complementary law n. 184/2018. Nowadays, it comprises 22 municipalities (Map 1), namely: Belford Roxo, Cachoeira de Macacu, Duque de Caxias, Guapimirim, Itaboraí, Itaguaí, Japeri, Magé, Maricá, Mesquita, Nilópolis, Niterói, Nova Iguaçu, Paracambi, Petrópolis, Queimados, Rio Bonito, Rio de Janeiro, Seropédica, São Gonçalo, São João de Meriti and Tanguá (Britto et al., 2020). These municipalities cover an area of 6.7 million km², and house approximately 12.2 million inhabitants, with emphasis on Rio de Janeiro City, which has 6,390,290 inhabitants (approximately 52% of the total), and they account for GDP of approximately R$405 billion.

Map 1 – Metropolitan Region of Rio de Janeiro – 2017

Source: elaborated by the authors based on georeference data made available by IBGE (available at: https://www.ibge.gov.br/geociencias/organizacao-do-territorio/malhas-territoriais/15774-malhas.html?=&t=o-que-e; access on: August 7, 2020).

The Metropolitan Region of Rio de Janeiro (RMRJ) is an expressive picture of social, economic, infrastructural and environmental inequalities observed in most Brazilian and Latin American cities. The main challenge to be faced by RMRJ lies on reducing strong inequality, mainly in Baixada Fluminense,[2] which accounts for approximately 30% of the population living in the metropolitan region and presents the worst social indicators observed in it.

RMRJ nowadays: conflicts and challenges

The substantial inequality featuring RMRJ has clear territorial expression, and it can be seen in income distribution data depicted in Map 2. It is clear that neighborhoods in Southern Rio de Janeiro City and Barra da Tijuca (green areas) concentrate the highest-income population. The income *per capita* in these neighborhoods is often higher than 5 minimum wages and it gets higher than 10 minimum wages in areas closer to the seashore, where the wealthiest people live in. The income *per capita* is often lower than 2 minimum wages in areas of Rio de Janeiro City, such as the so-called Zona Oeste (Western Zone – except for Barra da Tijuca neighborhood, which is close to the seashore) and Zona Norte (Northern Zone), as well as in other municipalities of RMRJ, except for Niterói, where a significant number of individuals belonging to the upper--middle-class lives in. The income *per capita* in extensive areas of Baixada Fluminense, Western Zone and other municipalities located in Guanabara Bay, may be lower than 1 minimum wage.

Map 2 – Mean income per capita (in minimum wage*)
in the Metropolitan Region of Rio de Janeiro – 2016

Legend
0 – 1/2 SM
1/2 SM – 1 SM
1 SM – 2 SM
2 SM – 5 SM
5 SM – 10 SM
Acima de 10 SM
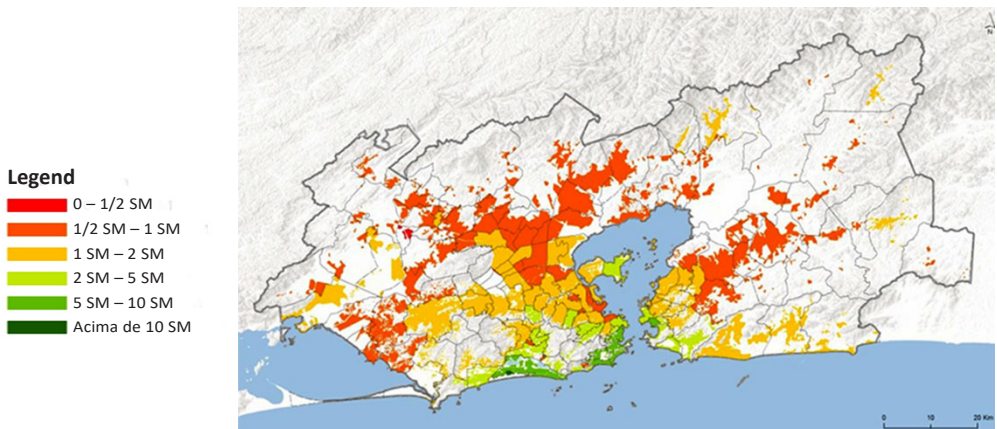
* The minimum wage is informed by SM in the legend.
Source: *Modelar a metrópole* (available at: https://www.modelarametropole.com.br/wp-content/uploads/2017/03/06-economia_-renda.jpg; access on: August 7, 2020).

