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# The Impact of COVID-19 Pandemic on the Resilience of Sustainable Mobility in Sicily

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**Abstract:** The COVID-19 pandemic has resulted in unprecedented measures changing travel habits in many countries. Many users have started to prefer traveling by private cars, which is against the sustainability policies of the European cities. The necessity of gaining a deeper understanding of road users' travel habit changes, their feelings on public transport use, and their perceptions of using sustainable urban mobility modes has emerged for future transport planning. Considering these facts, the study in this paper aimed to investigate the influence of the COVID-19 pandemic on road users' perceptions, needs, and use of sustainable travel modes (i.e., public transport, walking, and cycling). An online survey was carried out during the period from March to May 2020 in the case study area, Sicily of Southern Italy. Regarding the population of the case study, the survey was representative, with 431 individuals. The survey included variables, namely gender, age, city of residence, private car ownership, walking and cycling frequency before and during the pandemic, public transport use frequency for leisure activities before and during the pandemic, need for remote working, and the stress and anxiety perception of using public transport during the pandemic. The analysis started with descriptive statistics and it was followed by correlation analysis in order to explore the characteristics of the dataset and relationship between variables. It was found that these were not statistically significantly correlated at a 95% confidence level. An ordinal regression model was applied for determining the predictions. The results suggested that women were less likely to walk during the pandemic than men. Participants were more likely to resume remote work even after the second phase in order to reduce their daily travel needs and keep their isolation. Participants have expressed a positive opinion on the use of micromobility during pandemic situations. These results can be considered as a basis for sustainable urban planning and a guide for decision-makers who aim to encourage the use of public transport, walking, cycling, and micromobility.

**Keywords:** COVID-19; sustainable mobility modes; transport resilience; ordinal regression model

## 1. Introduction

China declared the first case of a COVID-19 infected person who died from this virus, when the first case was registered in Italy, in Europe [1]. The pandemic has spread in a fast manner, and this caused a long period of lockdown in many countries. Activity participation has changed significantly due to the social distancing policy [2]. Remote work became a solution to meet isolation needs. There was limited use of crowded places such as public transport modes (i.e., bus, subway, and bus

rapid transit), bus stops, and stations [3]. As a result, travel demand decreased and the use of private cars and public transport dropped significantly [2,4].

After lockdown, a few companies have preferred to extend the remote work period to reduce the possibility of contagion and the costs of providing protection. However, a majority of the people in many countries must return to their workplaces taking into account social distancing [5]. Future waves can be expected, and it is not known to what extent the protection measures have an impact on reducing the spread of the virus. Therefore, road users may be anxious to return to their previous travel habits, particularly when the use of public transportation is considered, during possible further waves. Due to these pandemic issues, transport decision-makers have been looking for ways to reduce private car use and air pollution following the lockdown period [6].

Understanding the travel patterns and providing recommendations during a viral pandemic is relatively a new research area. Only a few studies [7–9] have been carried out by applying a survey in order to explore the change in travel patterns. It was suggested [7] that road users were more dependent on private vehicles (i.e., cars, bicycles, micromobility) and walking. On the other hand, using public transport was affected significantly due to safety issues. Safety concerns, anxiety, and stress level increased in society regarding using public transport after the beginning of the pandemic. In addition, it was suggested [10] that continuing remote working conditions might be a better option during the pandemic and even in the future. It is clearly seen that the COVID-19 pandemic has a significant influence on travel patterns and causes people to use private vehicles more [9]. However, the evidence for future predictions is still not enough and valid for determining road users' travel patterns, feelings, and perceptions. Therefore, the drop in the use of public transport is a significant issue for sustainable urban transport planners. In addition, a prediction for walking and cycling shifts should be investigated more in detail for providing recommendations to decision-makers and local transport authorities.

Before the COVID-19 pandemic, there already has been a positive trend in cycling [11,12]. Therefore, many authorities around the world have decided to implement policies aimed to improve cycling infrastructure by expanding shared micromobility services and banning private cars in urban travel corridors. In the last decade, there has been an increase in shared cycling for daily trips in urban areas [13]. Also, walking has increased significantly, because people enjoyed their daily exercise and/or have walked for essential trips which could have been done by public transportation [14]. This trend is remarkably raised during and post lockdown conditions. Therefore, the strategies, such as the temporary expansion of pavements and cycle paths, were implemented by authorities [15]. It was aimed to reduce private car use by encouraging road users to shift to sustainable travel modes until the blockages are lifted or released.

Implementing additional walking and cycling facilities could allow local authorities to gain rapid and long-term benefits such as reducing traffic congestion in urban areas to improve public health with fewer emissions and to achieve climate change goals [16]. Therefore, local authorities would like to preserve the positive awareness on walking and cycling during the pandemic to meet their long-term targets. However, there have already been some barriers to the expansion of walking and cycling in society. For example, socio-demographic characteristics and road user's behavior and perception had a significant influence on cycling and walking in urban areas [17]. Therefore, these barriers should be eliminated by decision-makers to meet the health and environment-related aims.

The study in this paper aimed to investigate the influence of the COVID-19 pandemic on road users' perceptions, needs, and use of sustainable travel modes (i.e., public transport, walking, and cycling). The objectives of the study are given as follows: (i) to explore the change in travel patterns during the COVID-19 pandemic; (ii) to predict walking and cycling shifts by applying the ordinal regression model; (iii) to identify the level of stress and anxiety impact on the use of public transport. The research explores the need to facilitate pedestrian and bicycle mobility in order to provide guidance for implementing a comprehensive sustainable transport strategy. The research results demonstrate the variations in travel choices, characterized by the need to respect regulations (still present on travel) in order to maximize the potential of underutilized infrastructures. To this end, the experience of other cities and the use of

the studies carried out can support operational criteria [17]. The state-of-the-art review is presented in Section 2 and this is followed by the materials and methods in Section 3. The results were shown in Section 4; and they were interpreted in Section 5. The outcomes were discussed and concluded in Section 6. Finally, limitations and recommendations for future studies were given in Section 7.

