

# **IMPACT OF COVID-19 ON URBAN TRANSPORTATION HABITS IN THE CITY OF GIJÓN**

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## **ABSTRACT**

The COVID-19 pandemic, which has been ravaging the world since the beginning of 2020, has greatly changed daily habits in terms of mobility, particularly in cities. The fear of prolonged contact with other users on public transport, may cause great changes in citizens' preferences towards transport in private vehicles, motorized or not, and sharing. The aim of this study was to assess the changes in mobility habits based on an online survey in Gijón (Spain) taken at the end of summer 2020, after the first wave, and generation of the so-called “new normality”. This document presents a preview of the main results, related to the vehicles most used by Gijón's population. The results have allowed us to observe an increase in the use of private vehicles and, consequently, decrease in use of the bus. In addition, the survey sample also demonstrated the scant insertion of PMVs, motorcycles and bicycles in citizens' preferences. Finally, they also showed gender and age differences in urban mobility.

## **1. INTRODUCTION AND OBJECTIVE**

At the beginning 2020, the virus later known as SARS-CoV-2 began to spread through the city of Wuhan, China. On March 11, 2020, the WHO determined that the situation of the COVID-19 disease caused by SARS-CoV-2 was pandemic. Days later, and in harmony with what occurred in surrounding countries, on March 14<sup>th</sup>, the Spanish government decreed a state of emergency and home confinement until June 20<sup>th</sup>.

The effects of this pandemic, and of confinement, caused substantial changes in the habits of millions of people in all walks of life; among others, there are signs that the preferences for use of different means of transportation have been profoundly affected. This relationship is not exclusive to COVID-19, as after a detailed analysis of extant literature, Muley et al. (2020) found a strong relationship between the appearance of contagious

diseases and a series of significant changes in the transportation sector, demonstrated by other pandemics in the 21<sup>st</sup> century before COVID-19: SARS (2003), influenza A (2009) and MERS (2012). However, during the past year, interest in knowing the effect of COVID-19 on mobility habits has generated an enormous amount of information. This was emphasized in surveys and indicators such as Apple's reports on trends in mobility (Apple Maps, 2020); and the Nextdoor app noted that in cities like Madrid and Barcelona, over half of the population has changed its customs for going from place to place (Interempresas, 2020), and other services, such as the Moovit platform (Moovit, 2020) have also suggest this. Likewise, with tremendous immediacy, scientific journals began to publish a considerable number of studies that analyzed the effect of the pandemic on transportation habits in different countries (Awad-Núñez, Julio, Moya-Gómez, Gomez, y Sastre González, 2021; Carteni, Di Francesco, y Martino, 2020; Gunthe y Patra, 2020; Linka, Peirlinck, Sahli Costabal, y Kuhl, 2020; Orro, Novales, Monteagudo, Pérez-López, y Bugarín, 2020; Tian, An, Chen, y Tian, 2021), and databases focused on future studies of mobility during the pandemic (Barbieri et al. 2020).

The methods for evaluating these changes have been diverse. Thus, Aloi et al. (2020) collected data from traffic counters, ITS public transportation, and recordings from traffic control cameras and environmental sensors, to evaluate the effect in Santander (Spain); Bucsky (2020) took data from official sources to measure the changes in Budapest; Klein et al. (2020) used mobility data from the Cuebiq platform; Brough et al. (2021) combined data from government administrations and own surveys; Khaddar and Fatmi (2021) used data from the 2020 COVID-19 Survey for Assessing Travel Impact (COST); and Bartuska and Masek (2021) analyzed data from traffic surveys.

