

Effects of COVID-19 social distancing on urban mobility: Longitudinal evidence from the Federal District-Brazil

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Abstract

The COVID-19 pandemic has impacted people's daily life in several ways, especially given that social distancing appears to be the most effective way to reduce the spread of the virus till date. Analyzing longitudinal data from a group of residents in the Federal District of Brazil, we verified the impact of physical distancing recommendations in April of 2020. Of 351 respondents of a 2017 survey regarding healthy urban mobility, 77 answered the second survey in 2020. Considering leaving home behavior, were found significant reduction in commuting to work, making social visits, leisure activities and taking care of health. On the other hand, the use of active transportation modes (walking and cycling) did not change significantly, while the use of motorized transportation modes was reduced significantly. We conclude that during the pandemic and post-pandemic periods, special attention should be given to stimulating active mobility and to reduce the use of motorized transportation modes.

Keywords: mobility; transportation; COVID-19; physical distancing.

Resumo

Efeitos do distanciamento social do COVID-19 na mobilidade urbana: evidência longitudinal do Distrito Federal-Brasil. A pandemia do COVID-19 impactou a vida das pessoas, especialmente considerando que o distanciamento social parece ser a maneira mais eficaz de reduzir a disseminação do vírus até o momento. Analisando dados longitudinais de um grupo de residentes do Distrito Federal do Brasil, verificamos o impacto do distanciamento físico em abril de 2020. De 351 participantes de uma pesquisa de 2017 sobre mobilidade urbana saudável, 77 responderam a uma segunda pesquisa em 2020. Considerando o comportamento de sair de casa, foram encontradas reduções significativas nas saídas para ir ao trabalho, visitar amigos, realizar atividades de lazer e cuidar da saúde. Além disso, o uso de mobilidade ativa (caminhada e ciclismo) não mudou significativamente, enquanto o uso de modos de transporte motorizado diminuiu substancialmente. Concluímos que, durante os períodos pandêmico e pós-pandêmico, atenção especial deve ser dada para estimular a mobilidade ativa e reduzir o uso de modos de transporte motorizados.

Palavras-chave: mobilidade; transporte; COVID-19; distanciamento físico.

Resumen

Efectos del distanciamiento social del COVID-19 en la movilidad urbana: evidencia longitudinal del Distrito Federal-Brasil. La pandemia del COVID-19 ha impactado el cotidiano de las personas, especialmente porque el distanciamiento social parece ser la forma más efectiva, hasta la fecha, de reducir la propagación del virus. Analizando datos longitudinales de un grupo de residentes del Distrito Federal de Brasil, verificamos el impacto de las recomendaciones de distanciamiento físico dadas en abril de 2020. De los 351 participantes de una encuesta del 2017 sobre movilidad urbana saludable, 77 respondieron una segunda encuesta en el 2020. Se encontraron reducciones significativas en las salidas para ir al trabajo, visitas sociales, ocio y el cuidado de la salud. El uso de los modos de transporte activos (caminar y andar en bicicleta) no cambió significativamente, pero hubo reducción del uso del transporte motorizado. Concluimos que, tanto durante el período de la pandemia como en la Postpandemia, se debe estimular la movilidad activa y reducir el uso de modos de transporte motorizado.

Palabras clave: movilidad; transporte; COVID-19; distanciamiento físico.

The first World Health Organization report of the Coronavirus Disease (COVID-19), published on January 20th 2020, informed that only four Asian countries reported cases of the virus, for a total of 282 infected individuals (World Health Organization [WHO], 2020a). Not quite four months later, on May 1st, 224,172 deaths had been registered around the world (WHO, 2020b). This infectious disease can be transmitted through respiratory droplets and contact routes, with no reports of airborne transmission (Liu et al., 2020). Spread occurs by having contact with infected individuals or with surfaces or objects used by them (WHO, 2020a).

To contain the growing spread of the virus and to rapidly recover the economy, physical distancing appears to be the key strategy (Ainslie et al., 2020; Kraemer et al., 2020). Also referred to as social distancing, it means keeping space between individuals, avoid agglomeration and stay away from crowded places; the idea being to limit close contact with others not part of one's household, considering that people can spread the virus before even they know to be sick themselves (Centers for Disease Control, 2020).