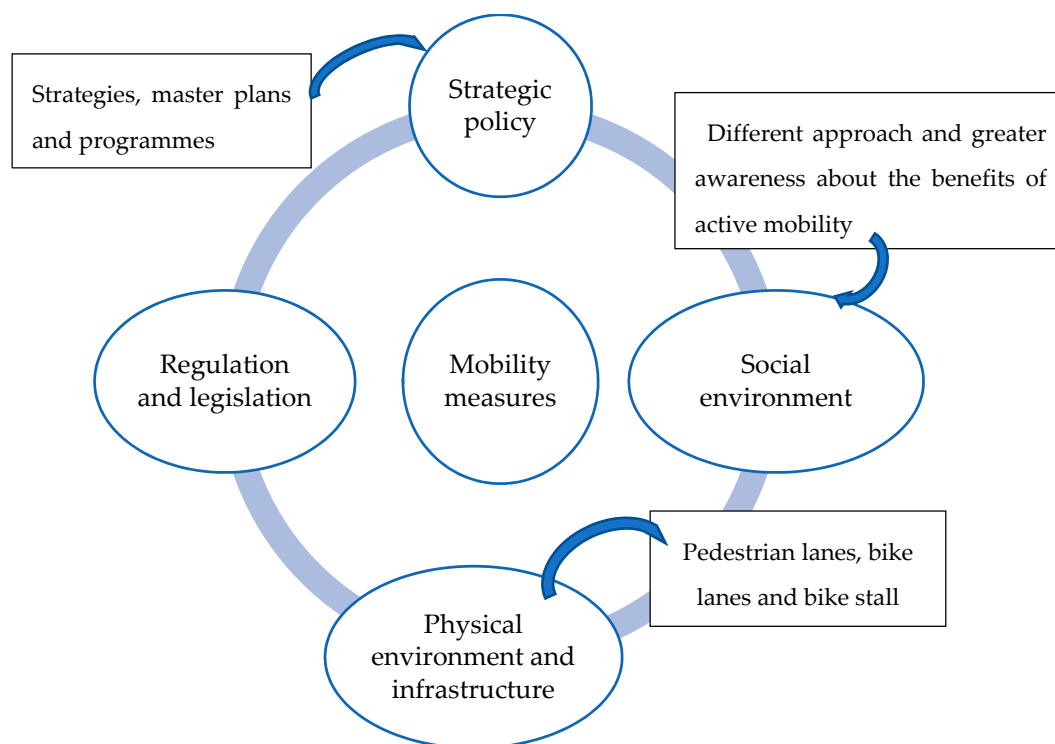
## 2. The State-of-the-Art Review

According to the statistics of the Wuhan (COVID-19 epicenter) bike-sharing system Mobikes were taken for around 2.3 million trips between 23 January to 12 March. It should be also highlighted that the single ride average daily distance was raised by 10% and hence the citizens' dependence on cycling for longer trips increased [18]. As far as the current situation in the United States of America (USA), the cycling level shift due to the lockdown differs. Specifically, cycling levels have increased by about 150% during the COVID-19 outbreak in Philadelphia [18]. Furthermore, in New York, a sharp rise of 67% in the demand for the city's bike-share program has been seen. The increase in the use of bicycles is evident if we compare the period of 1–11 March, we can see that in 2020 a total of 517,768 bikes were used, while in 2019 about 310,132 were used. In the same direction, Chicago saw also a strong rise in cycling as the city's bike-share program doubled its trips compared to 2019. However, some cities experienced a decline in cycling trips because of the COVID-19 spread such as Seattle and San Francisco [19].

The survey-based studies [7–9] suggested that the COVID-19 pandemic had a significant influence on urban travel patterns. The use of shared mobility during the pandemic period decreased 35% compared to before the pandemic and road users became more dependent on private mobility modes (i.e., cars, bicycles, and e-scooters) [7]. The same study suggested that there is a potential of incorporating walking and cycling into sustainable urban transport planning permanently; however, some measures, such as road users' travel patterns, perception, and feelings should be investigated more in detail. Exploring the limitations and providing guides can increase public health by encouraging road users to choose sustainable mobility modes and supporting the social distance policy.

In Europe, as reported by an online survey conducted by the University of Amsterdam regarding respondents' perceptions about working from home instead of commuting, 55% of car commuters do not miss commuting compared to e-bike commuters who miss commuting. Specifically, 91% of e-bike commuters miss some commuting aspects [20]. In Finland, in an effort to mitigate the COVID-19 spread, the City of Helsinki, the Helsinki City Transportation (HKL), and the City of Espoo as well decided to expedite the opening of the bike city season. A total of 351 stations and 3500 bikes will be at the citizens' disposal [21]. Further, research conducted during the lockdown among 3800 Spanish adults revealed that walking time as well as energetic activities decreased by 16.8% and 58.2% as well. However, it should be noticed that men's reduced time was far higher than women's, while the latter increased their time for moderate physical activity by 11% [22].

Regarding the use of public transport, road users perceived that using public transport is not safe due to the virus contagion risk [9]. Therefore, people started to prefer using private cars particularly for leisure activities [8]. However, many people still had to use public transport because they did not have alternative modes [9]. In the last decades, the incidence of pandemics has increased significantly due to the fast growth in the world population [23]. In the case of the COVID-19 pandemic, it is also expected that a resurgence may be expected until 2024 and even further [24]. Therefore, the influence of pandemic on public transport should be investigated in detail in order to provide a safe travel environment for different segments of society. There is also a need of reducing the shift from public transport use to private cars due to the environmental issues. In light of these, the limitations, such as safety concerns, feeling, anxiety for use of public transport in pandemic conditions should be determined. This approach will improve the resilience of sustainable mobility. In order to pursue policies that allow the implementation of resilient mobility strategies, measures are needed as shown in the chart below in Figure 1.



**Figure 1.** Mobility measures description and possible strategies.

The good practice measures have been selected for their specific characteristics are related to: (i) innovative aspects related to new methodologies to obtain the maximum beneficial effect from active mobility [25,26]; increase in active mobility linked to feedback in terms of benefits on health conditions [27]; establishment of intersectoral and institutional partnerships for the design and implementation of active mobility projects [28]; feedback in terms of social aspects, sustainability, health, economic added value [29] and correspondence with new challenges such as demographic change and environmental issues [30]. In the literature, there are several researches concerning the strategies or indicators to be adopted in order to evaluate the different transport choices in terms of resilience (See, Table 1).

**Table 1.** Research during the last 20 years related to transport resilience.

Period	Author	Research Details
2006	[31]	Transportation resilience analysis considering 10 variables such as redundancy, diversity, and efficiency
2012	[32]	Analysis of the critical factor that decreases transportation resilience
2013	[33]	Analysis of robustness, redundancy, resourcefulness, and rapidity
2014	[34]	The potential of walking and cycling to increase resilience in case of fuel shocks
2015	[35]	A measure of maximum agitation a system can take in before getting displaced from one state to another
2017	[36]	Analysis of the resilience of transport through the evaluation of the score of housing diversity, gross population density, and proximity to supermarkets.
2017	[37]	The study of resilience related to the selection of road projects and investment opportunities related to disasters and other disruptions

Table 1. Cont.

Period	Author	Research Details
2018	[38]	A systematic review of transportation resilience with an emphasis on its definitions, characteristics, and research methods applied in different transportation systems/contexts.
2019	[39]	The review of metrics and mathematical models used to measure resilience and the strategies used to enhance resilience
2020	[40]	Resilience measurement parameters (modeling based on the mode of transportation and modeling based on the mathematical technique used to quantify resilience)
2020	[41]	Analysis of the problem through a double modeling based on the mode of transport and the mathematical technique used to quantify the resilience
2020	[42]	Research on the problems and stresses of the contemporary city, mainly due to natural and health factors, related to climate change and pandemic COVID-19 with reference to the responses in terms of resilience of infrastructure and territory

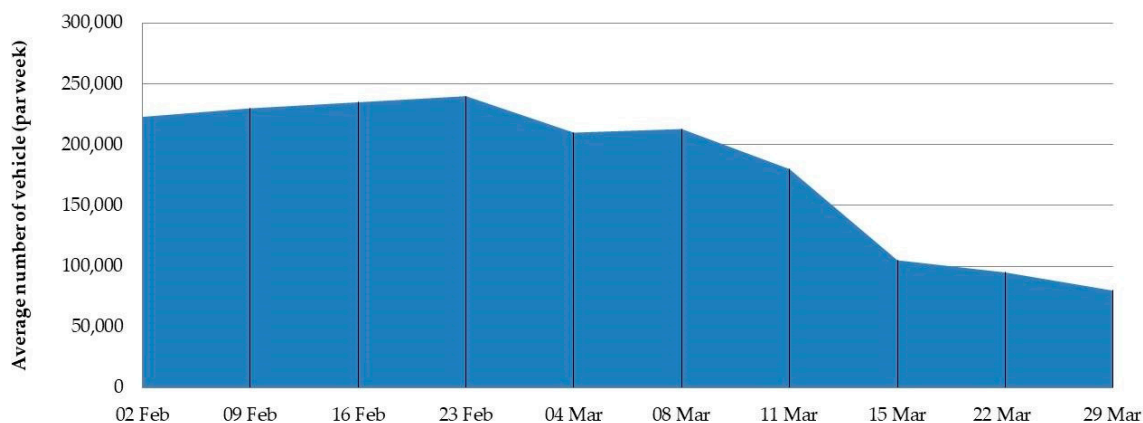
Of course, the modal shift can also be affected by natural disasters (natural, man-made) except of pandemics. Specifically, natural (e.g., earthquake) and man-made (e.g., terrorist attack) can redirect passengers' choices towards the use of individual means of transport (e.g., car or carpooling) characterized by higher capacity and resiliency [43]. Additionally, disasters can also alter tourists' travel decisions and experience [44].