Along with these methods, some research teams and individuals have chosen to take surveys of their own. Logically, the survey method is widely used for acquiring information on transportation (Ampt y Ortúzar, 2004; Ortúzar, Armoogum, Madre, y Potier, 2011; Plasencia-Lozano, 2021). Table 1 shows a diversity of studies carried out in different places. In general, strong changes in urban mobility are observed in all of them in line with what was noted in the abovementioned study by Muley, who found the following effects on travel behavior: Decrease in the number of trips, in the use of public transportation and in distances covered, and an increase in the use of private vehicles, bicycles and walking. All of them were done before the summer of 2020 and analyzed the effect of COVID-19 during its most complicated moment, due to its novelty, and therefore more in contrast to the prepandemic situation.

Source	Place	Sample size	Dates
(Campisi et al., 2020)	Sicily (Italy)	431	March 13 - April 13, 2020
(Mogaji, 2020)	Lagos (Nigeria)	329	May 18 - May 24, 2020
(Beck y Hensher, 2020)	Australia	1,073	March 30 - April 15, 2020
(Shamshiripour et al., 2020)	Chicago (USA)	1,200	April 25 - June 2, 2020
(König y Dreßler, 2021)	Altmarkkreis Salzwedel district (Germany)	117	April - May, 2020
(Irawan et al., 2021)	Indonesia	1,062	March - April, 2020

**Table 3 - Survey studies on variations in mobility habits related to COVID-19.**

At the end of spring and beginning of summer 2020, there was a strong descent in contagion, and the authorities in Spain began to talk about remission of the pandemic in a context baptized as “the new normality”. On June 20<sup>th</sup>, “reconquering mobility” was expressly suggested, and on July 4<sup>th</sup>, citizens were encouraged to “recover the streets” (Benito, 2021). Although we now know that this first wave was followed by several more, at that moment between the first and following waves, which coincided with the summer of 2020, is of interest for studying mobility habits, at least in Spain, because on those dates, society (or part of it) made decisions within a context of “reconquered mobility” and “recovered streets”. Therefore, it could give us a clue to what were going to be the mobility habits in the final scenario mentioned, when it occurs. With this in mind, on those dates, during the summer and beginning of autumn 2020, we conducted a study using an online survey to evaluate the effect of the pandemic on the mobility habits of the population of Gijón, a middle-sized Spanish city with several transportation options.

## 2. MATERIALS AND METHODS

### 2.1. Description of the Case Study

Our study focused on the city of Gijón (Spain), which currently has a population of 271,780 and an area of 181.7 km<sup>2</sup>. It is a city with a large urban bus system, with 16 lines with different routes, plus one special line only for workdays and five night-service routes, operating daily from 06:30 to 00:00 making 80,611 trips daily (Gijón City Council, *Plan de movilidad urbana municipal sostenible* [Sustainable Municipal Urban Mobility Plan]). Since 2019, a car-sharing and moped-sharing service has also been in growing demand in the city, and since 2018, the Tucycle e-bike service.

### 2.2. Procedure

A survey was designed for the study (Table 2) and distributed to the population of Gijón in an online form from August 15, 2020 to November 5, 2020 (date the state of emergency that officially determined the beginning of the second wave was declared) related to mobility habits. A link to the survey was distributed by email, in social networks and in QR codes linked to the form at several different points in the city.

A statement clarified that only those inhabitants of the city aged 18 to 99 who must move around it and need to use a vehicle to do so could answer. Descriptive statistics were used in data processing, although in future these data could be used for developing an inferential statistics research.

Question	Answer choices
1 State your age	Open answer
2 State your sex	Female, Male
3 Before March 2020, what type of transportation did you mostly use to get around?	Private car, Bicycle, Motorbike (own or sharing), Scooter, Bus, Taxi
4 Before March 2020, did you have a bicycle, motorbike or electric scooter?	Yes, traditional bicycle. Yes, e-bike, Yes, e-scooter. Yes, traditional motorbike. Yes, e-moped. No.
5 After March 2020, what type of transportation did you mostly use to get around?	Private car, bicycle (own or sharing). Motorbike (own or sharing). Scooter. Bus. Taxi.
6 After March 2020, have you acquired some type of bicycle or e-scooter?	Yes, traditional bicycle. Yes, e-bike. Yes, e-scooter. Yes, traditional motorbike. Yes, e-moped. No.
7 Related to the e-bike sharing service "TuCycle"	I was a member and still am. I was a member before March 2020 but am not now. I was not a member before March 2020 and am still not. I was not a member before March 2020, but now I am.
8 Related to the e-moped sharing service "HiMobility"	I was a member before March 2020 and still am. I was a member before March 2020 but am not now. I was not a member before March 2020 and am still not. I was not a member before March 2020, but now I am.

