

Article

# Will the Effects of COVID-19 on Commuting and Daily Activities of the University Students Be Maintained? Evidence from a Small Town in Sicily

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**Abstract:** As many studies have already shown, the COVID-19 pandemic has had a great impact on the daily routines of people all over the world. University students form one of the most affected groups of people, since they have had to interrupt many of the activities that they usually perform, and have also had to get used to a new way of learning (e-learning). An important question that now arises is whether the changes that were identified within the pandemic period are to be maintained when the risk of being infected is eliminated. To this end, 537 university students of the Kore University of Enna, Italy, were surveyed. Their responses are analyzed descriptively, and an ordinal regression model is being developed to shed more light on the likelihood of retaining changes related with to transport mode choice. The results show that the likelihood of retaining all the changes when commuting and during daily activities is very high, demonstrating such willingness from the participants. Moreover, it has been shown that public transport has increased the probability of people being negatively affected by the pandemic in the long-term, and opportunities appear for increasing the modal share of active modes.

**Keywords:** COVID-19; pandemic; university students; modal shift



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## 1. Introduction

The spread of the COVID-19 virus in Europe began with isolated cases: the first three were identified on 24 January 2020 in France, whereas in Italy (Rome), the first two cases were recorded as early as 31 January 2020. In Italy, the first epidemic outbreaks were recorded in Lombardy, Veneto, and Emilia-Romagna on 21 February 2020. The global pandemic has led to the imposition of numerous health-oriented restrictions and safety protocols that have significantly changed the travel behavior and daily course of actions. An increasing number of citizens, either voluntarily, by force, or both, engaged in a range of virtual activities, notably teleworking and e-commerce, due to the new stringent regulations [1]. Several studies examined the effects of teleworking on the physical and mental health of the workers, and its implications in the context of the evolution, development, and spread of COVID-19, as well as its position in the status quo in the post pandemic era [2,3]. These studies highlighted the pivotal health risks for teleworkers, which were mainly related to the use of non-ergonomic equipment and the absence of a dedicated workspace, the risk of overwork, and the psychological stress of working from home. These studies essentially underscored the emerging challenges and

related risks of overwork in terms of mental health impact. Prolongation of teleworking can negatively affect both physical and psychosocial health. Although, some authors have also described its potential health benefits [4,5]. Being flexible and compliant to the evolving health and travel restrictions, teleworking models are rapidly expanding to new categories of employees, changing factors that are traditionally considered important for its eligibility.

López-Igual and Rodríguez-Modroño [6] confirm this heterogeneity in the profiles of teleworkers; i.e., casual teleworkers are usually male managers or professionals, but a significant proportion of highly mobile teleworkers are technicians and associate professionals, whereas support employees constitute a large group of home-based teleworkers. During COVID-19, the importance and frequency of engagement in teleworking, teleconferencing, e-learning, telehealth, and e-shopping significantly increased across the world [7]. Those who telework, teleconference, and video call with family or friends daily quadrupled during the pandemic, whereas daily online learners increased sevenfold [8,9].

Although telehealth and e-commerce had a slow start, they increased exponentially after just a few months of the pandemic. E-commerce turned out to be an important medium to address the need for shopping, comply with the evolving travel and crowd restrictions posed by the local health administrations, and keep people away from any potential health and safety risks; therefore, with the continued restrictions on crowd and occupancies in various facilities, such as grocery stores to limit the widespread infection of COVID-19, people's mobility have undergone a visible transition. Almost all the stores made their e-commerce presence robust to capture the heightening virtual demand for shopping and other related services. As it turns out, many stores lost their businesses, became bankrupt, and eventually disappeared from a city's landscape. Although slow in pace, this has caused a critical transformation in cities' conventional land use as well as spatial structure [10–12]. As a result, this has disrupted and challenged the interconnected conventions between urban form, spatial structure, the nature of decision, and conscious awareness of the social and physical infrastructure for the future of cities [8,10,13]. Several studies have shown a direct proportional impact between the duration of the quarantine period and state of mental health, with increasing symptoms of post-traumatic stress [8,14,15]. Many people quarantining and teleworking at home increased their sedentary behavior through heightened screen time (e.g., watching television, using mobile devices, playing games, etc.) and significantly reduced the volume of physical activities. This, in turn, has worsened people's quality of life, especially for the elderly and frail people with obesity, among others [16,17].

