

# Monitoring the Transmission of COVID 19 through Geoprocessing Technique

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## Abstract

*In 2020, world society faced a pandemic caused by the SARS-CoV-2 virus. From this perspective, it should be noted that the virus entered the geographic space of Manaus on March 11, 2020. The transmission of this virus occurs through particles expelled in the air by the infected person, therefore the preventive measures adopted by the world organization for the control of the transmission was the isolation and control of regions with agglomeration of people. Analyzing the problem of contagion, the study aims to investigate the impact of generating poles on the spread of the disease. The study's methodology was based on a survey of news from relevant generating poles for the agglomeration of people and the relationship with spatiality of the numbers of disease cases, which were subsequently partnered with data from the Integrated Control Center - CIF, as well as the monitoring of case data provided by the City Hall, the Amazonas Surveillance and Health Foundation, Atlas ODS Amazonas and Google Mobility. Therefore, the purpose of the study is to have a relationship between the number of cases and the poles of trip generators through geoprocessing and whether there are impacts of points on the contagion index of COVID 19. Keywords: Geoprocessing, generator poles, COVID 19*

**Keywords:** COVID 19, Transportation, PGV.

## 1. INTRODUCTION

The National characterization of Brazil in the month of April presents the record according to the Ministry of Health (2021) the cumulative of 14,659,011 cases of Covid 19. According to this monitoring of data Manaus in that month is characterized as the sixth capital with the highest number of people infected. Based on this, the epidemiological period according to the G1 Amazonas (2020) began on March 11, 2020 in Manaus with the arrival of a woman from London. The Amazonas Health Surveillance Foundation adhered on an emergency basis during this period to the measures adopted by the World Organization for social isolation. The aforementioned action to combat this new disease is caused by the lack of effective pharmaceutical diagnosis, so non-pharmacological intervention methods - INF are used, which include individual, environmental and community measures, social distancing, restriction or prohibition to the functioning of schools, universities, places for community interaction, public transport, as well as other places where people gather. (Garcia and Duarte, 2020) Thus, the primary containment measures are actions directed at the so-called PGVs - Travel Generator Poles. According to Moura (2010) PGVs are enterprises that impact road traffic, as they attract a large number of trips. Therefore, the study to be analyzed

seeks to investigate the specifications for controlling the movement of individuals in these traffic flow zones and their correlation with the number of cases in the neighborhood. The development of the study is based on references from the news and the website of the organ, as well as the weekly epidemiological bulletin of the Fundação de Vigilância em Saúde do Amazonas. The monitoring system of the City of Manaus and the Atlas ODS Amazonas, which is a Covid 19 data monitoring product developed by UFAM and other bodies in partnerships, are also used as sources of data. Consequently, the segmentation of these data analyzes was divided into two research cycles. The first cycle of research focused on the observation of generating centers in the food sector supermarkets, which at the beginning of the period of implementation of social isolation were the only ones allowed to open to the public, since according to Decree No. March 2020 where it suspended the operation of bars, restaurants and other services not defined as essential (GOVERNMENT OF AMAZONAS, 2020). In the second moment of the research, which began in November, the research was guided by the investigation of activities at clandestine parties in the city of Manaus. In the balance of the work carried out by the Integrated Inspection Center - CIF , coordinated by the Public Security Secretariat - SSP / AM in ten months of inspection focused on the prevention of Covid-19, the CIF prevented the holding of 48 clandestine parties, 42 of which in the capital and six more in the interior of the state (PUBLIC SECURITY DEPARTMENT, 2021). Therefore, the elaboration of the study allows investigating the impact of information made available in the media and the incidence of cases in the urban geographic space. In this way, the project will result in the elaboration of maps and the help of spreadsheets as a georeferenced information bank, thereby presenting the impact characteristics of the generating poles in the period to be addressed.