**Table 4 – Questions and answer choices in the online form**

### 2.3. Sampling

After the survey was distributed, a total of 630 responses were received as of November 5, 2020, all of them valid. Of these 55.6% were women (350) and 44.4% were men (280); these figures are similar to the social reality of Gijón (Table 3). There were strong differences with respect to reality in age groups, as people aged 18–25 are hardly represented at all, while there is a significant overrepresentation of people over 65.

Category	Sample		Gijón
	Frequency	Percentage	
Gender	Female	350	55.6%
	Male	280	44.4%
Age	18-25	159	25.2%
	26-65	450	71.4%
	>65	21	3.4%

**Table 3. Respondents by gender and age, and comparison with real population in Gijón 18 years and over**

The margin of error was found applying the following formula:

$$n = \frac{N \cdot z_{\frac{\alpha}{2}}^2 \cdot p \cdot (1-p)}{e^2 \cdot (N-1) + z_{\frac{\alpha}{2}}^2 \cdot p \cdot (1-p)} \quad (1)$$

The values entered were: size of the population of Gijón over 18 years of age,  $N = 235,075$ ; sample size  $n = 630$ ;  $p = 0.5$ . Following a normal distribution,  $z_{\frac{\alpha}{2}} = 1.96$ , for a confidence level of  $(1 - \alpha) = 95 \%$ . The margin of error was therefore  $e = \pm 3,9 \%$ .

#### 4. RESULTS

The answers to Question 3 (Table 4) show that the means of transportation most used in Gijón before the pandemic by over 50% of the users, excluding pedestrians, was private vehicle. The bus was used by 36.8% of users, and the rest were hardly used at all.

Comparing this to the answers to Question 5 (Table 5), it may be observed that private car users increased greatly (14.1 points) as did bicycle users (3.8 points), while use of bus diminished (19.5 points). The rest of vehicles increased slightly.

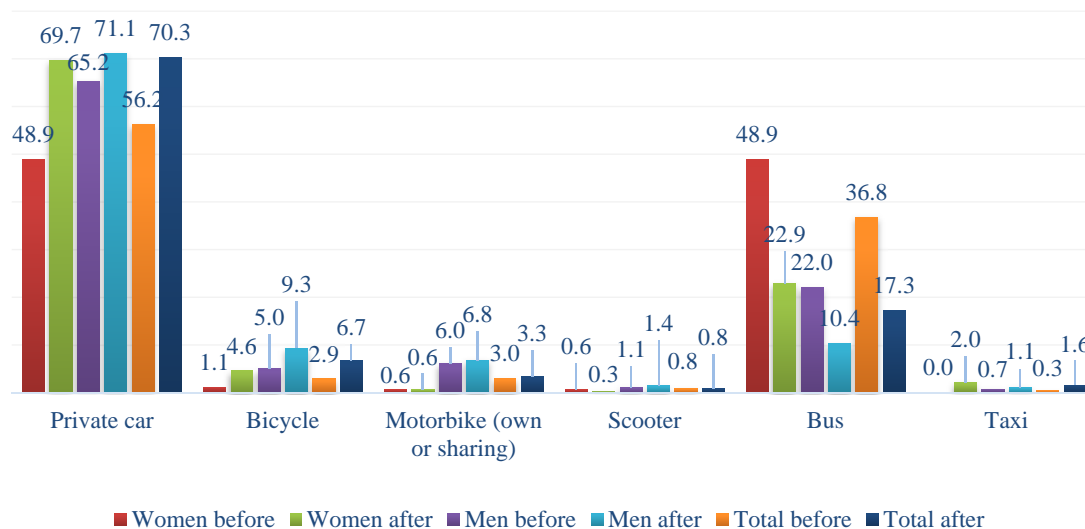
There was an unequal evolution of data by gender: before March 2020, women used private cars less than men, but used the bus to a similar extent. However, after the first wave of the pandemic, their use of the private car was practically the same as men. Men in turn, have chosen to use alternative private vehicles more than women: the set bicycle+moped+scooter rose among men from 12.1% to 17.5%, while in women it went from 2.3% to 5.5%. By age range, the private car was observed to increase greatly in the 18-25 group by 36.1%, and 7.6% in the 26-65 age range, while over 65 remained the same, and this rise was due to the drop in use of the bus, in the group of 18 to 25 by 44.2%, in the 26.65 group by 12.1%, and in the group over 65, the drop is 5.1%.