The inequality exposed by the recent health crisis triggered by the new coronavirus is a well-known historical process that has followed RMRJ's growth since it was created in the 1970s. According to Osorio et al. (2020), Rio de Janeiro State recorded decreased participation in the national GDP by 38.8% between 1970 and 2017, which was the biggest loss among all federative units. Increased oil prices, several large investments in the exploration of hydrocarbons and the preparation of major sports events, such as the World Cup and the Olympic Games in the 2000s, have favored RMRJ's economy and resulted in significant improvement in the labor market. However, the labor market has rapidly deteriorated when oil prices started to fall in 2014, and the demand for workers in construction sites linked to major sports events in late 2015 decreased.

The comparison of unemployment rates among the main Brazilian metropolitan areas shows that the economic crisis that has been plaguing the country since 2014 was more intense in RMRJ than in any other region. Unemployment rates recorded in metropolitan areas are shown in Table 1; this information enables seeing that the labor market's condition has worsened in all major Brazilian urban centers since January 2015. However, there were significant differences between them; the most significant worsening was observed in the Metropolitan Region of Rio de Janeiro. At that time, RMRJ recorded the lowest unemployment rate among Brazilian metropolitan areas (3.21 points below the average recorded for other areas). Five years later, one month before the health crisis broke out, RMRJ unemployment rate became the third-highest among all metropolitan areas;

it was only surpassed by unemployment rates recorded for Salvador and Recife. Its unemployment rate (14.80%) was 1.63 points higher than the average recorded for other regions. In other words, the unemployment rate increased by 8.8 points in RMRJ, whereas it increased by 3.967 points in other metropolitan areas, on average. This outcome has generated a severe social crisis.

Therefore, the health crisis caused by the Covid-19 pandemic emerged in a scenario of economic crisis and social, economic and spatial inequalities. Does the Covid-19 pandemic deepen the social, economic and spatial inequalities featuring the metropolis of Rio de Janeiro? Are individuals living in peripheral areas, such as Baixada Fluminense, more likely to experience income decrease due to the effects of Covid-19 on the labor market than individuals living in the Southern Zone of Rio de Janeiro City? And do white men living in the Southern Zone of Rio de Janeiro City have much better chances of maintaining their income than brown or black women living in the Western Zone? What were the professional categories that mostly experienced income losses due to the Covid-19 pandemic?

Data

An online survey (web-based survey) was conducted in mid-April 2020 in order to collect information capable of answering the aforementioned questions. Although this survey type has restrictions that cannot be minimized (representativeness issues deriving from sample bias are the most prevalent

Table 1 – Unemployment rate in the main Brazilian metropolitan areas
between 2015 and 2020

	Metropolitan Region								
	Rio de Janeiro	Fortaleza	Recife	Salvador	Belo Horizonte	Belém	São Paulo	Curitiba	Porto Alegre
01/2015	6,00	7,80	7,70	14,80	9,70	13,40	8,70	5,30	6,30
04/2015	6,50	8,80	7,10	16,80	9,2 0	12,90	9,30	5,90	6,70
07/2015	7,60	9,60	10,20	17,10	9,70	11,90	9,80	5,70	7,30
10/2015	7,70	9,20	11,80	14,60	10,20	11,90	10,60	5,20	7,00
01/2016	9,20	11,50	13,40	18,40	13,10	13,60	12,60	8,90	8,30
04/2016	10,70	11,80	14,60	19,20	13,90	14,00	12,70	8,90	10,10
07/2016	11,60	14,20	16,50	19,60	14,40	15,60	14,00	9,40	10,40
10/2016	13,20	12,00	15,80	19,10	13,60	13,90	13,50	8,90	9,90
01/2017	14,30	14,00	18,00	18,30	15,80	15,40	15,20	11,20	10,90
04/2017	15,60	13,50	19,70	19,10	16,20	14,00	14,60	10,40	10,20
07/2017	14,50	11,40	20,00	18,30	16,20	14,10	14,20	10,90	9,50
10/2017	15,20	10,60	18,60	16,50	13,50	12,60	14,20	10,90	10,30
01/2018	14,90	13,30	19,20	19,20	15,70	13,80	15,00	12,10	10,40
04/2018	15,70	12,30	18,70	20,30	14,10	14,10	15,00	11,60	10,10
07/2018	14,60	11,60	18,70	18,20	13,50	14,40	14,60	10,20	10,10
10/2018	15,10	11,00	16,60	17,30	12,60	12,20	14,20	9,10	8,90
01/2019	15,40	12,70	17,70	18,70	13,20	14,30	14,80	10,10	8,90
04/2019	15,40	11,70	17,90	18,60	11,70	14,80	14,10	10,00	10,10
07/2019	15,00	12,10	18,10	16,70	11,80	15,00	13,10	10,80	10,10
10/2019	13,90	10,60	15,50	16,40	11,00	12,40	12,70	8,30	8,80
01/2020	14,80	12,60	15,20	18,90	13,50	12,70	13,50	9,20	9,80