Social distancing, however, can bring about not only social and economic consequences, but also impact on the daily lives on an individual level. There are many who live under conditions that challenge the practice of social distancing, such as residing in shared homes or working in essential services, such as drugstores or supermarkets. Thus, all over the world, COVID-19 is impacting the way people move in and within cities. For instance, in some Brazilian cities, such as São Paulo, citizens had to adapt themselves to road space rationing based on license plate numbers. In other cities, such as São Luiz, Maranhão, with higher transmission rates of the virus, the government has imposed a lockdown.

While mobility issues are mostly investigated by engineers or architects, it is also a concern for environmental psychologists, as travel behavior directly impacts people's quality of life and the way they relate with the urban environment. Investigating the time people spend inside cars or buses, or if they use, or not, healthier options to get around, such as walking and cycling, allows psychologists to make inferences about their psychological wellbeing and about how they interact with the urban environment. During the pandemic, these mobility aspects are impacted by the reduction of the number of daily trips imposed by the quarantine. As to the Federal District of Brazil, the location of the present study, it is not clear if the residents are following

the government's orientation to stay home and, if not, how they are moving about the city.

Parting from the assumption of environmental psychology that mobility influences people's well-being and the connection with the urban environment, this study set out to analyze how physical distancing during the early weeks of the pandemic impacted on mobility in the Federal District, especially how mobility patterns changed comparing daily lives before and during the quarantine.

Mobility during COVID-19 Pandemic

Mobility is an attribute inherent to human nature in that it allows access to different kinds of goods and services available in the environment (Günther, 2003). Moving from one place to another requires different instruments (such as cars or bicycles) and different contexts (such as going shopping or to work, or to pursue leisure activities). Analyzing mobility implies looking at two essential dimensions: (a) the individual, who gets around and carries out daily activities, and (b) the environment, within which the individual moves; the assumption being that mobility only occurs when there is need or interest in getting around and there is a place where it is possible to do so (Günther & Neto, 2015).

In the context of COVID-19, moving from one place to another is facing an immense transformation. The pandemic has decreased transport demand and reduced everyday mobility, even in cities with no confinement policies (Organization for Economic Co-operation and Development, 2020). Travels using all modes of transport have been reduced in different parts of the world: even where individuals want to go from one place to another, they are asked to remain at home in order to preserve collective health. On the other hand, the environment continues to be attractive, with less traffic congestions, noise or pollution (Serafimova, 2020; Zambrano-Monserrate, Ruano, & Sanchez-Alcalde, 2020).

Besides the concerns with physical and mental health brought about by COVID-19, environmental psychologists are interested in investigating what kinds of transportation alternatives exist for residents of urban areas where people need to maintain social distancing. Is it possible to use healthier transportation modes in order to avoid sedentarism and physical inactivity imposed by social distancing?

As to public transportation, at the same time that it is necessary to rapidly and effectively move large numbers of individuals (Daqrouq & Anjimani, 2019), in order to provide access to health care and to food facilities (Union Internationale des Transports Publics, 2020), the pandemic has increased user concerns, regarding the spread of the virus (Transformative Urban Mobility Initiative, 2020). Large numbers of individuals in closed spaces, the difficulty to control the entrance of sick persons and a variety of common surfaces being touched constitute some of the risk factors while using public transportation during the pandemic (Union Internationale des Transports Publics, 2020).

Among the recommendations for public transportation, entities such as the American Public Transportation Association (2020), the European Commission (2020), the Department of Transportation of the United Kingdom Government (2020) and the Union Internationale des Transports Publics (2020) recommend operations staff to provide cleaning and protection equipment, frequently disinfecting common surfaces and hands. There is also the orientation to reduce both services offered as well as passenger density, provide natural air ventilation and electronic ticketing service. As to passengers themselves, recommendations include the use of face masks, the maintenance of social distancing, avoidance of touching common surfaces and one's face, and carrying less luggage. Thus, there was a reduction of public transportation usage in the beginning of the pandemic in Brazil, decreasing the fleet and the offer of the service (Cristo, Soares Júnior, Luiz, & Nascimento, 2020).