Matias, Dominski, and Marks (2020) [18] reinforce the connection between physical activity at home and mental health during the pandemic, and they suggest that increased physical activity allows physical and mental well-being to reset. From a psychological point of view, the symptoms of COVID induced stress and anxiety are analyzed by a number of studies on different target populations, such as the elderly, young populations under 18, and university students. Depression status and functional impairment of the adults are analyzed in the USA by [19], and symptoms of anxiety have been verified in university students in China and India, which could be caused by social detachment [20,21]. Other countries, such as France [22], the USA [23], Russia, and Belarus [24] also suggest similar findings for the student populations.

Given this backdrop, this study aims to explore the effects of the COVID-19 pandemic on the changes in travel behavior of university students in Sicily, Italy. The characteristics of the changes in travel behavior, daily activities during the pandemic, and factors influencing such changes are investigated. More specifically, this study aims to advance the state of the knowledge by:

- examining whether the effects of the COVID-19 pandemic (which have been proven to a large extent by other studies in the literature) will be maintained when the risk of being infected is eliminated;
- understanding which transport modes will gain or lose popularity in the long-term due to the pandemic;

- identifying the characteristics of those that are more likely to maintain their new transport mode choice; and
- exposing some of the unexplored benefits of the pandemic that would help re-build future (green) cities in the post-pandemic era.

### **Changing Habits during the Pandemic**

Limited travel led to more hours per day at home and greater PC use. The university students covered in this research found themselves attending classes online and living at home with their families or friends. Many university towns continue to depopulate, leading to a decline in rent being paid, and a decline in the service sector economy [25]. The fear of health risks associated with traveling has led to an increased propensity for e-commerce; shopping from home has proven to be easy and convenient for many students (not having to leave home and look for products that are often not readily available in the area where one lives). The increase in e-commerce use has yielded negative effects during different phases of the pandemic, notably the closure of small shops, as well as problems related to logistics of the increase in the transport of goods. A survey conducted by the United Nations Conference on Trade and Development (UNCTD) showed that during the pandemic, over half of the respondents rely on e-commerce more frequently than ever [26]. Online purchases increased by at least 10 percent in most product categories, particularly electronics, DIY, education, cosmetics, household products, and pharmaceuticals. Despite the growing use of e-commerce for shopping, the average monthly expenditure per shopper fell, because in a period of uncertainty, people preferred to postpone big purchases and focused more on everyday products. The average monthly spend per shopper did not fall evenly and had different impacts depending on the age of shoppers.

Different age groups had a different response to purchases during the pandemic; however, Generation Z and millennials felt the impact of the crisis the most and had concerns for the future, thereby drastically reducing their purchases. On the other hand, only a small percentage of people in Generation X said they were concerned about the situation, and were more inclined to save at this economically sensitive time, whereas most people born in the 1960s and 1970s did not change their spending and habits.

The increase in sedentariness has also changed sporting habits. Many people have adapted to the circumstances by seeking appropriate responses to cope with the change. This is exactly what happened during the pandemic: the activation of online courses, training sessions scheduled at the same time that people were used to meeting in the gym, in-depth 'lessons' on discipline-specific topics, and meetings with specialists from other sectors, all made it possible to maintain the connection between people, leaving room for relationships, even during a period of forced distance. Staying active and fit for people of all ages and abilities is also vital for lowering the risk of infection. Due to the lockdown period and closures of schools, offices, and other venues, people have been restricted in their activities. Sedentary behavior and physical inactivity can cause profound negative effects on health and well-being, as well as on individuals' quality of life. This negative effect on well-being can also have an impact on mobility choices [27]. Restrictions can also induce additional stress that challenges people's mental health [28]. Although many restrictions were widespread, outdoor training could be conducted safely by maintaining social distances and taking other appropriate precautions.

The resumption of all activities, including sports, allowed for an almost complete return to the daily routine that had vanished overnight. The reopening of fitness centers, gyms, and the resumption of contact sports have provided a much-needed new space for physical and psychological well-being. As with any new situation, the pandemic has also led to the need for adaptation and subsequent learning, as well as bringing a new awareness of the importance of keeping relationships alive between people to the surface, even when distance prevents contact. Several research studies have evaluated the physical activity of university students either by administering questionnaires or by using accelerometers. Compared with the pre-isolation values before March 2020, five studies showed a reduction in light/moderate physical activity (walking), whereas seven studies revealed a reduction

in high/vigorous physical activity. Levels of walking, as well as moderate, vigorous, and total physical activity were reduced during COVID-19 pandemic confinement in university students in several countries [29].