Source: Ipeadata (available at: http://ipeadata.gov.br/beta3/). Access on: August 7, 2020).

ones), it is a low-cost instrument used to collect opinions and preferences anonymously with quality responses (Weber and Bradley, 2006); Moreover, it does not critically affect the most significant association patterns (Heiervang and Goodman, 2011).

Thus, the analysis presented below has focused on assessing the association between economic insecurity (measured based on the impact of the Covid-19 pandemic on the likelihood of losing income) and participants' social features, more specifically their place of residence, self-declared color, gender, age and socio-professional occupation. However, it is important to present a quick description of variables composing the informational basis of the sample before analyzing these associations.

In total, 2,651 questionnaires were completed. Of these, 168 were discarded, either because they omitted most of the requested information or because they referred to individuals who did not live in RMRJ. Thus, the analysis was based on information deriving from 2,483 questionnaires. Participants' spatial distribution is shown in Table 2.

Baixada Fluminense was the RMRJ place presenting the largest number of completed questionnaires: 1,310 in total. The number of collected questionnaires was significant, since having access to information on RMRJ's periphery can be a challenging task, mainly in pandemic times. It was followed by the Northern (n=391), Western (n=365) and Southern (n=242) Zones, as well as by downtown Rio de Janeiro City (n=55); the remaining RMJR municipalities accounted for only 120 completed questionnaires. Based on the total size of the sample and of the main subsamples (those with information recorded in more than 100 questionnaires), we can be more confident that, despite the limitations associated with the application of online surveys, the analysis of the initial impact of Covid-19 on economic insecurity among several RMRJ places provides robust and valid statistical information and knowledge about the topic.

With regard to ethnic/racial distribution, most participants identified themselves as white; they accounted for 52.74% of the sample, as shown in Table 3. Self-declared browns were the second most important group

Table 2 – Participants' spatial distribution

	Total	%
Southern Zone	242	9.75
Baixada Fluminense	1.310	52.76
Downtown	55	2.22
Others	120	4.83
Northern Zone	391	15.75
Western Zone	365	14.70

Source: research data – elaborated by the authors.

Table 3 – Sample composition based on ethnicity/color

	Total	%
White	1.307	52,74
Asian	2	0,08
Indigenous	12	0,48
Brown	806	32,53
Black	351	14,16

Source: research data – elaborated by the authors.

(32.53% of the sample); they were followed by black individuals (14.16%). The sample also comprised 2 Asian and 12 indigenous participants. It is worth emphasizing that the ethnic-racial distribution observed in the survey was not different from that recorded by the National Household Sample Survey (Pnad – Pesquisa Nacional por Amostra Domiciliar) carried out by IBGE. According to Pnad (2015),[3] the ethnic composition of RMRJ comprised 45% of white, 39% of brown and 15% of black individuals.

Women accounted for more than two--thirds of the sample – 1,708 fully-answered questionnaires (Table 4). Women's differentiated

participation is a feature that affects most web-surveys (Busby and Yoshida, 2015) since it leads to sample bias. However, given the large number of male participants (764 individuals, in total), the analysis of the association between economic insecurity and gender remained valid. The same cannot be said about the gender classified as "other" since the sample only presented nine records in this category. Consequently, it was not taken into consideration in the analysis.