		Private car	Bicycle	Motorbike (own or sharing)	Scooter	Bus	Taxi	Total
Women	Responses	171	4	2	2	171	0	350
	Percentage	48.9%	1.1%	0.6%	0.6%	48.9%	0.0%	100.0%
Men	Responses	183	14	17	3	61	2	280
	Percentage	65.4%	5.0%	6.1%	1.1%	21.8%	0.7%	100.0%
18-25	Responses	34	3	1	0	117	0	155
	Percentage	21.9%	1.9%	0.6%	0.0%	75.5%	0.0%	100.0%
26-65	Responses	303	15	18	5	111	2	454
	Percentage	66.7%	3.3%	4.0%	1.1%	24.4%	0.4%	100.0%
>65	Responses	17	0	0	0	4	0	21
	Percentage	81.0%	0.0%	0.0%	0.0%	19.0%	0.0%	100.0%
Total	Responses	354	18	19	5	232	2	630
	Percentage	56.2%	2.9%	3.0%	0.8%	36.8%	0.3%	100.0%

**Table 4: Question 3. Before March 2020, what type of transportation did you mostly use to get around?**

		Private car	Bicycle	Motorbike (own or sharing)	Scooter	Bus	Taxi	Total
Women	Responses	244	16	2	1	80	7	350
	Percentage	69.7%	4.6%	0.6%	0.3%	22.9%	2.0%	100.0%
Men	Responses	199	26	19	4	29	3	280
	Percentage	71.1%	9.3%	6.8%	1.4%	10.4%	1.1%	100.0%
18-25	Responses	92	11	1	2	50	3	159
	Percentage	57.9%	6.9%	0.6%	1.3%	31.4%	1.9%	100.0%
26-65	Responses	334	31	20	3	56	6	450
	Percentage	74.2%	6.9%	4.4%	0.7%	12.4%	1.3%	100.0%
>65	Responses	17	0	0	0	3	1	21
	Percentage	81.0%	0.0%	0.0%	0.0%	14.3%	4.8%	100.0%
Total	Responses	443	42	21	5	109	10	630
	Percentage	70.3%	6.7%	3.3%	0.8%	17.3%	1.6%	100.0%

**Table 5: Question 5. Since March 2020, what type of transportation do you mostly use to get around?**



**Figure 1. Comparison, in percentage, of means of transportation used before and after March 2020 by gender.**

Questions 4 and 6 referred to the evolution of the private vehicle pool other than cars.