### 2.1. COVID-19 Impact on Italian Mobility

Italy's blockade has been applied more restrictively than other states except for China. The regions further north of Italy implemented the restrictions through the creation of limited zones called Red Zones which were subsequently extended nationwide on 9 March. In these areas, circulation in public places has been banned except for work, needs, and health emergencies. All sporting events and public meetings were banned, and schools, universities, and recreational facilities were closed. During the first weeks of the pandemic, Italy had registered over 7300 confirmed infections, of which 366 resulted in deaths. On 11 March, restaurants and bars were closed. After 12 March, the Italian government banned all travel and forced people to stay at home. On 20 March, parks, gardens, and playgrounds were closed as well. Industries producing non-essential goods were closed on 22 March. The number of confirmed cases and deaths of COVID-19 reached 115,000 and 13,900, respectively, on 3 April, which were the highest figures in the world [45]. In accordance with [46] the first research on the impact of COVID-19 on mobility showed that there has been a 50% reduction in total travel between Italian provinces. During the COVID-19 pandemic in Italy, many non-essential services slowed down to a halt. As measures to combat the spread of the virus are tightened, more and more people have started working from home, or have stopped working altogether.

This has led to a large decrease in the number of cars on the street, with most of the citizens having reduced travel to a minimum, also given the high number of checks. It should be noted that in Figure 2 the following dates have been related to the following national events:

- 23 February 2020 first death in Codogno (small town of Lombardy),
- 8 March 2020 Italy is declared an "orange zone" (with middle-high risk),
- 10 March 2020 Italy is declared in the "red zone" (with maximum risk),
- 22 March 2020 closures of all non-essential [47].



**Figure 2.** Distribution of the average number of vehicles (per week) during the period of 2nd February–29th March.

The highest number of severe cases was recorded in Lombardy, Piedmont, Emilia Romagna, and Marche Regions in accordance with [48]. The COVID-19 emergency resulted in measures such as restricting the movement of people, almost completely blocking urban and rural mobility. Approximately 70–90% reduction in using shared micromobility and public transport occurred in many Italian cities [49]. However, public transportation services have had to continue operating to ensure accessibility in cities for all social classes. Therefore, transportation is one of the most negatively affected among the other sectors during the COVID-19 pandemic period.

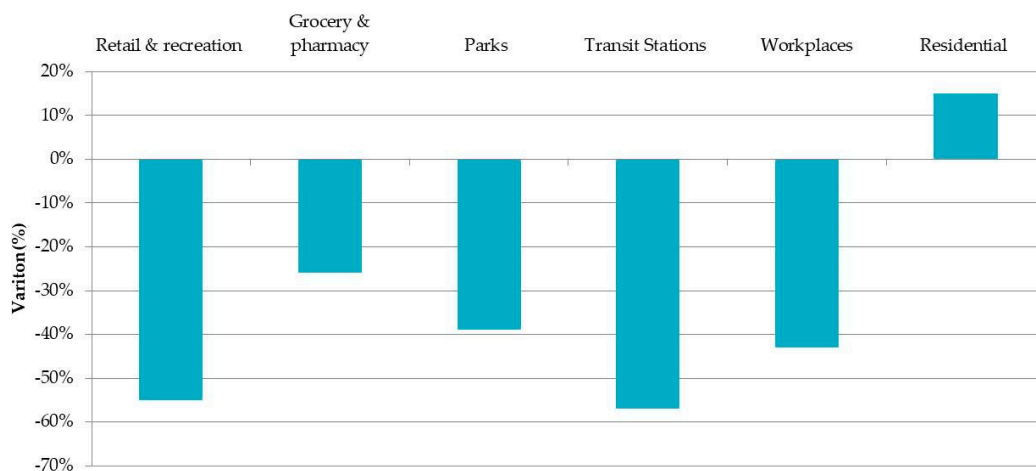
In order to cope with the difficulties of public transportation systems, some cities currently are developing new cycle paths and adaptations of the urban space that can provide an alternative to road users [50]. These actions can be implemented by promoting the use of technologies such as APP for geo-localization or ITS systems [51]. The spread of the concept of Mobility as a Service (MaaS) will also make it possible to better correlate the different forms of transport by providing the best options for the user in terms of time, costs, and inter-modality [52]. From the point of view of infrastructure, on the other hand, it will be necessary to adopt technologies that allow controlling the various infrastructure design and control stages, such as I-BIM modeling, through processes [53]. The use of technologies such as applications (APPs) for smartphones and tablets [54] and ITS systems [55] and vouchers for the purchase of electric mobility and national measures that allow to improve or design with new technologies such as I-BIM, can improve the infrastructures for soft mobility (i.e., pedestrians). The actions implemented since the end of April 2020 have attempted to gradually reduce confinement by promoting slow mobility with the incentive to widen spaces for pedestrian traffic in order to guarantee social distancing and Limited Traffic Zone management and parking policies [56]. Furthermore, in the medium term, policies aimed at restoration of the use of other forms of mobility and in particular by promoting targeted management of public transportation; the creation of an Emergency Mobility Network to stimulate the use of fast, light, and non-congestive means of transportation. The priority at this time must therefore be to reorient citizens' mobility choices according to criteria of social desirability by intervening on the offer of dedicated spaces according to the following Table 2:

**Table 2.** The correlation between distance and transport mode and possible alternatives.

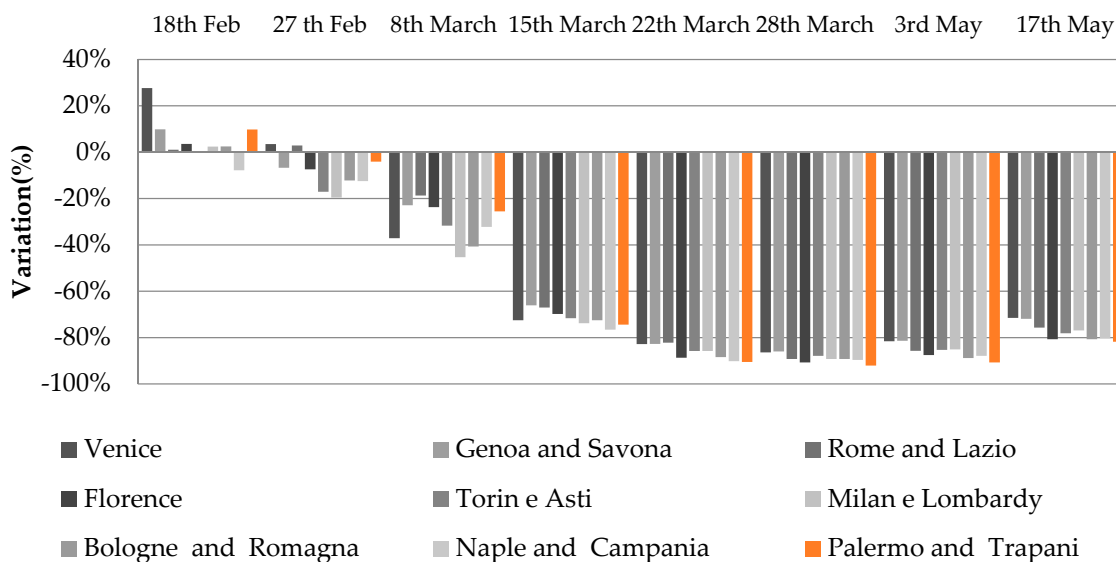
Distance	Transportation Modes	Transportation Solution
<3 km	pedestrian mobility—walking	free and widen the sidewalks
3–10 km	micromobility (e-bike, hoverboard, mono-wheel)	to set up an urban emergency mobility network
>10 km	car + bike + micromobility + train + bike + micromobility	promoting shared mobility and intermodal solutions
	motorcycle	increase the stalls for motorcycles (reducing those for cars)

### 2.2. COVID-19 Impact on Sicily Mobility

Different technologies have made it possible to acquire data on movements in European and non-European states [57]. Several countries including Italy (See Figures 3 and 4) have had the opportunity to provide and evaluate displacement data through the Google platform, considering an average value for each Italian region. It shows how on 15 May 2020, after the second phase, the number of trips was reduced overall due to various reasons, apart from a small increase for residential trips (+15). The percentage of the decrease in the use of public transport, compared to the use in a working day, is explored [58]. In the Sicilian cities of Palermo and Trapani there was a negative trend with a limit value equal to -93% during the end of March (period of the “Red Zone”).



**Figure 3.** Trends for moving in Sicily (15 May 2020) related to changing reasons (source: <https://www.google.com/covid19/mobility/index.html?hl=it>).



**Figure 4.** Public transport trends during the period 18th February–17th May in Italy.

During the lockdown in Sicily, people had to stay at home to keep the isolation. After this period, they could move freely even though the pandemic was not over. There have been some protection measures such as social distancing and wearing protective masks. However, people preferred to use private cars which are more secure than public transport [59]. According to the Italian national data [60], there has been an increase in using not only private cars but also micromobility modes after the lockdown period. On the other hand, the use of public transport has already decreased significantly during the lockdown (See Figure 4). Road users may still hesitate to use this mobility mode after

lockdown, and this issue needs further investigation. Considering these facts, the study in this paper aimed to explore the influence of COVID-19 on changes in the use of sustainable travel modes with a comparative analysis between before and during the pandemic. The case study area in this work was Sicily of Southern Italy.

Sicily is an island with a high rate of private car ownership and a well-established public transport network (See Figure 5). The railway connection is old and poorly maintained and connects only some parts of the island. With the recent national regulations, the use of shared mobility and micromobility modes have an increasing trend in the area.

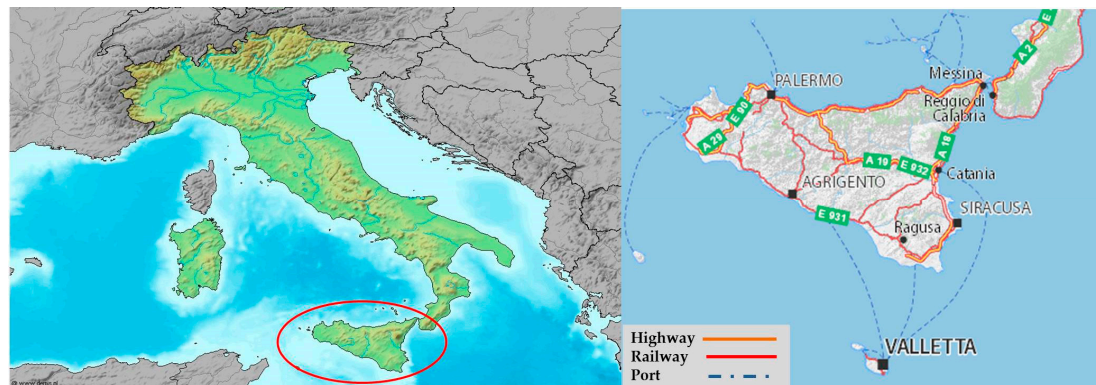


Figure 5. Sicily principal transport lines.

### 3. Materials and Methods

Regarding the provided state of the art review, the study in this paper aimed to investigate the frequency of use of the different modes of transport before and during the COVID-19 lockdown period. It was focused on the variation of walking and cycling in order to gain a better understanding of how to plan transport strategies with respect to resilience. Therefore, the research was conducted with a participatory approach, which included a series of methodological techniques such as the selection of the parameters and definition of a questionnaire. Participatory research involved an investigation by data acquisition and statistical evaluation of variations of the considered variables related to different modes of transportation. A questionnaire is a tool used in the social fields (psychology, sociology, economics, market studies, opinion surveys) which is applied to collect information in a standardized way and from more or less large samples, such that it is possible to build a matrix of data, and then carry out mathematical, statistical or psychometric analyses [61].

Regarding the state-of-the-art review, the method, which was adopted in this study, was selected as qualitative-quantitative. Qualitative survey-based research is a less structured methodology that is used to obtain in-depth information on the underlying arguments and motivations of the subjects involved [61,62]. The goal is to develop a deeper knowledge of a specific problem, theme, or topic from an individual perspective. Qualitative research can be defined as any form of information gathering organized for the purpose of providing a description, but not a forecast, as in the case of quantitative research [62]. These investigations are used to formulate hypotheses, subsequently verified by means of quantitative research.

This study focused on the definition of an estimation methodology applied to the influence of endogenous and exogenous factors on mobility. It considered the propensity of users toward forms of slow mobility, public transportation, and shared mobility both before and after the COVID-19 pandemic. The data was collected through randomly selected road users and the administration of an online questionnaire via the Google survey platform [63]. The survey included travel habits (i.e., type of vehicle and motivation of movement) in order to understand to what extent does socio-demographic data influence displacement attitudes, considering the new PPE (Personal Protection Equipment) [64] needed and acquiring the sensations perceived by users in terms of anxiety, stress, and fear.



The survey was carried out with 431 participants who have been living in the Sicily region, particularly the cities located in the eastern part of the area. The data acquisition period took place between 13 March and 13 April 2020 in the middle of the pandemic period. The number of users interviewed is representative for the first phase of research covered by this article. The sample is concerned as appropriate for a margin of error of 5.66% at a significance level of  $\alpha = 5\%$ . Sample estimation is accomplished using the following estimation formula which was referred to by [65,66].

$$n = \frac{N \times z^2 \times p \times (1 - p)}{\varepsilon^2 \times (N - 1) + z^2 \times p \times (1 - p)} \quad (1)$$

where:

$n$ : the sample size

$N$ : the population size of the Palermo, Catania, Enna, and Syracuse Provinces

$z$ : the z-statistic for a level of confidence

$p$ : the expected population proportion

$\varepsilon$ : the margin of error

For the realization of the present research, the following values were used for the sample size calculation:

$$N = 2,895,735 \text{ [67]}$$

$$z = 1.96 \text{ (since } \alpha = 5\%)$$

$$p = 0.5$$

$$\varepsilon = 0.0566$$

Hence, Equation (1) gets the following form:

$$n = \frac{2,895,735 \times 1.96^2 \times 0.5 \times (1 - 0.5)}{0.0566^2 \times (2,895,735 - 1) + 1.96^2 \times 0.5 \times (1 - 0.5)} = 300 \quad (2)$$

Thus, it is clear that the research' sample (431 questionnaires) is appropriate for the given population ( $N$ ).