Sample composition based on occupation type was another category presenting significant sample bias in the survey. According to Table 5, the survey was

Table 4 – Sample composition based on gender

	Total	%
M	764	30.79
F	1.708	68.84
Other	9	0.36

Source: research data – elaborated by the authors.

Table 5 – Sample composition based on occupation

	Total	%
Public server	727	29,29
Retiree	131	5,28
Unemployed	139	5,60
Housewife	64	2,58
Businessperson	55	2,22
Intern	78	3,14
Student	251	10,11
Freelancer/Side job	24	0,97
Microentrepreneur	123	4,96
Other	59	2,38
Independent professional	110	4,43
Salaried employee	554	22,32
Non-salaried employee	167	6,73

Source: research data – elaborated by the authors.

Table 6 – Sample composition based on income loss

	Total	%
No loss	698	31,93
Up to 10%	140	6,40
From 10 to 20%	230	10,52
From 20 to 50%	548	25,07
From 50 to 75%	308	14,09
Higher than 75%	262	11,99

Source: research data – elaborated by the authors.

answered by a large proportion of public servants. However, as previously mentioned, this bias did not invalidate analysis results about the association between income loss and occupation recorded for other occupation categories comprising a reasonable number of participants. The analysis of these associations allowed observing that sample subsets comprising more than 100 participants have guaranteed analysis validity. Thus, analysis results about the association between income loss and socio-professional categories, such as entrepreneurs, interns, housewives or "side jobs", should be interpreted with caution. However, one can safely rely on the validity of other results.

Finally, Table 6 shows the distribution of income losses. It was possible noticing that the Covid-19 pandemic had already affected the earnings of approximately 68% of participants in the second half of April 2020. More than a quarter of them had losses equal to, or higher than, 50%, and more than half of them had their income reduced by more than 20%. Who

else was affected by the significant increase in economic insecurity? What were the areas of RMRJ where economic insecurity increase was most intense? The current study has found the answer to these questions.

Economic insecurity and socio-spatial features

The analysis of the association between economic insecurity and socio-spatial features was performed in two different stages. First, this association was investigated in separate, based on simple correspondence analysis, which is a bivariate technique that enables the graphical representation of associations between two categorical variables (Fávero and Belfiore, 2017; Friendly and Meyer, 2015; Greenacre, 2017; Husson, Le and Pages, 2016). Next, a logit model for categorical data was generated in order to analyze the associations altogether (Agresti, 2003; Fox, 2015).

The graphical representation of the association between income losses and RMRJ's spatial profile is shown in Graph 1,[4] which is a perceptual map of similarities and differences between categories such as economic insecurity and different RMRJ zones. This graph translates their association on a two-dimensional plane, and it enables visualizing behavioral similarities and differences between categories.

Based on the coordinates, there are two fundamental oppositions. One between Baixada Fluminense and the Southern Zone and the other one between economic security (represented by coordinates of categories "no loss" and "up to 10%") and income loss higher than 20%. On the one hand, there was a correlation between Baixada Fluminense coordinates and the highest income loss, whereas, on the other hand, there was a correlation between the Southern Zone and economic security.

The analysis of the cross table, according to which, lines represent income loss categories and columns represent spatial RMRJ categories, has completed the graphical analysis. Table 7 presents the standardized residuals; positive values indicate a likely positive association between categories, whereas negative values indicate the opposite. On the one hand, the most significant associations take place between the Southern Zone and economic security, and, on the other hand, between Baixada Fluminense and income loss higher than 20%.

Graph 1 – Perceptual map of similarities and differences
between income loss and zones in the RMRJ
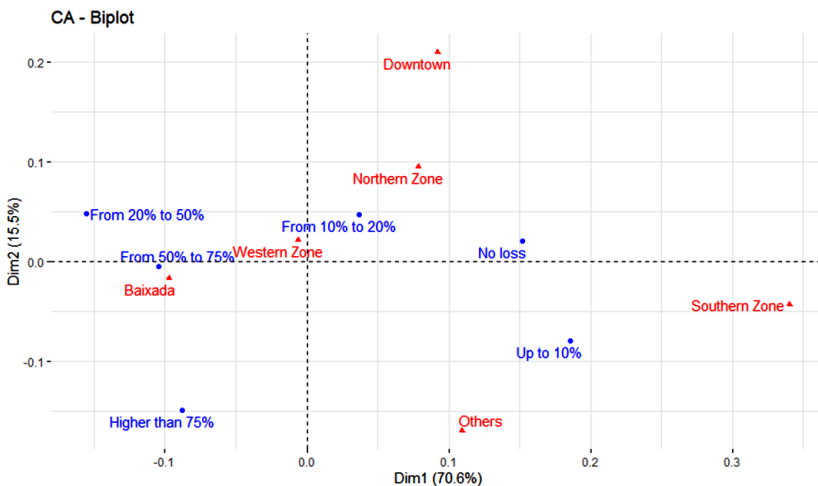
Source: research data – elaborated by the authors.