Concerning vehicle use, traveling by car has significantly decreased in cities impacted by the virus. Factors such as school closing, working from home and unemployment contributed to less commuting (Klein et al., 2020). On the other hand, there are those who consider cars an attractive alternative, not only because it reduces social contacts, but also due to less road traffic congestion during lockdown (Union Internationale des Transports Publics, 2020).

Despite the advantages of moving by car, the use of this transport modality should not be encouraged, given that injury and death rates among automobile occupants are significantly higher than those among public transportation users (Litman, 2021). Thus, during and after the pandemic, public policies oriented toward reduced car use and speed limits reduction should be stimulated not only to avoid overburdening public

health systems, but to reduce the occurrence of accidents in the first place. In this manner, resources may be freed up for the treatment of COVID-19 patients.

Furthermore, excessive use of cars is generally associated with sedentarism and obesity (Davis, Valsecchi, & Fergusson, 2007; Dias, 2020). While driving, people remain seated in the car, without burning too much body energy. Hence, active mobility, such as walking and cycling, is being encouraged as an important alternative for motor vehicle use, since it can contribute to reducing social contact and crowding (Transformative Urban Mobility Initiative, 2020). On the other hand, it will also reduce demand and pressure on the public transport system and the road network (Department of Transportation of the United Kingdom Government, 2020; Oliveira & Silva, 2021). Active mobility can also help meet public health objectives through physical activity (Honey-Rosés et al., 2020). Some cities, such as London, made temporary road changes, stimulating active travel as a measure to allow local people to take daily exercise while maintaining social distance (Transport for London, 2022).

Considering the current changes in people's daily lives, specifically as concerns mobility habits and patterns, the present study aims to investigate how people are dealing with the restrictions imposed by the policymakers to contain COVID-19 contamination: a) to what extent do they respect the quarantine and avoid leaving their homes; and b) if leaving home, what is their preference for using active versus motorized transportation modes?

Method

Overview

We report results from a longitudinal study. The first wave was conducted in 2017, in the context of the research project Healthy Urban Mobility (Jones et al., 2019). The second wave occurred in April of 2020.

The study was carried out in the Federal District of Brazil, which was the first city in the country to engage in social isolation measures to avoid the spread of COVID-19 ("Em Brasília, a ordem é: fique em casa", 2020). The first measures imposed by the local government, on March 13th, were the closing of schools, cancellation of events with more than 100 visitors and cultural venues, such as theaters, religious assemblies and the like (Decreto N° 40.520, 2020). Six days later, the governor decreed teleworking for public employees and

the closing of nonessential workplaces, such as restaurants, bars, gyms, churches, parks and shopping centers (Decreto N° 40.539, 2020).

No total confinement measure was implemented in the city until the time of the preparation of this paper, even though the number of cases and deaths has been increasing day by day (Secretaria de Saúde do Distrito

Federal, 2020). Data in Figure 1 indicate that right after the first measures were instituted by the local government on March 13th (Decreto N° 40.520, 2020), a substantial increase in social isolation could be observed. However, after the initial adherence, the rate of social isolation decreased, indicating serious risks for the spreading of the virus.