Participation in extracurricular activities has been found in the literature to be associated with greater well-being during the first wave of the pandemic. In Canada, for example, students were surveyed through a questionnaire administered during the stressful COVID-19 pandemic blockade in April 2020 [30]. This period coincided with a new period of online examinations, and how these activities related to perceived well-being, anxiety, social aspects of activities, and personality were examined. In general, there was a high level of anxiety, which led students, in some cases, to seek psychological assistance. The results showed that listening to music and watching movies/television series were the most frequent activities, followed by virtual socializing and engaging in social media. The activities that students rated as most beneficial to their well-being were somewhat different, with outdoor exercise rated highest, followed by virtual socializing, and listening to music [31].

#### **COVID-19 and Mobility behavior of the University Students in Italy**

According to an ISTAT report (2020) on commuting before COVID-19, there are 33 million commuters in Italy—22 million people daily commuted to work and 11 million commuted to school. Half of them live in the northern regions whereas 10 million live in southern Italy. Approximately 3.5 million students commuted outside their municipality. At the start of the pandemic, about 3 million people remained mobile, but only 10% (i.e., 300,000) of them used public transport [32].

Public transport was used more often in the Northern regions of Italy than in the Centre, South, and Islands. Restrictions imposed on mobility have affected commuting patterns for both the working and student populations. Students are the largest number of commuters in many university-based Italian cities where the largest campuses are located. To facilitate their mobility, a series of safety protocols were put in place in order to board, as required by Greenpass, notably reducing the number of people onboard public transport, and continuous sanitization was also required. Aggregated and anonymized data processed by Google Maps makes it possible to show how crowded certain places are to identify, for example, peak times, and thus make critical decisions on safety restrictions to fight against COVID-19. There has been an increasing focus on public health strategies (e.g., physical distancing measures) to slow down the rate of transmission or to schedule reopening in areas subject to travel restrictions. Table 1 shows a decreasing trend of purpose oriented national, regional, and local trips from October 2020 to January 2021. This period was characterized by the fourth wave of the pandemic with the spread of the Delta variant of COVID-19 and the start of the three-dose vaccination campaign.

Universities and campuses are places where students live and study near each other [33]. University students form a group of people with special transportation-related needs and preferences [34]. Since 2020, education officials have been forced to cancel classes and close the doors of campuses around the world in response to the growing coronavirus epidemic [35–37]. For instance, educational institutions in the USA have shifted classes to online learning and canceled spring break trips; students studying abroad in China, Italy, and South Korea have been encouraged to return home to complete their studies. The most effective tool for maintaining student retention, and maintaining access to learning, has been online courses. Universities in several states around the world adjusted their programs in response to the spread of the coronavirus [38]. During the different waves of the pandemic, people over 60 years of age were affected by coronavirus first; however, university students were also affected, and they suffered from a relatively high risk of the disease in subsequent waves, with Delta and Omicron variants being active since the end of 2021.

The effect of the pandemic on mobility habits in Italy was conducted through statistical methods [39], multicriteria analysis such as AHP and BWM [40], and multiple linear regression models [41]. Several studies have been conducted on the restrictions adopted in

terms of means of transport or in the workplace, whereas other studies have been conducted analyzing the psychosocial aspect resulting from the pandemic and the restrictions on different target populations, including university students. A study conducted on public transport users in Sicily highlights the feelings of fear and stress that have modified travel behavior and modal choice [42–44]. The COVID-19 pandemic represents a public, economic, and mental health crisis. A study of six lower-middle-income countries, and nine upper-middle-income countries and higher-income countries, found that the overall percentage of study participants with clinically significant depressive symptoms was 21.39%. The prevalence of clinically significant depressive symptoms was significantly lower in countries where governments promptly implemented strict policies [45].