Table 7 – Standardized residuals of the cross-table
"income loss *versus* RMRJ zones"

	Southern Zone	Baixada Fluminense	Downtown	Others	Norther Zone	Western Zone
No loss	**3.331**	**-4.196**	0.865	1.453	2.387	-0.535
Up to 10%	**2.951**	-1.005	-0.439	-0.345	-1.009	0.323
From 10 to 20%	0.739	-0.529	0.295	-1.053	0.054	0.592
From 20 to 50%	**-3.532**	**3.210**	-0.190	-2.018	-0.100	-0.135
From 50 to 75%	-1.968	1.057	0.485	0.263	-0.944	0.778
Higher than 75%	-0.883	**1.865**	-1.455	1.580	-1.573	-0.689

Source: research data – elaborated by the authors.

The largest deviations between expected and observed values were associated with these categories. The significant value recorded for the standardized residual in the association between categories "no loss" and "Southern Zone" indicated that individuals living in the "Southern Zone" are more likely not to lose any income than the average of RMRJ residents, whereas the negative value recorded for the standardized residual between categories "no loss" and "Baixada Fluminense" indicated that individuals living in this place are more likely to lose some income than residents of other places in RMRJ. In other words, research data pointed towards spatial inequalities leading to the risk of income loss due to the Covid-19 pandemic. The Southern Zone was the place presenting the lowest risk of income loss, whereas Baixada Fluminense was the place presenting the highest risk of it.

Graph 2 shows the association between racial/ethnic composition and income loss. This graph omits data about Asian or indigenous participants because the subsample formed by them was too small and did not provide any reliable information. Based on the correspondence analysis, the most significant associations (graphically represented by categories of line and column variables that are close to each other and farther from the center) were the ones linking "white" to "no loss", "brown" to losses from "20% to 50%" and "black" to losses of "up to 10%". Overall, Graph 2 highlights racial inequality associated with income losses caused by the Covid-19 pandemic, the economic security of "white" individuals contrasts the economic insecurity of other ethnic-racial groups.

Graph 2 – Perceptual map of similarities and differences
between income loss and ethnicity/color
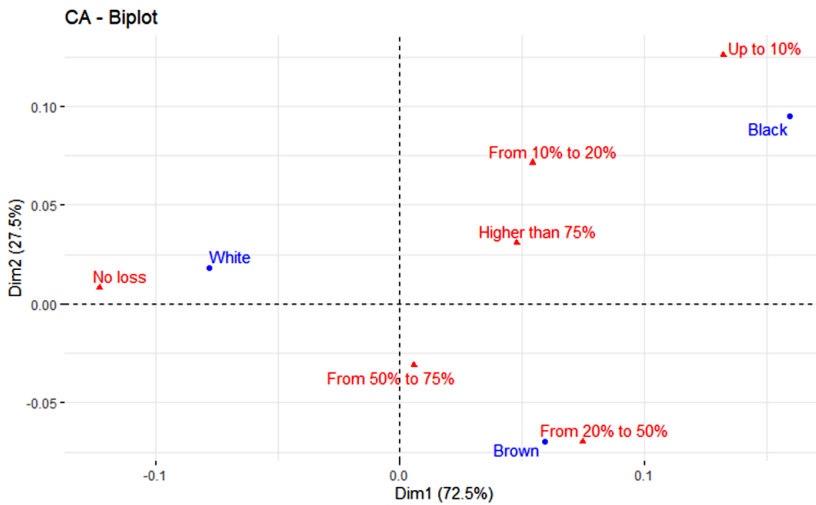
Source: research data – elaborated by the authors.