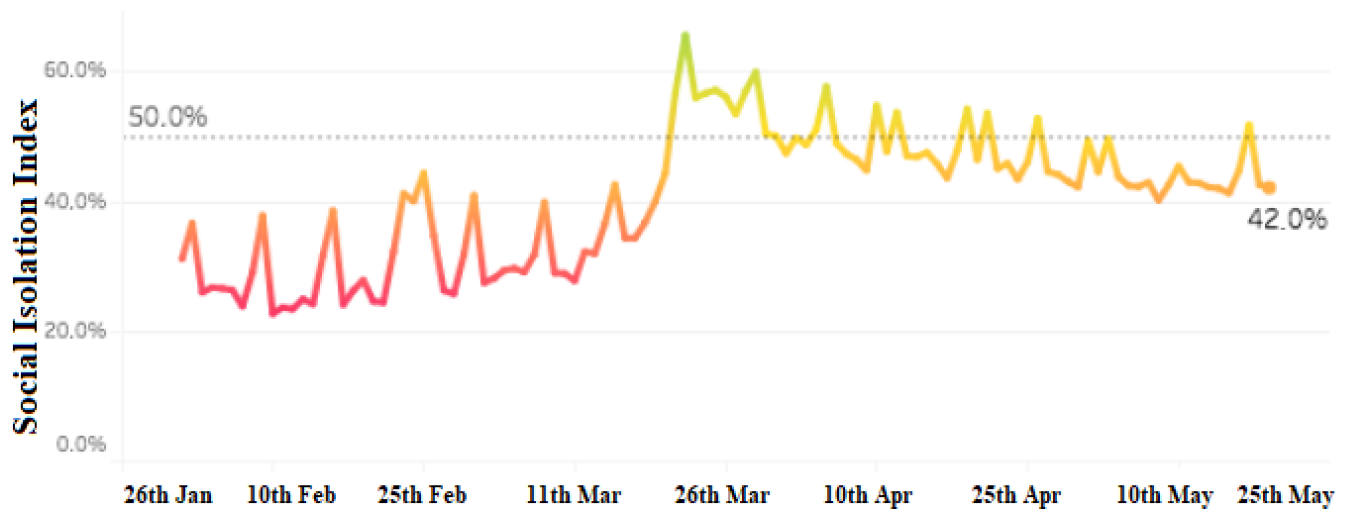


Figure 1. Adhesion to Social Isolation in the Federal District-Brazil between January 26 and May 25, 2020

Note. From InLoco (2020). Mapa Brasileiro da COVID-19.

Overall, Brasília counts with one of the most extensive cycling networks in Brazil, with 400 kilometers of exclusive or segregated bicycle paths. However, the structure of sidewalks and cycling paths projected are not always appropriate, due to hostility of traffic due to inhabitant / car ration (Coelho Filho & Saccaro Filho, 2017). Comparing with cities with similar demographic indexes, Brasília is facing a rapid growing, being characterized by high per capita income, quality of life and access to public services (Augusto, 2017).

Participants

In the first wave of the study, some 1107 respondents participated in a survey dealing with health, mobility, and the quality of life. Asked about willingness to participate in a subsequent part of the study, some 351 respondents provided e-mail addresses and/or cell phone numbers. Of these previous 351 participants, 86 responded when contacted in April of 2020, and, of these, 77 respondents could be linked to respondents

of the 2017 survey, representing 24.4% of the sample. The average age of these 77 respondents was 44-2 years, ranging from 21 to 72 years of age ($SD = 14-1$ yrs.). Some 70% of these respondents were female and 57% lived with children and/or partners. The prevalent travel mode is driving a private car (50.6%), followed by walking on foot (28.6%), and using the bus (9.1%). Only one participant reported using the bicycle as prevalent travel mode.

Instruments

We repeated items from the previous 2017 survey derived from a questionnaire regarding mobility behavior (Bird, Panter, Baker, Jones, & Ogilvie, 2018), previously adapted to Brazilian Portuguese (Neto et al., 2021).

Procedure

We conducted the 2017 survey in three neighborhoods of the Federal District of Brazil. That

survey was undertaken in the form of face-to-face interviews in the home of the respondents, with addresses randomly selected from lists obtained from local government agencies. Participants of the 2017 survey that had furnished emails and/or cellphone were contacted in April of 2020 and received an online survey right after the start of the COVID-19 quarantine.

To analyze the data, we used the software Statistical Package for the Social Sciences. Chi-square statistical tests were calculated, to evaluate differences in mobility in both data collection waves (2017 and 2020).

