A Geographical Method for Assessing Social Distancing as a Preliminary Tool for Implementation Planning. A Case Study: Chapinero, Bogota[a]

Método geográfico para la evaluación del distanciamiento social como una herramienta preliminar para la planificación de la implementación. Caso de estudio: Chapinero, Bogotá

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Abstract

Due to the COVID-19 pandemic, rethinking lifestyle and quality of life through the appropriate use of public space is necessary. This study aims to verify the measures of social distancing in Chapinero Centro, which, according to the mobility survey 2019 of Bogota, has an average of 4,633 trips on foot between 10 and 20 minutes according to the travel patterns in the areas of transportation analysis studied. Despite having great social and economic dynamics, this area has small sidewalks that hinder compliance with social distancing, which is necessary to mitigate the coronavirus pandemic. Therefore, geographic analysis of this area was performed using data provided by the vulnerability map of the Coronavirus web in Colombia by the National Planning Department, the Institute for Health Technology Assessment, and the National Administrative Department of Statistics. This geographic analysis made it possible to calculate the variables of population indicator per block, maximum population per sidewalk, and the criterion of compliance with social distancing. When developing the vulnerability and social distancing maps, it became evident that 37% of the sidewalks do not comply with the 2 meters of social distancing between people, so we propose extending them to 3.5 meters and reducing this same value in the vehicular space to design an effective social distancing map. We concluded that the widening of the sidewalks allows flexible use of the streets oriented to a healthy distance, which could be complemented with an accessibility study and a study of vehicular traffic to measure the impact of this intervention.

Keywords: Pedestrian mobility, social distancing, coronavirus

Resumen

Debido a la pandemia por el Covid-19, es necesario replantear el estilo de vida y la calidad de vida mediante el adecuado uso del espacio público. Este estudio tiene como objetivo verificar las medidas de distanciamiento social en Chapinero Centro, el cual según la encuesta de movilidad 2019 de Bogotá cuenta con un promedio de 4,633 viajes a pie entre los 10 a 20 minutos según los patrones de viaje en las zonas de análisis de transporte estudiadas, a pesar de tener grandes dinámicas sociales y económicas, cuenta con andenes muy reducidos que dificultan el cumplimiento del distanciamiento social, necesario para mitigar la pandemia del Coronavirus. Por tal motivo, se hizo un análisis geográfico de esta zona, mediante el uso de los datos proporcionados por el mapa de vulnerabilidad de la web Coronavirus en Colombia del Departamento Nacional de Planeación, el Instituto de Evaluación Tecnológica en Salud y el Departamento Administrativo Nacional de Estadística. Este análisis geográfico permitió calcular las variables de indicador poblacional por manzana, la población máxima por andén y el criterio de cumplimiento del distanciamiento social. Al desarrollar los mapas de vulnerabilidad y distanciamiento social, se evidenció que el 37% de los andenes no cumple con los 2 metros de distanciamiento social entre personas, por lo cual se propone ampliarlos a 3,5 metros y reducir este mismo valor en el espacio vehicular, para diseñar el mapa de distanciamiento social efectivo. Se concluye que la ampliación de los andenes permite hacer un uso flexible de las calles orientado a la sana distancia, lo cual podría ser complementado con un estudio de accesibilidad y un estudio de tráfico vehicular que midan el impacto de esta intervención.

Palabras Clave: Movilidad peatonal, distanciamiento social, coronavirus.

Introduction

The locality of Chapinero is made up of five zonal planning units (UPZ), which are divided into fifty neighborhoods, and the village of El Verjón Bajo is a rural planning unit. The five UPZs in Chapinero are El Refugio (UPZ 88), San Isidro Patios (UPZ 89), Pardo Rubio (UPZ 90), Chicó Lago (UPZ 97) and Chapinero Centro (UPZ 99) [1]. According to the statistical bulletin of Business Dynamics of Bogotá in December 2019, Chapinero is the third locality in Bogotá with the highest number of registered companies, adding 10.1% of business participation in 2019. The Bogota companies that are in Chapinero represent the following percentages according to the economic sector, occupying first place in the professional services sector with 15.3% and the sixth position in the commerce sector with 6%. Likewise, the companies that are in the locality according to their size, by the staff plant and the level of assets, occupy fourth place of the microenterprises with 9.8%, first place of the small companies with 18.1%, first place for medium-sized companies with 21.5% and first place for large companies with 24.9% [2]. These figures show that Chapinero Centro is a commercial UPZ located in the southwest of the locality of Chapinero, with an extension of 159.3 hectares that represents 12.1% of the total area of the locality. Regarding its borders, Chapinero Centro borders UPZ Chicó Lago to the north, UPZ Sagrado Corazón to the south, UPZ Los Alcázares, Galerías and Teusaquillo to the west and UPZ Pardo Rubio to the east [3].