Before 2020, over 42% of the population owned some type of vehicle of the following types: bicycle or e-bike, e-moped or motorbike, e-scooter. After March 2020, 6.3% of the population claimed to have acquired a vehicle of this kind. An analysis by gender showed that before the pandemic, a higher percentage of men and women had vehicles of this type (57% vs 30%); after the pandemic, the percentage of men who acquired these vehicles was higher than women (8.9% vs 4.3%). Analyzing these data by age range, over 44% of the group of young people (18-25) had one of the vehicles mentioned, and similar in the 26-65 group (42%), however in the group over 65, only 18% had one of these vehicles. After March 2020, in all of the groups, over 93% had not acquired any of the vehicles mentioned above.

		Yes, traditional bicycle	Yes, e- bike	Yes, e- scooter	Yes, motorbike	Yes, e- moped	No	<b>Total</b>
Women	Responses	88	3	3	12	1	249	<b>356</b>
	Percentage	24.7%	0.8%	0.8%	3.4%	0.3%	69.9%	<b>100.0%</b>
Men	Responses	126	5	11	25	0	126	<b>293</b>
	Percentage	43.0%	1.7%	3.8%	8.5%	0.0%	43.0%	<b>100.0%</b>
18-25	Responses	62	0	6	3	0	89	<b>160</b>
	Percentage	38.8%	0.0%	3.8%	1.9%	0.0%	55.6%	<b>100.0%</b>
26-65	Responses	149	8	8	34	1	268	<b>468</b>
	Percentage	31.8%	1.7%	1.7%	7.3%	0.2%	57.3%	<b>100.0%</b>
>65	Responses	3	0	0	1	0	18	<b>22</b>
	Percentage	13.6%	0.0%	0.0%	4.5%	0.0%	81.8%	<b>100.0%</b>
Total	Responses	214	8	14	37	1	375	<b>649</b>
	Percentage	33.0%	1.2%	2.2%	5.7%	0.2%	57.8%	<b>100.0%</b>

**Table 6: Question 4. Before March 2020, did you have a bicycle, moped or e-scooter?**

		Yes. traditional bicycle	Yes. e- bike	Yes. e- scooter	Yes. motorbike	Yes. e- moped	No	<b>Total</b>
Mujeres	Responses	11	1	2	1	0	335	<b>350</b>
	Percentage	3.1%	0.3%	0.6%	0.3%	0.0%	95.7%	<b>100.0%</b>
Hombres	Responses	17	2	1	5	0	256	<b>281</b>
	Percentage	6.0%	0.7%	0.4%	1.8%	0.0%	91.1%	<b>100.0%</b>
18-25	Responses	6	1	1	2	0	150	<b>160</b>
	Percentage	3.8%	0.6%	0.6%	1.3%	0.0%	93.8%	<b>100.0%</b>
26-65	Responses	23	2	2	5	0	420	<b>452</b>
	Percentage	5.1%	0.4%	0.4%	1.1%	0.0%	92.9%	<b>100.0%</b>
>65	Responses	0	0	0	0	0	21	<b>21</b>
	Percentage	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	<b>100.0%</b>
Total	Responses	28	3	3	6	0	591	<b>631</b>
	Percentage	4.4%	0.5%	0.5%	1.0%	0.0%	93.7%	<b>100.0%</b>

**Table 7: Question 6. Since March 2020, Have you acquired a bicycle, moped or e-scooter?**

Questions 7 and 8 asked about bicycle and e-moped sharing services. With regard to e-bikes, new and leaving members led to lack of variation in the number of members. e-mopeds went from 2.1% of the population before the pandemic to 3.6% afterwards, for a relative increase of 71%. By age group, in the group of young people, there were 0.6% fewer, while in the group 26-65 there was a 0.4% increase.