## **2. THE COVID 19 DISEASE IN MANAUS.**

Covid19 is a disease caused by the corona virus that arrived in the Urban space of Manaus on March 11 , 2020, through a passenger who landed in the city. From that date, the numbers of cases within the city were multiplying, this action resulted from the contact of the infected with other individuals. This period was determined as the first where cases of Covid 19 in reference to the increase in the sick curve. On March 23, 2020, through Decree No. 42101, it ratifies the state of public calamity in Amazonas. As a way to contain the pandemic and avoid the collapse of the health system, the State Government has decreed the adoption of social distancing measures, with the closure of all non-essential commercial activities as of March 21, with a forecast of closing at end of May (WHITE; TEIXEIRA, 2020). During this period, there were numerous restrictions on services within the urban space, which characterized this period with less circulation in commercial areas and concentration in supermarkets with daily operation. The use of this sector, even following safety measures, requires care due to the intense flow of movement of individuals and contact with food. After the 1st wave of cases according to the website Amazonas Atual (2020) at the opening of the Baratão da Carne supermarket chain store, in Manaus, this Thursday, in addition to the crowd, consumers fought inside the establishment in the dispute over products, which were promotional price. Consequently, with the relaxation of social isolation measures and reopening of commerce according to the newspaper G1 Amazonas (2020) After experiencing collapses in the health and funeral system, between the months of April and May, and having the total reopening of activities, Manaus returned to register

nights of parties and agglomerations. In view of this relaxation of isolation measures, Manaus began at the end of December an increase in the number of cases of Covid 19. Thus, on the 23rd, the governor of the state announces the decree suspending non-essential activities to be suspended from the 26th, however on the 28th, it changes the measure to reduced hours of activities due to demonstrations by businessmen and traders. Barreto et al (2021) in the last weeks of December 2020 and the first weeks of January 2021, a new wave of cases leaves the city in shock, now bringing the collapse of the municipal health system due to lack of infirmary beds, ICU beds and oxygen. Thus, actions to suspend non-essential activities were resumed in the period from January to February until the 22nd, when the number of cases began to decrease. After the softening of the case curve in Manaus and the initiation of a vaccine campaign since January 2020, the government of Amazonas predicts a third wave of contamination by Covid 19 in the state in May. (CNN, 2021)

### 3. COVID 19 TRANSMISSION

The coronavirus is a severe acute respiratory syndrome SARS-CoV-2, which causes coronavirus disease 2019, which emerged in 2019 in the city of Wuhan. Covid 19, because it is a respiratory syndrome, the spread of this virus occurs on a large scale by particles expelled in the air. According to the Ministry of Health (2020) states that the methods of contagion are those established, namely: I. droplets of saliva; II. sneeze; III. cough; IV. phlegm; V. close personal contact, such as touching or shaking hands; SAW. contact with contaminated objects or surfaces, followed by contact with the mouth, nose, or eyes. According to FIOCRUZ (2020) viral particles released along with saliva can remain floating in the air for about 40 minutes and up to 2h30min. Based on this premise, it is necessary to understand that sometimes these particles with viruses end up adhering to surfaces of different types of matter, which alters the active period of all viruses established by FIOCRUZ. Table 01 establishes the life span of viruses in these materials.

| Material  | hours                 |
|-----------|-----------------------|
| Steel     | 72                    |
| plastic   | 72                    |
| Cardboard | 24                    |
| Copper    | 04                    |
| Dust      | 40 minutes to 2 hours |

**Table 01: Duration of active Sars Covid 19 virus in materials. Source: FIOCRUZ, 2020.**

Thus, the need for the use and hygiene of hands and food are necessary tools to combat Covid 19. Consequently, this information is useful for society to understand which possible means that provide the risk of transmission of the Corona virus 19.

### 4. GENERATOR POLES

The so-called Travel Generating Poles can also be described as Traffic generating poles. According to Silva et al. (2006) are developments that generate or attract a large number of displacements, causing reflections on the circulation of traffic in the surroundings and, consequently, impairing the accessibility and fluidity of traffic in the entire region. It is also important to point out that the PVGs can also be considered as

temporary spaces that, due to their size or characteristics, attract a large number of trips, regardless of the mode, but generally motorized, to a certain point. (CASTRO, 2010) From this premise, it is clear to understand that there are a significant number of poles that generate trips in urban space, such as shopping malls, stores, theaters, universities, companies and other enterprises. Thus, the CET-SP (1983), based on studies carried out by it, presents a preliminary classification of the PGTs according to two categories: a) The micro pole, whose isolated impacts are small, but when grouped they can become quite significant; b) The macro pole, individual constructions, whose impacts are greater and more expressive, and therefore deserve special attention. Therefore, these definitions are necessary foundations in the approach of studying the flow of the trip generator pole, because through this detailing it is possible to understand that a region composed by the segmentation of small buildings can constitute a PGV. Thus, the didactics to be applied to a micro pole differs from the complexity of a macro pole.