Results

Changes in Leaving Home

The first question of this study deals with whether the respondents respected the quarantine and avoided leaving home. We asked about five destinations for leaving home: (a) work, (b) personal business and religious activities, (c) friends and relatives, (d) leisure activities, and (e) health care matters. For each of these destinations, we asked respondents to indicate whether they *left their homes not at all*, or *left their home at least once*. In Figures 2 and 3, we present the number

of times the respondents reported leaving their homes at the time of the 2017 survey and at the time of the 2020 survey.

A significant change in mobility can be noted when comparing frequencies of not having left home as reported in the 2017 and in the 2020 surveys (Figure 2) and the respective frequencies of having left home as reported in the 2017 and in the 2020 surveys (Figure 3). Except for taking care of personal business / religious activities, there were significant reductions in the number of respondents reporting to have left home from 2017 to 2020 in order to go to work ($\chi^2_{df=1} = 12.79$; $p = .000$), to visit friends and relatives ($\chi^2_{df=1} = 20.42$; $p = .000$), to take care of health matters ($\chi^2_{df=1} = 45.90$; $p = .000$) or to engage in leisure activities ($\chi^2_{df=1} = 7.99$; $p = .000$). Overall, while in the 2017 survey there were some 132 reports of not having left home, in the 2020 survey, this number nearly doubled to 247 ($\chi^2_{df=1} = 67.53$; $p = .000$). Thus, one may assume that respondents did respect the call for quarantine. However, leaving home to take care of personal business or undertake religious activities did not change significantly, suggesting that the restrictions instituted by the government did not affect this type of activity.

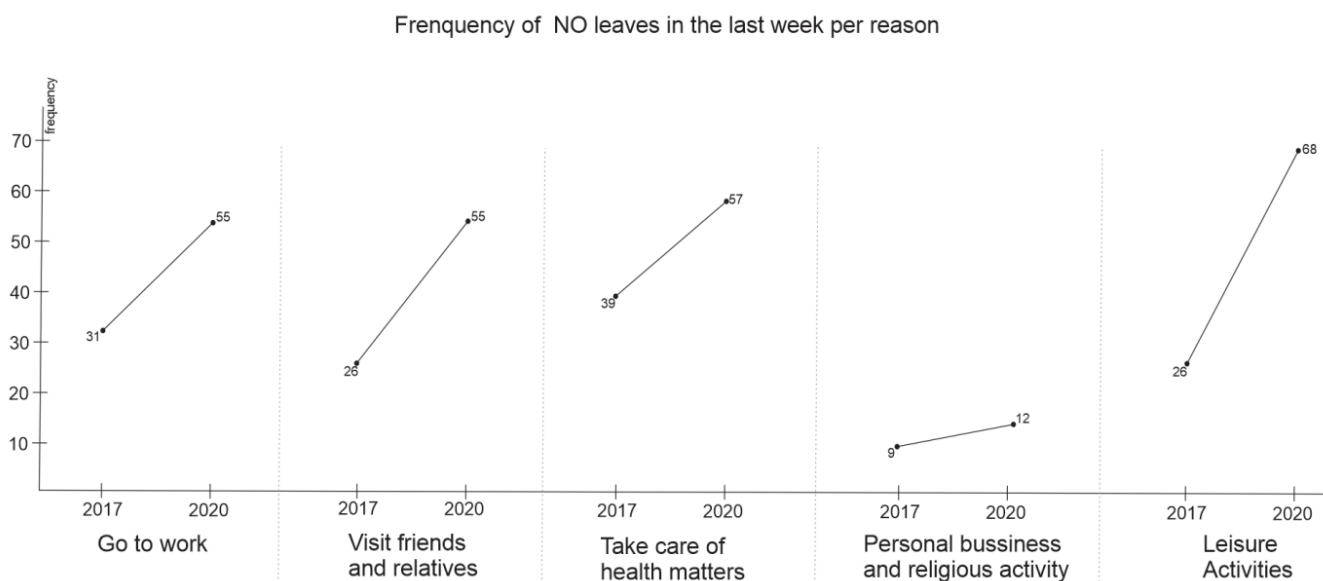


Figure 2. Frequency of not having left home in the last Week, as reported in the 2017 survey and the 2020 survey.