		I was a member and still am	I was a member, but am not now	I was not a member and am still not	I was not a member, but now I am.	Total
Mujeres	Responses	6	2	339	3	<b>350</b>
	Percentage	1.7%	0.6%	96.9%	0.9%	<b>100.0%</b>
Hombres	Responses	12	6	257	5	<b>280</b>
	Percentage	4.3%	2.1%	91.8%	1.8%	<b>100.0%</b>
18-25	Responses	1	4	151	3	<b>159</b>
	Percentage	0.6%	2.5%	95.0%	1.9%	<b>100.0%</b>
26-65	Responses	17	4	424	5	<b>450</b>
	Percentage	3.8%	0.9%	94.2%	1.1%	<b>100.0%</b>
>65	Responses	0	0	21	0	<b>21</b>
	Percentage	0.0%	0.0%	100.0%	0.0%	<b>100.0%</b>
Total	Responses	18	8	596	8	<b>630</b>
	Percentage	2.9%	1.3%	94.6%	1.3%	<b>100.0%</b>

**Table 8: Question 7. Related to the e-bike sharing service “TuCycle”**

		I was a member and still am	I was a member, but am not now	I was not a member and am still not	I was not a member, but now I am.	Total
Women	Responses	2	1	343	4	350
	Percentage	0.6%	0.3%	98.0%	1.1%	100.0%
Men	Responses	11	3	257	9	280
	Percentage	3.9%	1.1%	91.8%	3.2%	100.0%
18-25	Responses	1	1	155	1	158
	Percentage	0.6%	0.6%	98.1%	0.6%	100.0%
26-65	Responses	12	3	424	12	451
	Percentage	2.7%	0.7%	94.0%	2.7%	100.0%
>65	Responses	0	0	21	0	21
	Percentage	0.0%	0.0%	100.0%	0.0%	100.0%
Total	Responses	13	4	600	13	630
	Percentage	2.1%	0.6%	95.2%	2.1%	100.0%

**Table 9: Question 8. Related to the e-moped sharing service “HiMobility”**

## 5. DISCUSSION

The main conclusion arrived at from the survey responses is that, although the majority of users already used private vehicles as their usual means of transport before the pandemic, there was a large increase in their use, by both men and women, in a higher percentage than the margin of error mentioned above (total of 56% to 70%); at the same time, bus fare increased, and its use fell drastically (from 36% to 17%). In the rest of the means of transport no significant variations were observed (higher than margin of error).

It is also observed that those surveyed acquired one of the following types of vehicle: e-bike or bicycle, e-moped or motorbike, or e-scooter. Only 6.3% said they had acquired one after the pandemic began, and 4.4% were bicycles. Neither is there an increase in sharing services, as only 1.3% said they had become members of the city's bicycle sharing service, and 2.1% of the moped sharing service.

Furthermore, gender was important both before and after the pandemic, observing more use of the bus by women, and more use of private cars, bicycles and motorbikes by men.

This effect has been widely analyzed in the literature (Figueroa Martínez y Waintrub Santibáñez, 2015; Law, 1999) and even related to cities with mild climates (Williams y Larson, 1996) as is the case of Gijón. The gender effect in the city could also be related to women's employment sectors. Before the pandemic, most women worked in sales, healthcare, education and restaurants/hotels (INE, 2019). These establishments are usually in city centers or zones easily accessible by bus, which could be why those workers habitually make use of public transportation.

The reason for the increase in mobility by private vehicle may be fear of contagion in public transportation due to prolonged contact with other riders, especially at rush hour, as well as occasional drop in service level. Users decided to use private vehicles before using a personal mobility vehicle or a sharing service, which reflects the lack of safety of these vehicles, their price or the city's climate, which could be reasons for this deficit of users.

The results of this study are in line with what those cited in the introduction, which were done just before this one. As the Apple and Nextdoor app mobility reports demonstrated, in cities like Madrid and Barcelona, over half of the population had modified their mobility habits. In Gijón, a change in means of transport was also observed, although not as drastic as in Madrid or Barcelona, which are larger cities with more traffic and more public transportation choices. In this case, half of those surveyed were already usually using a private vehicle, so their habits were not modified; nevertheless, the 36% of users who traveled by bus before the pandemic was reduced to 17% after March 2020.