#### **4.1. Supermarkets**

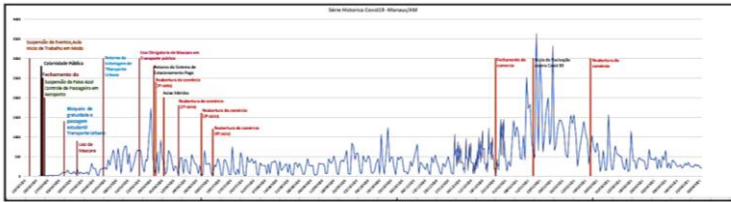
According to Portugal and Golder (2003) the conventional supermarket has 700 to 2,500 m<sup>2</sup> of sales area and operates at least the five traditional sections of the store: grocery, meat, fruits and vegetables, cold cuts and dairy products and non-food products. This service segmentation is quite expressive in the Brazilian economy, since, according to data from the Brazilian Association of Supermarkets (ABRAS, 2020), in 2018 alone, the sector's revenue represented 5.2% of the Gross Domestic Product - GDP. However, large enterprises, such as supermarkets and hypermarkets, cause significant impacts on the road and transport systems in the places where they are installed, thus characterizing them as potential Travel Generator Poles - PGV's (Silva, 2006).

#### **4.2. Parties and Events**

Parties and events are activities that, according to Meurer et al (2005), also be considered a PGT, as they demand a temporary and concentrated volume of traffic, reducing the flow of the road. Large parties and events are significant generating poles depending on the proportion of the public and end up interfering with the local flow where they are held. Currently, with the measures of restrictions on the generating poles of this delimitation, it occurs in a less notorious flow due to inspections. According to the article in the newspaper Vocativo (2021), the Secretariat of Public Security records in ten months of inspection that the CIF prevented the holding of 42 clandestine parties.

### **5. RESULTS AND DISCUSSION**

The elaboration of the study characterized, through the analysis of the data issued by the weekly bulletins of the Fundação de Vigilância e Saúde do Amazonas, the diagnoses of the neighborhoods referring to the rates of cases of Covid 19. Based on this premise, the study enabled a chronological synthesis of the actions of measures implemented by the government and municipality described in Graph 01.



Graph 01: Chronological series of actions x number of cases of Covid 19. Source: Own

At the beginning of the epidemiological cycle of the pandemic, the investigation provided an approach related to Supermarkets as the main poles that generate trips in the city. However, in the neighborhoods of Adrianópolis, Ponta Negra and Parque 10 de Novembro were listed respectively as the neighborhoods with the highest numbers of people infected by the virus, according to the FVS bulletin dated 03/27. With the growth rate, these neighborhoods took different positions in the aspect of leadership of contaminations. In the investigation of the study, each neighborhood has numerous Travel Generator Poles, through the Google tool (Google Maps) selected the 3 largest PGV's by increasing flow of people from the three largest infected neighborhoods in accordance with the map of the daily bulletin of the FVS. The selection criteria for the 3 largest PGV's were distinguished by the purpose of the service offered, local infrastructure and customer accessibility. Some PGV's will be found in adjacent neighborhoods due to the close approximation of the border from one neighborhood to another. The criteria for infected neighborhoods are flagged by presenting one or more individuals residing in that area with Covid 19. After selecting the neighborhoods with the highest rates of contamination, maps were prepared using the Arcgis tool , thereby defined in the form of a line of time to systematically demonstrate how the PGV could have had a major impact on the spread of Covid 19 through customer travel and circulation times in these developments.

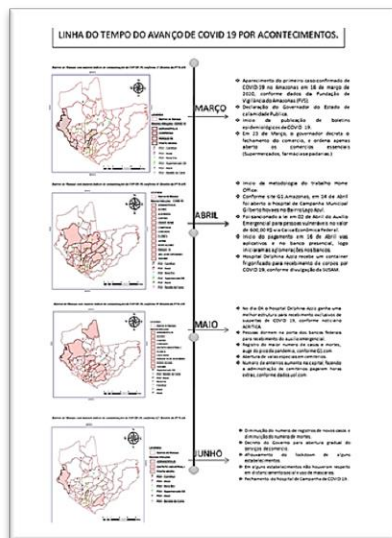


Figure 01: Map of Covid 19 in Manaus. Source: Own.