According to the Statistical Bulletin number 5 of the District Planning Secretariat [4], this UPZ is of a commercial nature when presented as activities according to the international uniform industrial classification (ISIC): i) 56 companies of agriculture, livestock, hunting, forestry and fishing, ii) 34 mining and quarrying companies, iii) 665 manufacturing industries, iv) 448 construction companies, v) 2350 wholesale and retail trade establishments, vi) 197 transport and storage companies, vii) 868 lodging and food service companies, viii) 606 information and communication companies, ix) 371 companies of financial and insurance activities, x) 520 companies of real estate activities, xi) 1352 companies of professional, scientific and technological activities, xii) 622 companies of administrative and support services activities, and xiii) 169 companies of education activities.

According to the socioeconomic dynamics of this UPZ, the present study seeks to present an effective social distancing map, in which an intervention per block is proposed that allows us to have a sidewalk for pedestrian traffic and connectivity with the public space, as well as where they have enough area for pedestrian mobility based on social distancing that allows the mitigation of even a high level of vulnerability, given the growing contagion of coronavirus at Chapinero and adhere to public space and/or on the sidewalk space, within the framework of the "Bogotá under the open sky" strategy.

The inverted mobility pyramid [5] proposes the prioritization of vulnerable road users headed by pedestrians, which is why complying with the geometric design of streets for pedestrians with commercial corridors stipulated by NACTO (National Association of City Transportation Officials) in the Global Street Design Guide is necessary. They specify a clear path of 3 meters or more to allow a continuous flow of pedestrians and enable people to comfortably pass one another, providing flexibility and dedicated space on the sidewalk adjacent to the clear path [6].

Materials and methods

The maps to show the urban design proposal were created by a Geographic Information System through a software suite selected for containing applications for the capture, edition, analysis, and design of the geographic information that was collected from UPZ 99 Chapinero Centro. This geographic information was obtained from the Vulnerability Map of the Coronavirus Colombia website [7], created by the Departamento Nacional de Planeación (DNP), the Instituto de Evaluación Tecnológica en Salud (IETS) and the Departamento Administrativo Nacional de Estadística (DANE).

This vulnerability map uses the vulnerability index suggested by DeCaprio, Gartner, Bugess, Kothari, Sayed, and McCall [6] and UNDP [8] as a methodology. In this sense, the DANE methodological note [9] presents its own index and calls it the Vulnerability Index per block, which uses demographic variables and comorbidities to identify the population in Colombian municipalities, which could suffer greater complications from COVID-19, due to its demographic characteristics and health conditions. These variables were obtained through information of the administrative records from the Archivo Nacional de Identificación (ANI), the Registro Civil de Nacimiento (RCN), the Registraduría Nacional del Estado Civil, the Base de Datos Única de Afiliación en Salud (BDUA) and the Registros Individuales de Prestación de Servicios de Salud (RIPS).

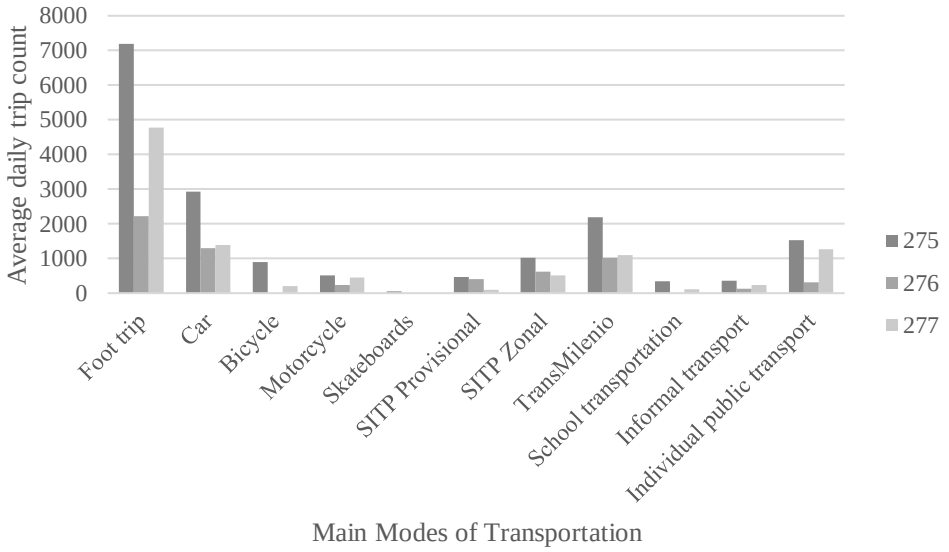
Once the information from the vulnerability map has been extracted, an information crossing is performed in relation to the sidewalks, identifying the accessibility in pedestrian mobility to access or interact under the current restrictions of social distancing, where a minimum of 1 meter is established for interaction with other individuals as a result of the health problems from the COVID-19 pandemic, seeking to reduce the probability of contagion and avoiding all types of agglomeration. From this, we worked with minimum distances for the three types of vulnerabilities (low, medium, and high) found in the UPZ. In this sense, this research seeks to analyze the geographic information of the UPZ Chapinero Centro to evaluate its compliance with the proposed measures and restrictions.