The questionnaire was divided into four sections (see Table 3). Sections 1–3 were characterized by a total of 20 questions with the possibility of single selection on a range of solutions expressed through time scales. Section 4 was characterized by 8 questions with graded answers. The online survey has been defined as follows:

- Section 1: socio-demographic data namely gender, age groups, profession, and possession of driving license and car.
- Section 2: walking habits before and after COVID-19 which investigated the movement habits (frequency and motivation) and the necessary post-pandemic equipment.
- Section 3: public transportation habits before and after COVID-19.
- Section 4: feelings and perceptions onboard public and private vehicles which allowed to acquire data on the state of anxiety, fear, and stress of post-pandemic people during travel activities, also assessing the propensity for alternative modes of transportation and alternative working methods such as prolongation of remote working times.

**Table 3.** The variables in the survey.

Variable	Description	Values
Sociodemographic	Gender	Male Female
	Age group	18–25, 26–40, 41–55, 56–70, >70
	City of Residence (City and/or Province)	Residence location (Catania, Palermo, Enna, Caltanissetta, Messina, Ragusa, Other)
	Car ownership	Yes and I drive; Yes but I don't drive it; No, I have not a driving license
Travel habits trend after lockdown	Walking shift	Judgment scale (Yes, increasing; No, I think that it does not change; Yes, decreasing)
	Cycling shift	
	Micromobility increasing use	Likert scale (from 1 = Completely disagree to 5 = Totally agree)
Public transport (PT) habits trend	PT use considering leisure activities before COVID-19 lockdown frequency	Frequency scale (>3 times/day, 2–3 times/day, 1 time/day, several times/week, never)
	PT use considering leisure activities after COVID-19 lockdown frequency	
Needs and perceptions after lockdown	Need for remote working	Likert scale (from 1 = Completely disagree to 5 = Totally agree)
	Stress perception	
	Anxiety perception	

In the previous studies, descriptive statistics [7,8] and the decision tree approach [9] were applied. This has been a relatively new research area; therefore, a prediction modeling, such as binary or ordinal regression, for gaining a deeper understanding has not been applied yet. As recommended [57], the study started with descriptive statistics and correlation analysis in order to explore the structure of the data. Regarding the examined structure of the data, the Pearson correlation was applied in this study. After these preliminary analysis steps, the study continued with evaluating the shift related to walking and cycling by applying an ordinal regression model and assessing the relative means. Ordinal regression is mainly used in social sciences for the prediction of ordinal variables. The main assumption of the aforementioned method is called the “assumption of proportional odds”. This assumption is examined by the test of parallel lines questions, the independent variables’ effect on the odds disregarding the variable’ threshold. Within the scope of the present research, the tests of parallel lines are non-significant and thus the independent variables’ effect is consistent across all thresholds. As a result, the use of the two proposed models is appropriate. Furthermore, it should be noted that ordinal regression models have been developed for the estimation of the perceived level of service (LOS) for pedestrian facilities [68,69]. Alongside, ordinal regression has been used to reveal the factors for the adoption of active modes of transport (walking, cycling) [70] as well as for the service quality’ analysis of coach terminals [71].

## 4. Results

### 4.1. Descriptive Statistics

The analysis started with descriptive statistics in order to explore the structure of the collected survey data. The majority of the participants were females (55.5%) and the highest number of age-group records were 41–55 and 26–40 with 40.4% and 37.1%, respectively. Regarding the educational level,

67.3% of the participants had a bachelor/master's degree. Additionally, 31.8% of the participants have been living in Palermo Province, while 29.5% have been living in Catania Province. The remaining 23.4% and 15.3% of the participants have been living in the Enna and Syracuse Provinces, respectively. Furthermore, an overwhelming majority (92.1%) owns and drives a private car. Table 4 presents the descriptive statistics of the variables used in the models' development.

**Table 4.** Data explanation and descriptive statistics of the variables used in the study.

Code	Description	Measure	Values	Frequency (%)
Gender	Gender of participant	Nominal	0: Male 1: Female	44.5% (192) 55.5% (239)
PT frequency leisure	Participant's frequency of travelling from home to leisure using public transport before COVID-19 spread	Ordinal	0: >3 times/day 1: 2–3 times/day 2: 1 time/day 3: Several times/week 4: Never	3.7% (16) 0.7% (3) 38.7% (167) 36.0% (155) 20.9% (90)
Micromobility use	Perception of more micromobility vehicles (scooters, hoverboards) use after lockdown	Ordinal	1: Completely disagree 2: Disagree 3: Neutral 4: Agree 5: Totally agree	6.5% (28) 23.0% (99) 26.9% (116) 27.6% (119) 16.0% (69)
Remote work	Perception of the need for remote work to remain	Ordinal	1: Completely disagree 2: Disagree 3: Neutral 4: Agree 5: Totally agree	0.5% (2) 0.7% (3) 4.6% (20) 5.6% (24) 88.6% (382)
Stress diffusion	Perception of the stress feelings diffused by public transport after lockdown	Ordinal	1: Completely disagree 2: Disagree 3: Neutral 4: Agree 5: Totally agree	0.23% (1) 2.32% (10) 18.33% (79) 37.59% (162) 41.53% (179)
Anxiety diffusion	Perception of the anxiety feelings diffused by public transport after lockdown	Ordinal	1: Completely disagree 2: Disagree 3: Neutral 4: Agree 5: Totally agree	1.6% (7) 6.3% (27) 18.3% (79) 29.5% (127) 44.3% (191)
Walking shift	Perception of walking shift frequency after the lockdown	Ordinal	0: Yes, increasing 1: No, I think that it does not change 2: Yes, decreasing	40.6% (175) 16.7% (72) 42.7% (184)
Cycling shift	Perception of cycling shift frequency after the lockdown	Ordinal	0: Yes, increasing 1: No, I think that it does not change 2: Yes, decreasing	61.25% (264) 26.00% (112) 12.75% (55)

Participants were also asked to reveal their travel habits before the COVID-19 pandemic. Regarding public transportation use frequency for traveling from home to leisure activities, 38.7% of the participants used once in a day and 36% used several times in a week. It should be highlighted that 20.9% of the participants have never used public transportation for leisure activities.

Regarding participants' onboard sensations and perceptions on public and private vehicle use after the lockdown because of the COVID-19 pandemic, the diffusion of stress feelings was significantly high such as 79.1% of the participants agreed that PT use is a big concern post-COVID-19. Furthermore, the majority of the participants (44.3%) totally agreed with the growing diffusion of anxiety feelings caused by public transportation use after the lockdown. With respect to the use of micromobility, 27.6% and 16% of the participants stated that they agreed and totally agreed, respectively, that there

could be increased use of this travel mode after the lockdown. On the contrary, 23% and 6.5% of the participants responded that they disagreed and completely disagreed, respectively, with the statement. Also, it should be highlighted that a high percentage of participants (88.6%) totally agreed with the continuation of remote working methods in order to reduce daily travel needs and keep the isolation.