With the follow-up of the monitoring presented in the maps and data collected from the agencies, the study realized that the social characteristics of the city were changing. The generating poles began to change, as we can see in the June map that the drop in the number of cases ends up leaving the areas where the PGVs in the Supermarket sector are concentrated. As a result of this perception, the study was guided by the survey of particular events existing in the city, thereby characterizing the possible relationship of these temporary PGVs with the number of cases collected by neighborhoods made available by the Manaus City Hall. In preparing the maps for the second phase of the studies, news sources made available by the Secretariat of Public Security for inspection operations of clandestine parties were used.

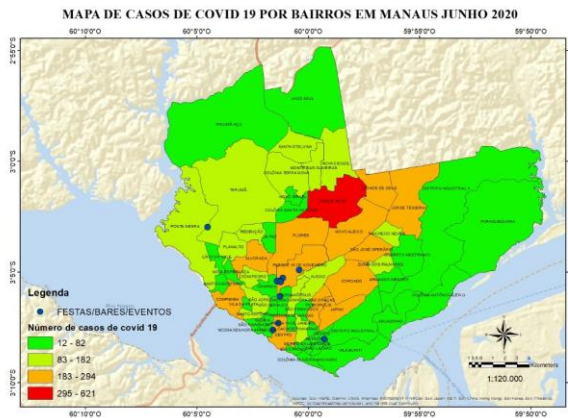


Figure 02: Map of Covid 19 cases and clandestine events in June 2020 in Manaus. Source: Own.

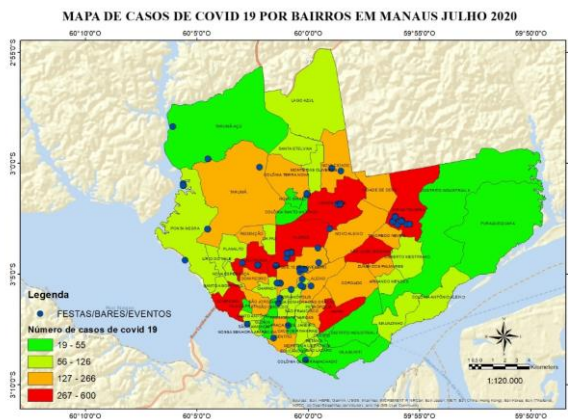


Figure 03: Map of Covid 19 cases and clandestine events in July 2020 in Manaus. Source: Own.

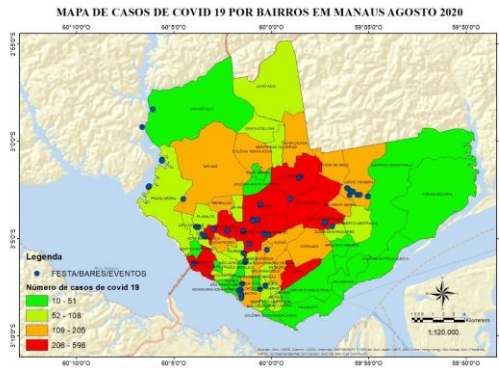


Figure 04: Map of Covid 19 cases and clandestine events in August 2020 in Manaus. Source: Own.

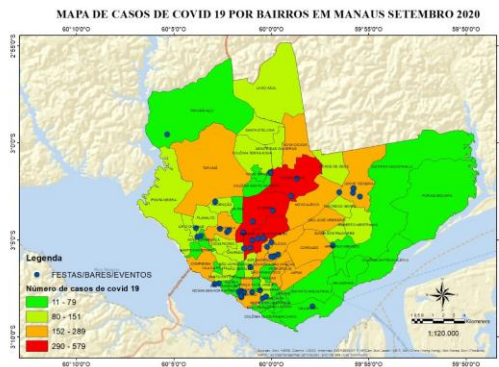


Figure 05: Map of Covid 19 cases and clandestine events in September 2020 in Manaus. Source: Own.

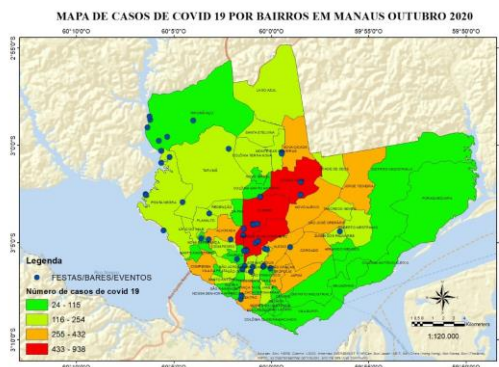


Figure 06: Map of Covid 19 cases and clandestine events in October 2020 in Manaus. Source: Own.