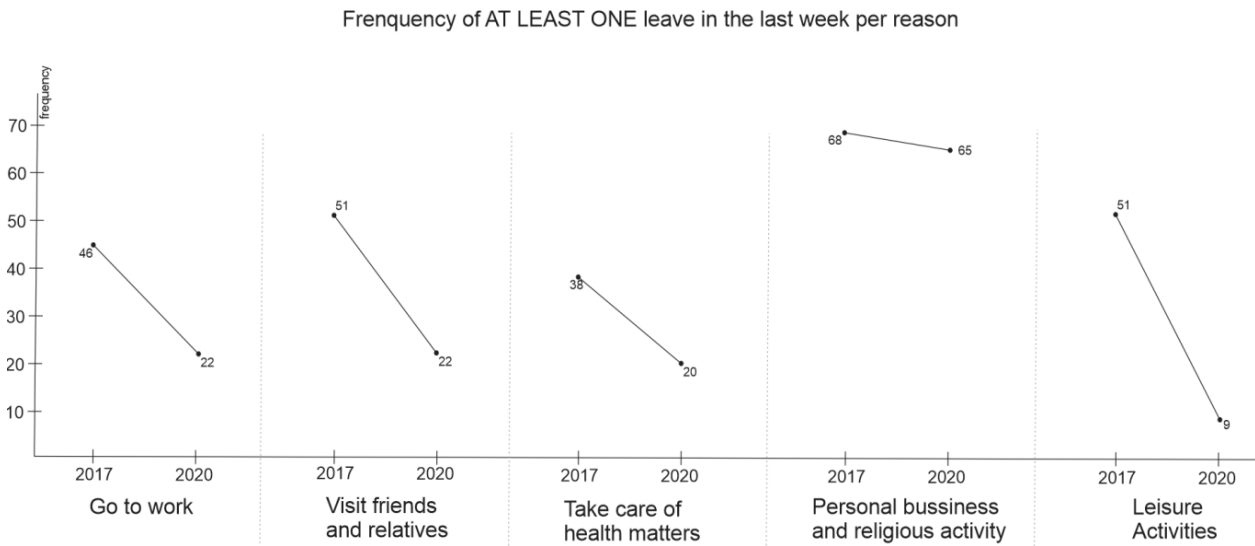


Figure 3. Frequency of having left home in the last Week, as reported in the 2017 survey and the 2020 survey.

Changes in Travel Mode

The second question of this study addressed changes in travel mode: to what degree did respondents report preferences for using active mobility, such as walking or cycling, versus for using motorized transportation modes, such as buses or cars, in 2017 and in

2020? To that end, we compared the choice of travel mode reported in the 2017 survey with the choices reported in the 2020 survey. In Figure 4, we present the total frequencies of using active mobility versus motorized transportation modes reported by each respondent in 2017 and in 2020.