Further, 42.7% of the participants stated that their walking frequency will reduce, while 40.6% stated that walking will increase after the lockdown. A total of 61.3% of the participants agreed that there will be more use of bikes in Italy after the lockdown. While 26% of the participants remained neutral with respect to the cycling increase post lockdown.

#### 4.2. Correlation Matrix

Before developing models for predicting the changes in walking and cycling shift frequency, a Pearson correlation matrix was computed in order to reveal any possible relationship between the variables (Table 5). Results suggested that a statistically significant relationship was found between gender and walking shift frequency after the lockdown ( $r = 0.113, p < 0.05$ ). Considering participants' sensations and perceptions onboard in public and private vehicles, both growing stress diffusion ( $r = 0.165, p < 0.01$ ) and anxiety diffusion ( $r = -0.110, p < 0.05$ ) were statistically significantly correlated with the walking shift frequency after the lockdown. Further, the variable regarding the continuation of remote working was related to the change in walking shift frequency ( $r = 0.125, p < 0.01$ ) statistically significantly. Change in cycling frequency was statistically significantly correlated with the frequency of public transportation use from home to leisure activities before COVID-19 spread ( $r = -0.127, p < 0.01$ ). Finally, the variable remote work was statistically significantly correlated with the change in cycling shift frequency after the lockdown ( $r = 0.111, p < 0.05$ ). However, the determined Pearson correlation values, which were statistically significant, were greatly below the recommended [72] value of 0.7. It suggested that the determined significant correlations were not meaningful statistically.

**Table 5.** Correlation matrix and two-tailed probabilities.

	1	2	3	4	5	6	7	8
1 Gender	1							
2 PT frequency leisure	0.073	1						
3 Micromobility use	-0.038	0.021	1					
4 Remote work	-0.017	-0.181 **	0.038	1				
5 Stress diffusion	0.002	-0.065	-0.015	0.266 **	1			
6 Anxiety diffusion	-0.053	-0.051	0.030	0.165 **	0.085	1		
7 Walking shift	0.113 *	-0.047	-0.007	0.125 **	0.165 **	-0.110 *	1	
8 Cycling shift	-0.045	-0.127 **	0.067	0.111 *	0.070	0.001	-0.001	1

\*\* Correlation is significant at the 0.01 level (two-tailed); \* Correlation is significant at the 0.05 level (two-tailed).

#### 4.3. Walking Shift Frequency Estimation by Ordinal Regression Model

In this section, the focus was given to the development of the model which predicted the walking shift frequency after the lockdown based on the survey data. The walking shift was considered as the dependent variable for the development of the regression model. All predictors are considered equally important to be included in the models. However, the interpretation of ordinal regression models is closely related to the estimation of the odds ratios. Hence, the selection of the models' explanatory variables is based on the estimation of meaningful and useful odds ratios which can give insightful findings regarding walking and cycling shift frequency due to COVID-19. Therefore, many trial and error tests were carried out and the predictor variables were selected as gender, stress diffusion, and anxiety diffusion. Due to the ordinal nature of the dependent variable, an ordinal regression model was applied.

Ordinal regression is one of the three main types of logistic regression. Ordinal regression models compute the odds of an event, and all the events that are ordered before it, to occur instead of not occurring. Hence, the odds are expressed as:

$$\theta_j = \text{prob}(\text{score} \leq j) / (1 - \text{prob}(\text{score} \leq j)) \quad (3)$$

The general mathematical expression of an applied ordinal regression model is:

$$\ln(\theta_j) = \alpha_j - \beta X \quad (4)$$

where  $j$  is numbered from 1 to the number of the dependent variable categories [73]. Coefficients' minus signs indicate that larger coefficients are associated with larger scores.

After taking into consideration the results of the descriptive and inferential statistical analysis as well, an ordinal regression model was developed in order to investigate the influential coefficients for the respondents' change in walking frequency after the lockdown due to the COVID-19 spread. An ordinal regression model, which concerns the ordinal nature of the dependent variable, is a differentiated version of the binary logistic regression model. Tables 6 and 7 present the parameter estimates and the overall fitting indices of the model. Model fitting information yielded a statistically significant reduction ( $\text{sig} < 0.05$ ) of the  $-2 \log$ -likelihood ( $-2LL$ ) when the variables were added to the model. Therefore, a significant improvement in contrast to the baseline model was observed that contained no independent variables (Intercept only). Furthermore, the Goodness-of-Fit tests yielded that the model was consistent with the data ( $p$ -values  $> 0.05$ ) since the null hypothesis defined that the fit was good. The Nagelkerke R-Square suggested that the model can explain 9.7% of the independent variable' variance. Finally, the Test of Parallel Lines was statistically insignificant ( $p$ -value  $> 0.05$ ) and therefore it could be claimed that the relation between the dependent variable' thresholds and the independent variables was the same for all thresholds. Hence, the key assumption of the ordinal regression model has been met.

**Table 6.** Estimated parameters for predicting walking shift frequency.

		Estimate	Std. Error	Wald	df <sup>2</sup>	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	walking shift = 0	−0.590	0.201	8.624	1	0.003	−0.983	−0.196
	= 1	0.138	0.199	0.480	1	0.488	−0.252	0.527
	gender = male	−0.384	0.189	4.144	1	0.042	−0.754	−0.014
	= female <sup>1</sup>	0			0			
	stress diffusion = 1	−21.359	0.000		1		−21.359	−21.359
	= 2	−0.194	0.638	0.093	1	0.761	−1.445	1.056
	= 3	−1.154	0.271	18.199	1	0.000	−1.685	−0.624
	= 4	−0.308	0.208	2.183	1	0.140	−0.716	0.101
	= 5 <sup>1</sup>	0			0			
Location	anxiety diffusion = 1	2.186	1.144	3.656	1	0.056	−0.055	4.428
	= 2	0.222	0.397	0.314	1	0.575	−0.556	1.001
	= 3	0.671	0.260	6.647	1	0.010	0.161	1.182
	= 4	0.535	0.221	5.879	1	0.015	0.103	0.968
	= 5 <sup>1</sup>	0			0			
	Link function: Logit							

<sup>1</sup> reference category. <sup>2</sup> df is the degree of freedom.

**Table 7.** Overall fitting indices for the model of walking shift frequency.

Model Fitting Information				
Model	−2 Log-Likelihood	Chi-Square	df	Sig.
Intercept Only	223.846			
Final	185.785	38.061	9	0.000
Goodness-of-Fit				
	Chi-Square	df <sup>1</sup>		Sig.
Pearson	72.413	61		0.150
Deviance	72.027	61		0.158
Pseudo R-Square				
Cox and Snell		0.085		
Nagelkerke		0.097		
McFadden		0.043		
Test of Parallel Lines				
Model	−2 Log-Likelihood	Chi-Square	df	Sig.
Null Hypothesis	185.785			
General	176.911	8.875	9	0.449

<sup>1</sup> df is the degree of freedom.

As the last part, the prediction power of the proposed model was examined. Table 8, which is a confusion table, presents the predicted and the actual values as well. The sum of the correct predictions was the same as the table's main diagonal (correct predictions). The model's accuracy was calculated by dividing the number of correct predictions by the total amount of predictions (431). The proposed model regarding the change in the walking shift frequency has a predicting power of approximately 52.7%.

**Table 8.** Classification between observed and predicted cases of walking shift frequency model.

Predicted	Observed			Total
	Yes, Increasing	No, I Think that It Does not Change	Yes, Decreasing	
Yes Increasing	103	31	60	194
Yes Decreasing	72	41	124	237
<b>Total</b>	175	72	184	431

#### 4.4. Cycling Shift Frequency Estimation by Ordinal Regression Model

A second ordinal regression model was developed to predict the change in cycling frequency after the COVID-19 pandemic.