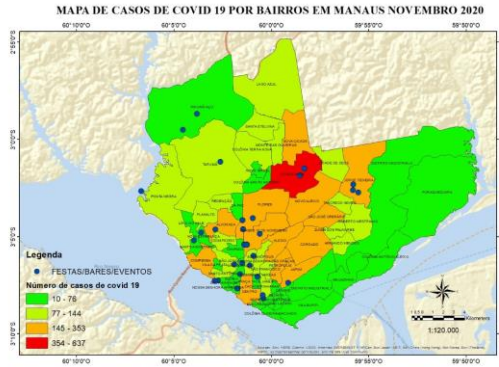


Figure 07: Map of Covid 19 cases and clandestine events in November 2020 in Manaus. Source: Own.

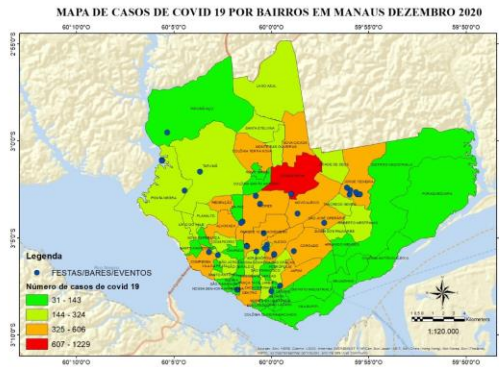


Figure 08: Map of Covid 19 cases and clandestine events in December 2020 in Manaus. Source: Own.

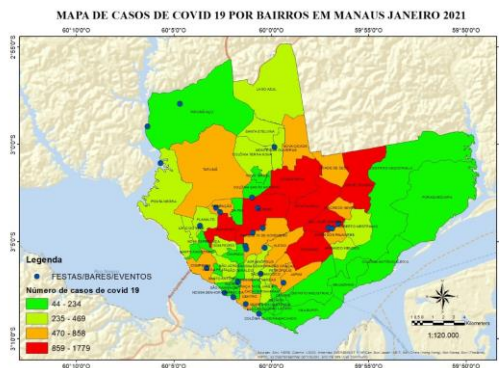


Figure 09: Map of Covid 19 cases and clandestine events in January 2021 in Manaus. Source: Own.



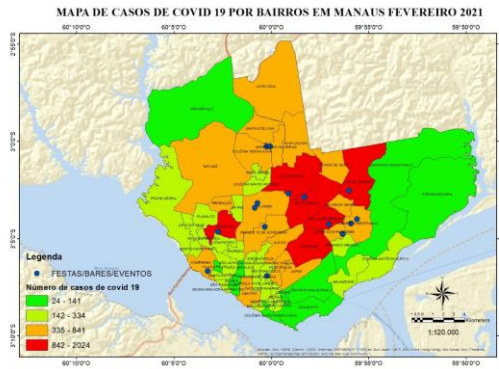


Figure 10: Map of Covid 19 cases and clandestine events in February 2021 in Manaus. Source: Own.



Figure 11: Map of Covid 19 cases and clandestine events in March 2021 in Manaus. Source: Own.

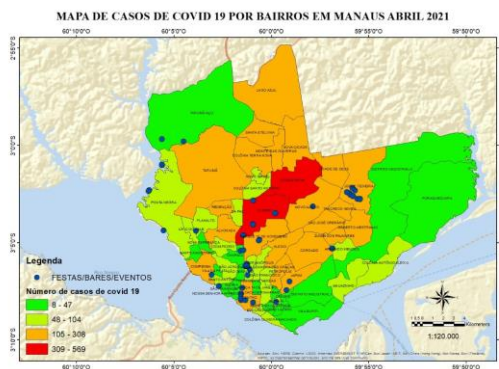


Figure 12: Map of Covid 19 cases and clandestine events in April 2021 in Manaus. Source: Own.