Table 8 shows values recorded for standardized residuals in the cross-table, whose lines indicate income loss categories, whereas its columns indicate different ethnicity/color categories. In addition to associations previously mentioned in the correspondence analysis, Table 8 highlights that "black" is the ethnic-racial group that most tends to experience some income-loss type. Values observed in this segment were more negatively distanced from their expected values regarding economic security.[5]

The analysis of similarities and differences between categories "professional occupation type" and "economic security" enabled observing three main groups of associations. On the one hand, the category "public server" was associated with "total economic security", as expected. On the other hand, individual microentrepreneurs, non-salaried employees and self-employed professionals were among those who were mostly exposed to economic insecurity.

Self-employed professionals have experienced significant economic impact caused by the Covid-19 pandemic since, in most cases, their income loss was higher than 50%. The most challenging situation is that of individual microentrepreneurs who were strongly associated with losses higher than 75%. Salaried employees hold intermediate position. Research data have evidenced that this category experienced income decrease at the order of 10% to 20% and these losses can lead to decreased workload.

Table 8 - Standardized residuals of the cross-table
"income loss *versus* ethnicity/color

	White	Brown	Black
No loss	3,774	-2,051	-2,655
Up to 10%	-0,966	-0,611	2,219
From 10 to 20%	-0,411	-0,611	1,419
From 20 to 50%	-2,548	2,594	0,154
From 50 to 75%	-0,305	0,566	-0,328
Higher than 75%	-0,582	-0,087	0,955

Source: research data – elaborated by the authors

Graph 3 – Perceptual map of similarities and differences
between income loss and professional occupation
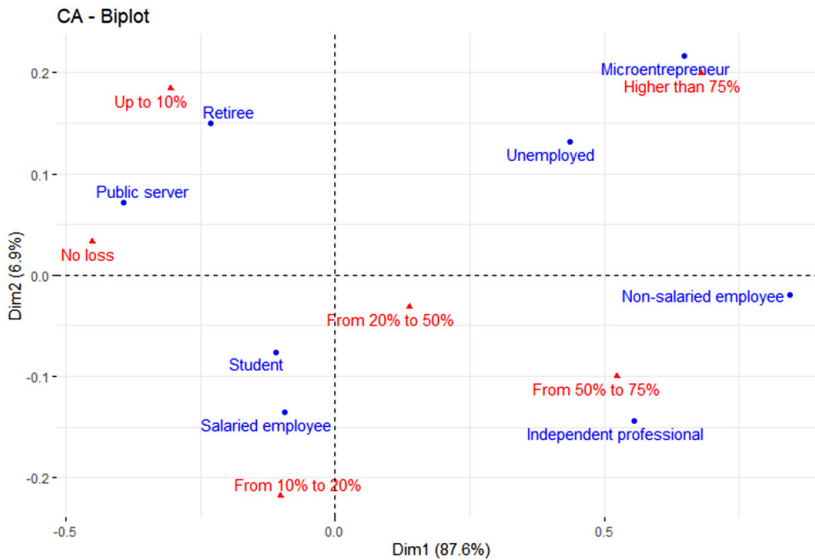
Source: research data – elaborated by the authors.

Table 9 shows the income loss distribution based on gender, as well as residuals (in parentheses), i.e., differences between observed and expected values. Data point towards the fact that women tend to experience higher income loss than men; the negative value of standardized residuals presented a negative association between the female gender and 100% secure income. Most importantly, the survey identified significant gender inequality concerning the impacts of the Covid-19 pandemic on individuals' income, when this loss was higher than 75%. This aspect has confirmed the structural gender inequality in the labor market (Abram, 2006; Neri, 2011; Santos, 2009).

Based on a logistic regression model, one can understand the association between economic insecurity and social features as a whole. In this case, the dependent variable is a binary variable that takes value 1 if individuals did not experience any income loss; otherwise, it takes value 0. White men living in the Southern Zone are used as reference in this model in order to compare the likelihood of other social profiles in RMRJ to experience some income-loss type. Results of the model are shown in Table 10.