According to the objectives of the study in this paper, the dependent variable was determined to be cycling shift and re-coded as shown in Table 9. A correlation analysis was applied to the re-coded variable.

**Table 9.** Recoding of the dependent variable of cycling shift frequency.

Initial Values	Final Values
Completely disagree	Yes, decreasing
Disagree	
Neutral	No, I think that it does not change
Agree	Yes, increasing
Totally agree	

The result suggested that the re-coded variable, cycling shift, was statistically significantly correlated with the perception of increased use of micromobility ( $r = -0.108, p < 0.05$ ).

Furthermore, the re-coded variable was statistically significantly correlated with public transportation use frequency ( $r = 0.142, p < 0.01$ ) and the need for the continuation of remote work ( $r = 0.141, p < 0.01$ ).

After many trial and error tests, the predictor variables were selected, namely PT frequency leisure, micromobility use, and remote working. Tables 10 and 11 present the model's parameter estimates and the overall fitting indices, respectively. Model fitting information revealed a statistically significant reduction ( $\text{sig} < 0.05$ ) of the  $-2 \log\text{-likelihood} (-2LL)$  when the variables were added to the model. Therefore, a significant improvement in contrast to the baseline model was observed that contained no independent variables (Intercept only). Furthermore, the Goodness-of-Fit tests yielded that the model was consistent with the data ( $p\text{-values} > 0.05$ ) since the null hypothesis defined that the fit was good. The Nagelkerke R-Square suggested that the model could explain 10.9% of the independent variables' variance.

Finally, the test of parallel lines was statistically insignificant ( $p\text{-value} > 0.05$ ) and thus it could be claimed that the relation between the dependent variables' thresholds and the independent variables was the same for all thresholds. Hence, the key assumption of the ordinal regression model has been met. As the last part, the prediction power of the proposed model was examined. Table 12 presented the actual and predicted values. The proposed model regarding the change in the cycling shift frequency had approximately 61.7% of predicting power.

**Table 10.** Parameter estimates for the cycling shift frequency model.

		Estimate	Std. Error	Wald	df <sup>2</sup>	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	cycling shift = 0	1.016	0.348	8.538	1	0.003	0.334	1.697
	= 1	2.593	0.371	48.928	1	0.000	1.867	3.320
	PT frequency leisure = 0	-1.551	0.805	3.714	1	0.054	-3.128	0.026
	= 1	-0.919	1.353	0.461	1	0.497	-3.570	1.732
	= 2	-0.313	0.278	1.266	1	0.261	-0.858	0.232
Location	= 3	0.375	0.270	1.934	1	0.164	-0.154	0.904
	= 4 <sup>1</sup>	0			0			
	micromobility use = 1	0.350	0.493	0.503	1	0.478	-0.616	1.316
	= 2	1.034	0.338	9.374	1	0.002	0.372	1.696
	= 3	0.511	0.332	2.378	1	0.123	-0.139	1.161
	= 4	0.388	0.332	1.360	1	0.243	-0.264	1.039
	= 5 <sup>1</sup>	0			0			
	remote working = 1	-18.754	0.000		1		-18.754	-18.754
	= 2	0.653	1.163	0.315	1	0.574	-1.626	2.932
	= 3	1.441	0.457	9.943	1	0.002	0.545	2.337
= 4	0.243	0.422	0.331	1	0.565	-0.585	1.071	
= 5 <sup>1</sup>	0			0				
Link function: Logit								

<sup>1</sup> reference category. <sup>2</sup> df is the degree of freedom.

**Table 11.** Overall fitting indices for the cycling shift frequency model.

Model Fitting Information				
Model	−2 Log-Likelihood	Chi-Square	df	Sig.
Intercept Only	222.466			
Final	181.283	41.183	12	0.000
Goodness-of-Fit				
	Chi-Square	df		Sig.
Pearson	82.903	74		0.224
Deviance	82.485	74		0.234
Pseudo R-Square				
Cox and Snell		0.091		
Nagelkerke		0.109		
McFadden		0.052		
Test of Parallel Lines				
Model	−2 Log-Likelihood	Chi-Square	df	Sig.
Null Hypothesis	181.283			
General	170.918	10.365	12	0.584

**Table 12.** Classification between observed and predicted cases of cycling shift frequency model.

Predicted	Observed			Total
	Yes, Increasing	No, I Think That It Does Not Change	Yes, Decreasing	
Yes, Increasing	258	108	45	411
No, I Think that it Does not Change	2	0	2	4
Yes, Decreasing	4	4	8	16
Total	264	112	55	431

## 5. Interpretations

This section provides interpretations of the results using determined odds ratios from the ordinal regression modeling. The interpretations for walking and cycling shift frequencies will be shown in individual subsections.

### 5.1. Interpretation of Walking Shift Frequency Model

The interpretation of an ordinal regression model requires the calculation of the odds ratios as recommended [74]. The odds ratios were computed among the statistically significant intervals (statistical significance 95%) of the response variables and their reference categories, as well as for those intervals which slightly overcome the research confidence level. Table 13 presented the calculated odds for the walking shift frequency model.

The results suggested that females were found to be 1.5 times more likely to reduce their walking frequency after the lockdown. Regarding public transportation use after the lockdown, both stress and anxiety's growing diffusion had a significant impact on the walking shift frequency. Particularly, respondents who stated that they totally agreed with the growing diffusion, were found to be 3.2 times more likely to reduce their walking shift frequency after the lockdown compared to the respondents who remained neutral. Furthermore, the respondents, who stated that they totally agreed with the growing diffusion of the sensation of anxiety caused by the use of public transportation after the lockdown, were found to be 8.9, 2.0, and 1.7 times more likely to raise their walking shift frequency after the lockdown compared to the respondents who stated that they completely disagreed, were neutral, or agreed with the statement.



**Table 13.** Odds ratio results for the walking shift frequency model.

Variables	Intervals	Odds Ratios
Gender	Male	1.468
	Female (Reference category)	
Stress diffusion	Neutral	3.171
	Totally agree (Reference category)	
Anxiety diffusion	Completely disagree	8.900
	Totally agree (Reference category)	
	Neutral	1.956
	Totally agree (Reference category)	1.707

### 5.2. Interpretation of Cycling Shift Frequency Model

The analysis was finalized by interpreting the cycling shift frequency model by using the determined odds ratios (Table 14). Concerning the frequency of public transportation use from home to leisure activities before the COVID-19 pandemic, respondents, who stated that they never used public transportation for this purpose, were found to be 4.7 times more likely to reduce their cycling frequency after the lockdown compared to the respondents who used public transportation more than three times a day. Additionally, respondents who totally agreed that there will be increased use of micromobility after the lockdown were found to be 2.8 times more likely to raise their cycling frequency compared to the respondents who stated that they disagreed. Finally, participants who stated that they totally agreed with the continuation of remote work were found to be 4.2 times more likely to raise their cycling frequency in comparison with the respondents who remained neutral regarding the need to maintain smart working methods [74].