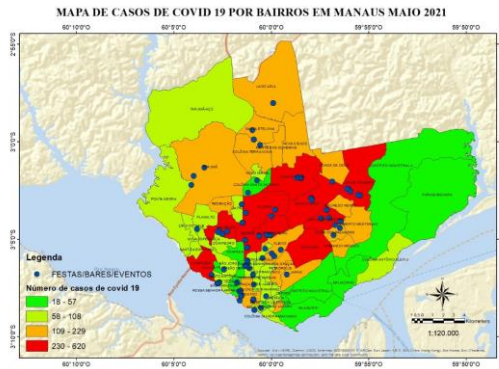


Figure 13: Map of Covid 19 cases and clandestine events in May 2021 in Manaus.  
Source: Own.

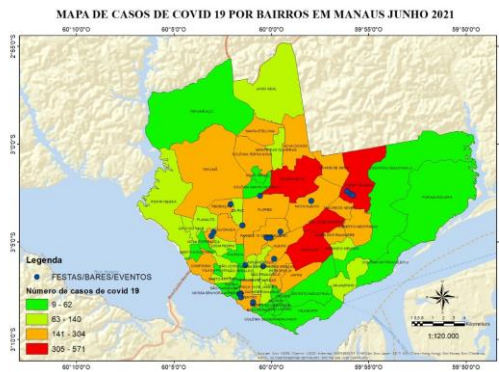


Figure 14: Map of Covid 19 cases and clandestine events in June 2021 in Manaus.  
Source: Own.

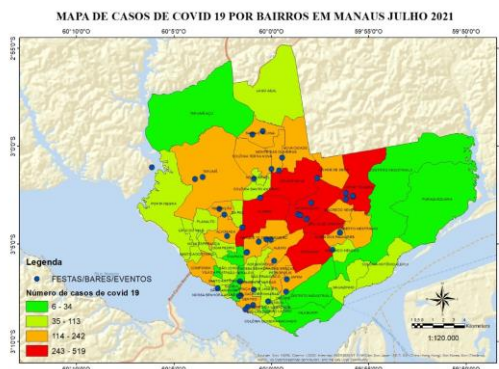
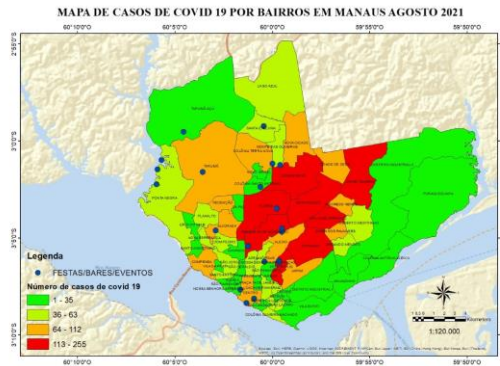


Figure 15: Map of Covid 19 cases and clandestine events in July 2021 in Manaus.  
Source: Own.



**Figure 16: Map of Covid 19 cases and clandestine events in August 2021 in Manaus.**  
Source: Own.

Therefore, in this second stage of the project, there was a high number of clandestine parties in the Tarumã neighborhood, a region close to the Cidade Nova neighborhood. Eventually, the monthly maps of this stage show that Cidade Nova remains the neighborhood with the highest numbers of cases of Covid 19 and that this proximity to the Tarumã area favors the spread of the coronavirus in that region. With this observation, the study underscores the need for organ control measures for monitoring in this area.

**6. CONCLUSION** Observing the behavior of travel generator poles during the pandemic is a primordial study segmentation for urban management in view of the need for social isolation in the face of Covid 19. Based on this, it is necessary to understand the social dynamism existing in the series addressed in the study, which presents a relaxation in the measures of social distance over the chronological course. The view that occurs at the first moment shows the beginning of the pandemic is a relevant impact of the population in the acceptance of the restrictive measures imposed. Thus, at this stage of the project, a specific view of the importance of Supermarkets as the main travel generator poles and their expressive action as a central point as a risk zone of contagion of the new coronavirus is obtained. In the second increase in cases in Manaus, a different conception was noted from the initial one, since in this stage of the study series it occurred from November to April. In this chronology, the population is against the acceptance of distancing and there are constant inspections of private party activities on weekends with agglomerations reported by public security. In the observation of private parties, the study stops observing macro poles to delve into the micro poles that, due to being in a smaller structure demand, do not fail to account for impacts and risk to urban health. Therefore, the systematic study composed of these two cycles enables the importance of understanding in the area of urban management which types of PVGs impact on the dynamics of preventive measures against Covid 19. In this way, the study of PVGs in transport engineering complements the information presented by the monitoring sites and thereby instigate a perception of the importance of engineering in the management of methodologies that encourage social distancing.

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