The likelihood of white men living in the Southern Zone to maintain their income is higher than that of all other RMRJ inhabitants. Therefore, economic

Table 9 – Cross-table "loss of income *versus* ethnicity/color"
(with standardized residuals)

	M	F	Other
No loss	223 (1.336)	474 (-1.144)	1 (-1.344)
Up to 10%	44 (0.371)	94 (-0.640)	2 (1.941)
From 10 to 20%	61 (-1.229)	168 (1.217)	1 (0.057)
From 20 to 50%	170 (0.647)	373 (-0.725)	3 (0.579)
From 50 to 75%	91 (-0.203)	215 (0.104)	2 (0.701)
Higher than 75%	67 (-1.680)	195 (1.828)	0 (-1.110)

Source: research data – elaborated by the authors.

Table 10 – Logit model used to estimate the association
between economic security and socio-spatial variables

	Dependent variable: No loss
Baixada Fluminense	-0.518*** (0.157)
Downtown	-0.073 (0.349)
Others	-0.145 (0.244)
Northern Zone	-0.126 (0.180)
Westerns Zone	-0.392** (0.186)
Asian	-11.794 (229.483)
Indigenous	-0.553 (0.815)
Brown	-0.206* (0.106)
Black	-0.393*** (0.148)
Women	-0.133 (0.100)
Other gender	-1.368 (1.071)
Constant	-0.185 (0.158)
Observations	2,181
Log Likelihood	-1,346.984
Akaike Inf. Crit	2,717.968
Note	*p**p***p<0.01

Source: research data – elaborated by the authors.

security during the Covid-19 pandemic has color, gender and place of residence. For example, in comparison to individuals living in the Southern Zone, those who live in Baixada Fluminense and in the Western Zone (except for residents of Barra da Tijuca and Recreio, who live close to the seashore) experience significantly higher economic insecurity. They are significantly more likely to experience income loss than those who live in the Southern Zone. In addition, brown and, above all, black individuals are significantly more likely to experience decreased purchasing power due to the economic impact caused by Covid-19 than white individuals.

Based on information deriving from the survey, the analysis applied to logit model results has suggested that individuals living in Baixada Fluminense are 1.67 times more likely to experience some income loss than those who live in the Southern Zone. Such a likelihood is 1.47 times higher among individuals living in the Western Zone. In addition, the economic insecurity resulting from the Covid-19 pandemic significantly plagues more black and brown individuals than white individuals, who are 1.48 times more likely than black individuals to keep their income. White individuals are also 1.22 times more likely to enjoy full economic security than browns. Survey data have also indicated that women are 1.14 times more likely to lose income than men. This result lacks statistical significance; however, as shown in Table 9, women are more likely to lose more than 75% of their income than men. Although these results should be interpreted with caution, due to sample bias, they point out the fact that economic inequality during the Covid-19 pandemic has spatial, racial and gender components.

Conclusion

Despite limitations regarding the sample representativeness of collected data and the impossibility of capturing the impacts of the Covid-19 pandemic on the insecurities of RMRJ residents more qualitatively, the survey's multivariate analysis enabled highlighting valid associations between socio-spatial categories. Web-survey data analysis has confirmed the hypotheses pointed out in the international literature about the role played by the Covid-19 pandemic in worsening pre-existing social inequalities. At the same time, these data have spatially materialized the overall trends in the specific context of structural inequality featuring the Metropolitan Region of Rio de Janeiro City: individuals living in municipalities and neighborhoods most far from the Southern Zone are the ones dealing with crowded urban transport in pandemic times, in order to get to work. Economic security during the Covid-19 pandemic is uneven. It has place of residence, color and gender.

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Notes

(1) It was created through federal complementary law n. 20/1974, which is the same law that instituted the merger of the old Rio de Janeiro and Guanabara states.

(2) Baixada Fluminense comprises 13 of the 21 municipalities of RMRJ, namely: Belford Roxo, Duque de Caxias, Guapimirim, Itaguaí, Japeri, Magé, Mesquita, Nilópolis, Nova Iguaçu, Paracambi, Queimados, São João de Meriti and Seropédica.

(3) The sample of PNAD at RMRJ comprised observations by 12,182 individuals.

(4) Correspondence analysis was performed in the R software, using the Factominer package (Lê et al., 2008).

(5) According to the research data, "black" individuals have 15% higher risk of losing some income than "white" individuals, whereas "brown" individuals recorded risk of 10%.

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