This study had some limitations. In this case, the main problem with the methodology used is the limitation in generating questions asked in the survey, because the form cannot be very long, or respondents will lose interest. This may have led to the omission of some interesting questions, such as those related to users who shared vehicles before and after the pandemic or the usual destination of the respondents, as their usual means of transportation would vary depending on where they work or study, in the city center or in the outskirts or even in another city in the region. Furthermore, the representativeness of the sample was not the most suitable in terms of age, which could affect the results in the 18 to 25 age group.

One of the results that might have been expected was a large increase in the number of users of the bicycle as their usual means of transportation after the pandemic, because the city has a bike lane. This did increase from 2.9% to 6.7%, although this difference is perhaps not as wide as could have been expected: the lack of connectivity between bike lanes in the city might be the reason why this does not seem a safe choice for regular transportation. In fact, at present, the city is working on a Mobility Plan to solve the problems in the current network's continuity (Grande, 2020), and in March 2021 approved a Mobility Ordinance promoting active mobility instead of private vehicles (Ayuntamiento de Gijón, 2021).

Future studies on mobility since the beginning of the pandemic could consider other factors, such as finding out whether people who usually share cars continue to do so or whether on the contrary, many users of public transportation have now decided to share a vehicle; whether there is any difference between mobility in the different waves of the pandemic, since in this case only the period after the first was evaluated; or include pedestrian mobility in the study to quantify its increase. It might also make sense to study a second wave a year after it, or in successive years; and likewise, the results could be combined with changes in the labor market (increase in telecommuting) or unemployment scenarios arising.

## 6. CONCLUSIONS

This study analyzed the effect of the appearance of the pandemic associated with COVID-19 on mobility habits in the Spanish city of Gijón, with a population of 270,000, where there is currently a good city bus system, and car-sharing, moped-sharing and bike-sharing services. Therefore, a survey was taken from August 2020 to early November 2020. We think that a large part of the value of this study is that it shows a snapshot of a particular moment: that moment at which there was a certain return to normality, in order to evaluate the changes that occurred between the situation before the pandemic and the situation in the summer of 2020, after the first wave.

The survey included eight questions focusing on finding out the variation in type of transportation most used for everyday travel, about possible acquisition of personal mobility vehicles, and joining and leaving bike-sharing and moped-sharing services. This is a pioneer study of the mobility habits related to the pandemic in Gijón, and the results were analyzed based on descriptive statistics.

The main conclusion is a strong increase in the habitual use of the private vehicle, by both men and women, and a decrease in use of the bus. In the rest of the means of transportation, no significant variation was observed.

After the first wave of the pandemic, a certain renewed high in acquisition of personal mobility vehicles by those surveyed was observed. Finally, in regard to shared vehicles, it could only be deduced that there were no important variations.

Gender was demonstrated to affect mobility. Both before and after the pandemic, women used the bus more, and men used private car, bicycle and motorbike more. With regard to the vehicles owned, before the pandemic, more men than women had personal mobility vehicles; after the pandemic, the percentage of men who acquired these vehicles was also higher than women (8.9% vs 4.3%). More people went from public transportation to private in the group of young people (18-25); the group over 65 did not change their habits, because most of them were already using a private vehicle for getting around before the pandemic. Similarly, in regard to owning a PMV, a sharp generational change was observed among those up to 65 years of age compared to those over, as over 42% of the first had a PMV before the pandemic compared to 18% of the latter.

The main limitations of the study were the underrepresentation of young people from 18 to 25, along with the short survey, which did not go into detail so the questionnaire could be answered quickly.

Finally, this study could be a model (both in how it acquired data and the brevity of the survey) for analyzing future modification of mobility habits, as the number of responses was representative (except for underrepresentation of young people), and interesting conclusions were arrived at concerning the objectives set. The possibility of following surveys on the same city to acquire a dataset that can be used to analyze evolution over time of urban mobility habits in Gijón remains open.

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