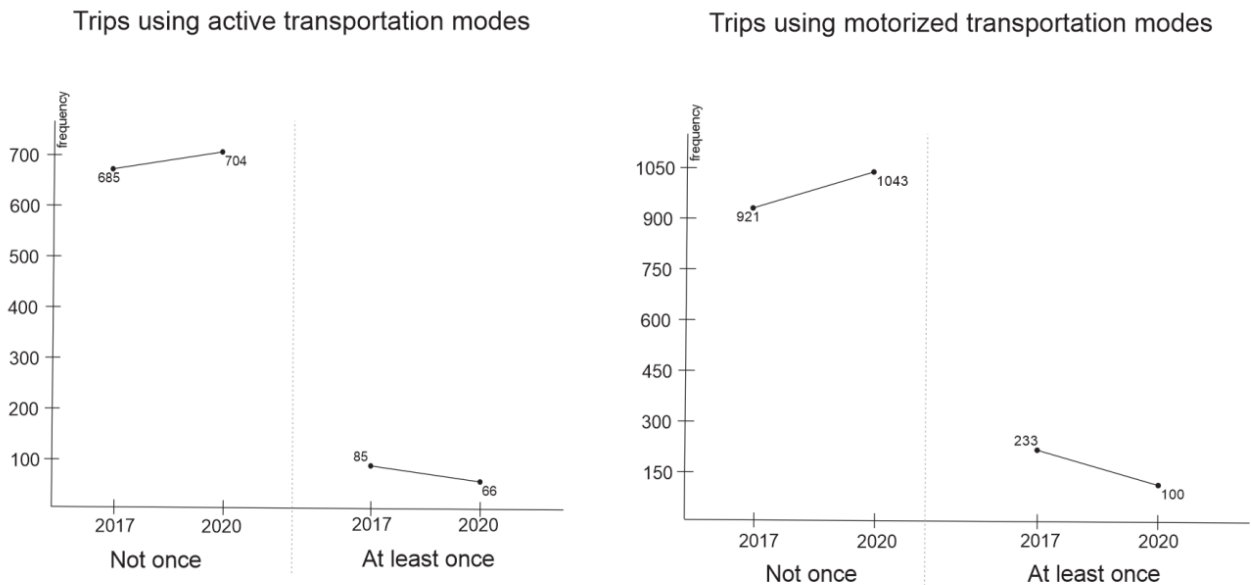


Figure 4. Comparison between the use of Active Mobility versus Motorized Transportation Modes in 2017 and in 2020.

As to the use of active mobility, we found no statistically significant change. However, as concerns the use of motorized transportation modes, statistically significant changes were observed ($\chi^2_{df=1} = 168.61$; $p = .000$) in the sense that respondents reported fewer motorized travel in 2017 as compared to 2020.

Discussion

In this study, we analyzed the degree to which the participants respected the COVID-19 quarantine and avoided leaving home. We analyzed two aspects of mobility, trip purpose and travel modes, in two different moments, in 2017, prior to the advent of COVID-19, and in 2020, during the COVID-19 quarantine. As concerns purpose and destination, it is noteworthy that respondents in this study reported reducing their travel activities in a significant manner to all destinations investigated, except for business and religious purposes.

The strongest decline was reported for leisure activities, which include fitness studios, running in parks and similar outdoors venues. Except for one of the neighborhoods studied, there are few green spaces that might substitute opportunities to run in parks. The marked reduction in leaving home for social visits with friends and relatives in the current sample is significant in that much of these kinds of activities take place in bars and restaurants, not just in the home of friends visited.

Another important decline can be observed in people leaving for work. This, of course, may be due to the fact that many of the respondents may have occupations that allow for working from home. Also, this could be explained by the lack of demand for some types of services, although unemployment was mentioned as a reason by only one participant.

The decline in leaving home in order to take care of health matters calls attention. Given that the origin of the 'stay home' order is a health issue, as concerns avoiding contact with individuals who may be infected with a highly contagious virus, social isolation led the population to use medical services less rather than more often. One possible explanation may be the concern that in hospitals or clinics, people could have a higher probability of contracting the virus.

The fact that there was no statistically significant change in leaving home to attend to business or religious matters, even registering a slight increase, might represent an artifact, in as much as the number of

individuals reporting that they had left home in 2017 for this purpose was quite low to begin with. Also, this question, compared to the others, aggregates a larger variety of possible destinations in the city.

Taken together, these results suggest that respondents respected the quarantine, at the time the data was collected, for the majority of the destinations investigated. It is important to mention that we conducted the study in the very beginning of the pandemic in Brazil, in April 2020, when individuals were more likely to engage in social distancing measures. Certainly, different results would be found if data collection was made in another time frame. Further research needs to explore the reasons why the respondents kept going to religious activities and personal business, even during the pandemic and propose solutions and alternatives for people to avoid this kind of place if necessary.