From these data, two maps are designed: a first vulnerability map and a second distance map. Finally, according to the vulnerability map and the distance map, it is proposed to design a third intervention map, in which the solution of a flexibility of the streets will be proposed to expand the pedestrian space to half of the current vehicular stream, thus achieving that the sidewalks that do not comply with the social distance manage to comply.

Results

The daily modal distribution in the transport analysis areas of Chapinero Centro in *Figure 1* shows clear data on the dynamics of pedestrians. Approximately 14,069 daily trips on foot are registered, with records of average travel times between 10 and 20 minutes. Therefore, the generation of trips in the study area is mainly walking on foot, meaning the inhabitants of the area require passable public spaces with connectivity and comfort [10].

Figure 1. Daily Modal Distribution of Transport at Chapinero's ZAT

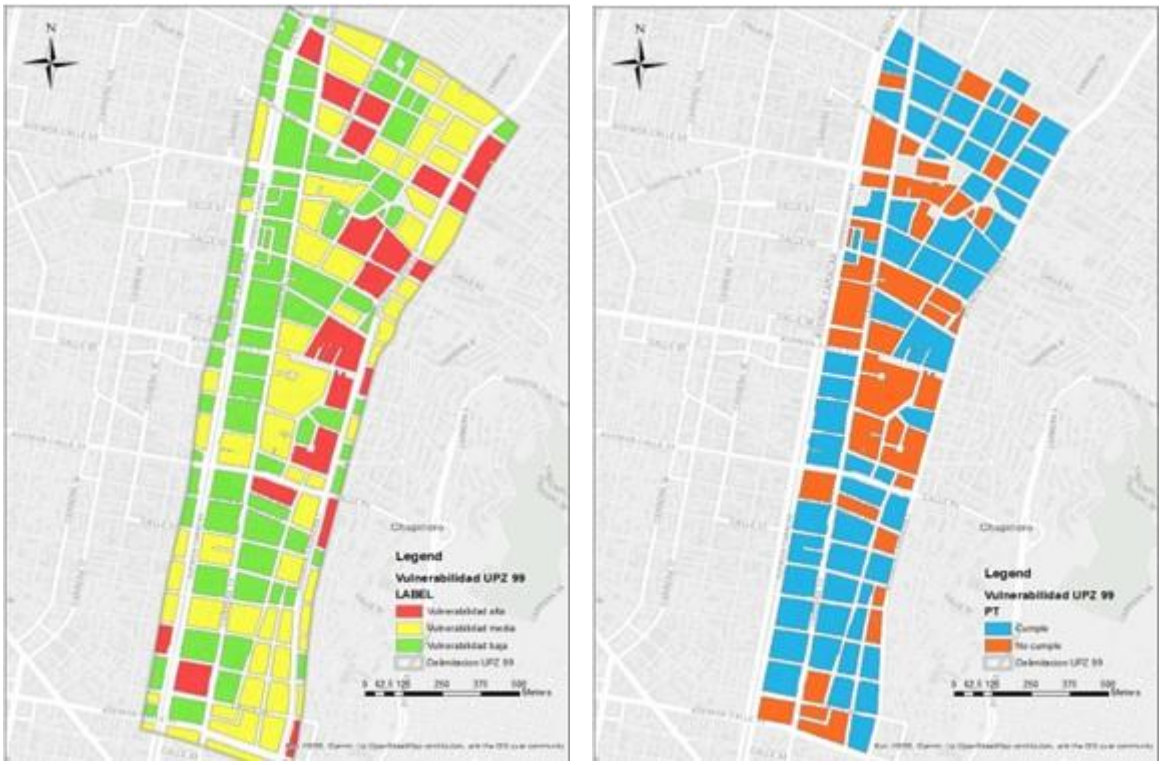


Source: Author's own creation

The UPZ Chapinero Centro has 102 blocks, which can be classified by the level of vulnerability, whose classification is from the vulnerability map of DANE [11], with new levels of vulnerability, which were low vulnerability (green), medium vulnerability (yellow) and high vulnerability (red), as shown in *Figure 2-a*. In this regard, 49% of area presented low vulnerability, 36.2% presented medium vulnerability and 14.7% presented high vulnerability.