**Table 14.** Odds ratio results for the cycling shift frequency model.

Variables	Intervals	Odds Ratios
PT frequency leisure	>3 times/day	4.716
	Never (Reference category)	
Micromobility use	Disagree	2.812
	Totally agree (Reference category)	
Remote working	Neutral	4.225
	Totally agree (Reference category)	

## 6. Discussion and Conclusions

The evolution of transport has suffered a serious loss generated due to the COVID-19 pandemic, which has reduced the mobility of people worldwide for a period of more than one month. The spread of the virus has forced the implementation of measures to encourage social distancing and this has not resulted from simple implementation within the public transport whose management companies have had to drastically reduce the filling coefficient by more than 40%, generating economic and social damage.

After phase II of COVID-19, a series of work, commercial, and various other types of activities were slowly reactivated, which pushed people to move with caution by adopting methods such as walking or cycling. States have implemented a series of actions aimed at encouraging micromobility vehicles and in favor of infrastructure redevelopment [75]. In this sense, this work shows an analysis carried out in the context of the southern part of Italy (Sicily) investigating changes in the tendency to move on foot and/or by bicycle. The study was carried out by administering an online questionnaire and statistically processing the data. Differences have emerged in the use of means before and after

COVID-19 related to gender and sensations such as the state of stress, anxiety, and fear in adopting forms of shared or public mobility [76]. The summary of the results is given as follows:

- Females were found to be 1.5 times more likely to reduce their walking frequency post lockdown.
- Respondents who stated that they completely disagreed, were neutral, or agreed, respectively, with the growing diffusion of the anxiety sensation caused by the use of public transport post lockdown were found to be 8.9, 2.0, and 1.7 times more likely to raise their walking shift frequency post lockdown.
- Respondents—non-users of public transportation for leisure activities before the pandemic—were found to be 4.7 times more likely to reduce their cycling frequency post lockdown compared to the respondents who used public transportation more than three times a day.
- Respondents—convinced of increased use of micromobility post lockdown—were found to be 2.8 times more likely to raise their cycling frequency compared to the respondents that were not convinced.
- Respondents—supporters of remote work—were found to be 4.2 times more likely to raise their bicycling frequency compared to the neutral respondents regarding remote work.

The study was preparatory to the exploration of exogenous (i.e., environment, type of means of transport) and endogenous (i.e., perception and sensations) variables that can change post-pandemic travel habits. The survey showed that women have less propensity to want to leave the house after the pandemic and that a feeling of anxiety and stress due to the fear of contagion but also to the negative effects on the economy that led COVID-19 has spread. These sensations worsened due to the use of public transport due to the overcrowding that often characterizes it and due to hygiene issues (cleaning the vehicle, sanitizing) [77]. In this context, different forms of mobility take on different values and roles. In this sense, the operational criteria are essentially three:

- the hierarchical reorganization of forms of mobility in the direction of sustainability [78],
- the declination of these according to the forms of settlement [79],
- the promotion of new forms of management for mobility under the banner of flexibility and on-demand transport [80,81].

Among the forms of mobility that allow moving while ensuring social distancing, there are the individual movements implemented through pedestrian mobility and soft mobility. Pedestrian mobility must therefore represent the primary form of mobility, to be privileged and guaranteed, given the rediscovered value that has had to be given to “proximity”, that is to say, to the movements of short distance.

Soft mobility (bicycles, scooters, etc.) can and must represent the great alternative, on which to focus in phase 2 and 3, especially in the more extensive parts of the city, thanks to the use of spaces previously dedicated to transit and parking of private vehicles [82]. Soft mobility (bicycles, scooters, etc.) is a great alternative to focus on, especially in cities where it is “uncomfortable” to travel on foot but perfectly accessible by bicycle. It will therefore be necessary to identify protected routes for bicycles, which may be able to use the corridors of the LPT.

In the peripheral urban bangs, also here thanks to the application of the “theoretical grid”, it will be possible to rationalize the circulation of private cars, identifying the complementary network of “fluid” roads. It will be necessary to identify some LPT corridors, focusing on increasing accessibility to “central places” and intramodality.

The use of new digital applications for booking public transport (LPT and cabs) and private transport (bicycles, scooters) in combination with the spread of reduced fares and incentives for the purchase of means of transport should allow the testing and dissemination of Mobility as a Service systems, aimed at ensuring the maximization of the use of sustainable means of transport in line with the guarantees of social distancing and opportunities for savings on transport costs for operators and users.

The possibility of reserving trips, combined with reduced traffic and the construction of corridors dedicated to forms of mobility, will give back sustainable mobility the credibility necessary for the modal transition and the conditions for its maximization in the post-COVID-19 phase.

A resilient approach to transport should be based on the use of new ways of managing user access in order to ensure social distance and transport safety and with the support, including promotional support, of new apps for mobility management (in the Mobility as a Service model) in the case of local public transport (such as buses, streetcars, metro, railways) and cab services, they should also catalyze medium and long-distance travel between different districts or from municipalities in the metropolitan area and the rest of the region [83,84]. Demand responsive or shared services can complete the public transport offer, performing the service exclusively by booking and transporting one passenger at a time (or two if they live together).

The use of private cars, limited to authorized travel only, will have to follow progressively stricter rules depending on the areas of the city. Through the creation of LTZs, zones 30, and the concomitant reduction of roads for cars, which will allow identifying new pedestrian areas in the nuclei of the neighborhoods, the “central places”, it will be possible to define a network of public transport corridors that will connect the individual neighborhoods [85,86].

In this framework, pedestrian mobility will have to have the maximum diffusion, characterizing in particular, the historical city and the consolidated one, as well as all those areas of the so-called “city of 15 min”, where walking for a maximum of 15 min will meet most of the basic structures, when not also the workplace.

In accordance with the obtained results, the last few months have been characterized by a rampant form of anxiety from COVID-19, so moving around by walking or bicycles could prove to be an excellent way to combat stress not only by understanding walking or cycling as a need to move but also as a sport or relaxation activity [87].

At a time when it can be more difficult to take flights, you can choose to walk close to home, a less impactful way that can become a nice opportunity to get to know the surrounding area and smaller towns. Walking close to home is one of the great discoveries we can make, and it is an easy way to start our journey. Likewise, the use of the bicycle, in addition to the physical and mental benefits, allows a strong reduction of pollution and the possibility to carry some things with you even in small quantities [88]. The interviewees also agree that there will be a greater approach to micromobility, and this is rewarded by state incentives but also the desire to move individually [89]. In accordance with the strategies of many nations, the population is in favor of keeping work from home although there are problems related to the management of the family and children often in small spaces [90].

## 7. Limitations and Recommendations for Future Studies

An online survey was applied in this study in order to explore the changes in mobility based on a pre-post COVID-19 lockdown comparison study. However, online surveys have some limitations to reaching different segments of society due to the uneven spread of the internet and technology in the case study area. Face to face interviews offer numerous advantages such as being well structured and flexible [91]. On the other hand, we must take into account the ongoing pandemic condition and the short period of time. Therefore, an online survey was used in order to overcome these limitations. Finally, it was decided to apply the first phase of research immediately after the beginning of the pandemic to highlight the sudden change in transport choices by the sample investigated. As explained in the methodology section, the online survey with 431 respondents applied in this study is representative [65,66].

Regions have a significant influence on human behavior in and perceptions of traffic, and the results of a study may not be valid for different regions [68]. For instance, road users in Sicily have some characteristics such as a high amount of private car use and less use of public transport and micromobility that may not be similar to the characteristics of road users in other cities. Hence, further studies should be conducted in different regions considering a multilevel analysis.

The study sets a ground for future research which will include a larger sample size, consider different national contexts, and define global mobility indicators. This approach will allow the consideration of several human factors, environmental aspects, means of transport, and connections between these modes.

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