Regarding transportation modes, individuals significantly reduced their use of motorized transportation, something that did not happen with active mobility. Even though there was a slight reduction in the use of active mobility from 2017 to 2020, it was not statistically significant, suggesting that people who used to walk and cycle continued to do so during the pandemic. These results suggest that those who walk and cycle perceive active mobility as safe or even important to maintain one's health during the pandemic. In fact, walking and cycling are being encouraged in different cities during the pandemic, in order to reduce public transportation demand and social crowding (Department of Transportation of the United Kingdom Government, 2020; Transformative Urban Mobility Initiative, 2020), and also to promote physical activity and daily exercise (Honey-Rosés et al., 2020; Transport for London, 2022).

Further research is needed to investigate why participants reduced the use of motorized transportation. One possible explanation for the fact that some participants reduced using public transportation is to avoid the agglomeration inside buses and metro, which increase the risk of contamination (Cristo et al., 2020; Union Internationale des Transports Publics, 2020). This reduction contributed to the decrease in the service, limiting the number of bus lines operating (Governo do Distrito Federal, 2020). In this manner, it produced a curious circle: fewer passengers for fear of agglomeration and contagion, lower number of bus lines, continuation with the same degree of density that had led to fewer passengers.

Concerning vehicle use, the decrease of traveling by this transportation mode was clearly impacted by the restrictive actions proposed by the local government (Decreto N° 40.520, 2020; Decreto N° 40.539, 2020), such as school closing and teleworking, corroborating the situation experienced in other cities affected by the virus (Klein et al., 2020). Some respondents indicated the continuation of the use of their cars, considering it an attractive alternative (Union Internationale des Transports Publics, 2020). However, most of them reported a significant car use reduction, suggesting that even if it is attractive, it is not perceived as safer than staying at home. Once again, it is important to emphasize the time frame data collection was conducted, when citizens tended to be more worried about the spread of the virus and followed the stay home measures more properly. Current studies already show a different pattern of mobility, indicating the growth of car use in Brazilian urban areas, as a form to avoid public transportation (Leiva, Sather, & Orrico Filho, 2020; Prefeitura da cidade de São Paulo, n.d; Summit Mobilidade Urbana, 2021). Thus, studies conducted during pandemic contexts reflect a very specific aspect of the reality faced by residents of urban areas in a given moment.

Conclusions and suggestions

The pandemic has brought about an extremely difficult situation, as concerns mobility and public spaces usage, by impacting people's everyday lives. Similar to the 1918-1920 influenza pandemic, COVID-19 brought up the sensation of the infeasibility of a modern, urbanized, and industrialized society (Goulart, 2005). In times like these, it is important to consider alternative possibilities, breaking old habits and create new ones.

The COVID-19 pandemic affected the whole world, disrupting the daily functioning of cities. At the individual level, the relevance of mobility became even more evident; with the severe restrictions on moving about provoking serious consequences for mental and physical health. Thus, this historical moment may very well offer a unique opportunity to reflect on the biases in using public space and ways to move away from the overvalued use of the motorized transport system, towards turning, especially large cities, into more livable urban areas (Appleyard, Gerson, & Lintell, 1981; Gehl, 2010).

Furthermore, considering such ecological and health considerations as the maintenance of air quality and collective health may be reinforced by the current

changes provoked by COVID-19 and may lead to important changes in the way we use and move about the city, allowing us to reach minimum levels of pollution, physical inactivity and obesity. Thus, despite the costs imposed by the disease around the world, it constitutes an important reminder of how to use and respect healthier and more sustainable modes of transportation.

Considering the interval between the first and second survey, obtaining 86 responses in 2020 out of 351 participants in 2017 (24.5%) may be considered a reasonable response rate, even if of these, nine responses could not be linked to the corresponding 2017 responses, due to incomplete names or e-mail addresses. One possible explanation for this response rate may be a reactance to the very topic of the survey, the pandemic situation itself; another that the second survey was conducted online. Furthermore, the recommendations by Dillman (2000) regarding the tailored design method were not followed, given the urgency of conducting the study during the early stages of the eclosion of the pandemic. Finally, there are indications that when conducting paper-based surveys, one tends to obtain a higher response rate as compared to online surveys (Nulty, 2008). Given the dynamic development of the pandemic and the spread of the virus, it will be desirable to contact this cohort once again in order to verify continuation changes in mobility.

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