Figure 2. Maps created from UPZ 99

a) vulnerability **b) distancing**



Source: Author's own creation

Modeling the sidewalks to the same number of blocks, there are 102 sidewalks with areas from 4 m^2 to 1955 m^2. Therefore, according to the area of each sidewalk and the total population of the UPZ (18,121 habitants), it was possible to estimate the resident population residing in each block. The population indicator was obtained from *Equation 1*, of which the dividend is the area of the sidewalk, and the divisor is its distance indicator. This indicator of distance is understood as the square meters of distance that each person should have according to the vulnerability of the block, with 1 m^2 for low vulnerability, 2 m^2 for medium vulnerability and 3 m^2 for high vulnerability. The population indicator (in the number of habitants) showed that the individual population of each sidewalk ranged between 4 and 978 habitants.

$$Population\ indicator\ = Area\ (m2)\ /\ Indicator\ of\ distance\ (m2) \qquad (1)$$

Likewise, to determine the average capacity of the UPZ 99 sidewalks, the maximum population per sidewalk was estimated using *Equation 2*, which has a dividend of the total population of the UPZ, which is 18,121, and a divisor of the total number of sidewalks, which is 102, resulting in 177.65 habitants.

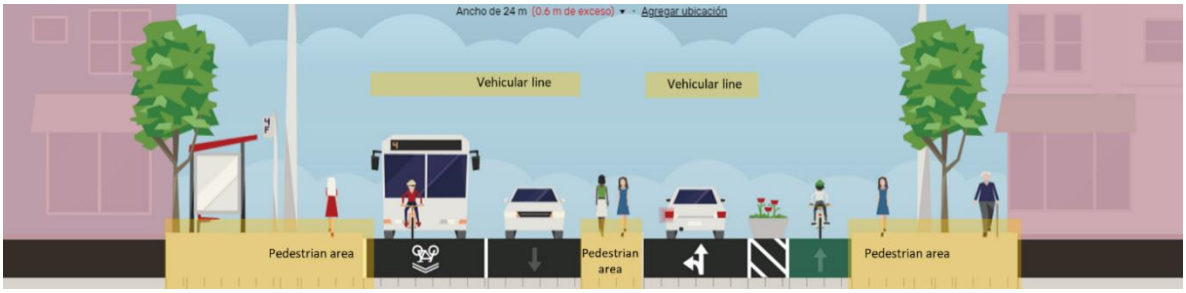
$$Total\ population\ in\ the\ UPZ\ 99 \\ /\ Total\ number\ of\ sidewalks\ in\ the\ UPZ\ 99 \tag{2}$$

By articulating the area, the population indicator, and the distance indicator of each sidewalk, the social distance map could be modeled. The criterion of compliance with social distancing allowed us to identify those blocks that complied with the minimum social distancing, which was estimated from *Equation 3*.

$$Population\ indicator\ \leq\ Maximum\ population\ per\ sidewalk \tag{3}$$

The distancing map (see *Figure 2-b*) showed that in UPZ 99, 63% of the sidewalks complied with social distancing (blue color), while 37% of the sidewalks did not comply with social distancing (orange color).

Figure 3. Flexibility of streets in the perimeter of action for pedestrians.



Source: Author's own creation

From a realignment of the sidewalks that did not comply with the distance, as presented in *Figure 2-b*, the expansion is performed at approximately 3.5 meters added to the trafficable public space for pedestrians, as exemplified in *Figure 3*. This figure is part of the proposal for flexibility of the streets in its perimeter of action of the Plan to reopen the Historic Center of CDMX [12], a proposal that served as a reference to obtain proper compliance with social distancing for pedestrians in UPZ Chapinero Centro (see *Figure 4*).

Figure 4. Map of effective social distancing in UPZ 99

Source: Author's own creation

Conclusions

A geographical analysis of the UPZ Chapinero Centro was achieved, allowing for the creation of vulnerability and distance maps. Based on these maps, an intervention proposal was made to create scenarios with enough space to face high levels of vulnerability and comply with the social distancing norm. This effort resulted in an effective social distancing map, with an extension of 3.5 meters on those sidewalks that did not comply with the criteria for compliance with social distancing, which represented 37% of the total sidewalks studied. This proposal could be complemented with a study of vehicular traffic that is relevant for road corridors that were modified as a result of the widening of the sidewalks so that not only the social distancing of pedestrians but also the vehicular traffic in these spaces are analyzed. Finally, as future work, we propose that an accessibility study be performed on these extended sidewalks to guarantee the pedestrian mobility of people with disabilities.

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