**Table 1.** Purpose oriented mobility trends.

	7 October 2020	7 November 2020	7 December 2020	7 January 2021
National scale: Italy (%)				
Retails and leisure	−5	−12	6	−20
Food and pharmacies	16	5	34	25
Parks	23	10	30	13
Public transport stations	−15	−10	−18	−38
Workplaces	−15	−5	−18	−48
Residential Areas	3	2	2	16
Regional Scale: Sicily (%)				
Retails and leisure	0	−16	1	−25
Food and pharmacies	25	−2	33	22
Parks	34	2	5	−20
Public transport stations	3	−4	−7	−28
Workplaces	−14	−8	−15	−39
Residential Areas	2	2	2	14
Local Scale: Enna (%)				
Retails and leisure	−7	−44	−7	−31
Food and pharmacies	43	13	57	52
Parks	41	10	44	8
Public transport stations	−7	18	−1	−12
Workplaces	−10	−17	−16	−39
Residential Areas	1	2	3	14

A study conducted in Italy, on university students' symptomatology and help-seeking behavior before and during the pandemic, assessed the impact of the different phases of the pandemic on students' mental health. It found that during the lockdown period, compared with the other phases, female students reported worse symptoms in the dimensions of obsessive-compulsive behavior, interpersonal sensitivity, depression, paranoid ideation, and psychoticism. The increase in symptoms disappeared after the isolation was lifted. The results showed no difference in the male groups [46].

A study collected prospective data on students' mental health on two occasions, namely in October and December 2019, and six months later, in April 2020, in the middle of the COVID-19 blockade in Italy, and in mid-May/June 2020 after the blockade was lifted. A total of 358 Italian students aged 18–30 years completed a series of questionnaires, and the results support the view that depressive symptomatology can be exacerbated during



the blockade, but they also underline that after lifting the blockade, the state of depression tends to fade away [47].

The subjective experience and behavior (health, learning/teaching) among university students was studied in other countries such as Egypt and Germany shortly after the first pandemic outbreak in May 2020. In this context, despite the small sample size, the survey provided important insights about the mental health of the university students of those countries and how they perceived the first COVID-19 pandemic outbreak in May 2020. More specifically, depressive symptoms were reported by 51.82% of the student sample, and health (mental and physical) concerns, perceived difficulties in identifying feelings, and difficulties in learning behavior compared with before the pandemic, were also significant [48].

In addition to the psycho-social aspect, several studies have focused on the issue of international student mobility and pandemics in a global context. There were reports and surveys investigating the effect of the COVID-19 pandemic on international students' mobility and education; for instance, with regard to the trend of international students' mobility, exchange programs and internships in higher education declined rapidly during the pandemic—in fact, autumn of 2022 has been the worst ever in this respect. However, the development of online courses and education programs have accelerated the adaptation to 'the new normal' in higher education systems [49].

The modal choice and home-university travel aspect in Italy was conducted in 2020 by the Universities Network for Sustainable Development (RUS), and the behavior of 85,000 people, who were representatives of the academic population, was analyzed. Sixty-six percent of respondents stated that they will continue to travel to university for work or study if the health risk is minimal. This scenario changes completely in the event of a more pessimistic picture: if the virus were to attack again, 61% of the people surveyed would only go to their university when strictly necessary. The percentage distribution of responses remains uniform in the four geographical areas examined (north-west, north-east, center, south, and islands), suggesting that the perception of risk is very strong and does not differ significantly within the Italian context.

The study suggested that public transport is the mode of travel that has suffered the greatest decline in percentage terms, which is probably also due to the reduced vehicle occupancy imposed by government measures to ensure social distancing. The results of this study indicate that most people who used to walk and cycle to university will continue to do so. Similarly, no change in habits is expected for those who used to use private cars. The most significant changes will occur among public transport users: in the most critical scenario, about 20% of public transport users will change their modal choice, switching to using their own car in 13.3% of cases and to active mobility in 6% [50].

To optimize students' university experience, it is crucial that both local authorities, and especially universities, recognize the importance of the fact that in-person interaction, even when it is of short duration, can be of great help to students. Both nationally and locally, Italian students have been looking for alternatives to have a satisfying in-person experience since the spring of 2021. Several universities have considered providing students with a third type of environment, away from home and campus, that is conducive to learning. In-person education is strongly connected to the need to commute, the synchronization and connection of home-work-study commuting, and the related management policies. This is critical for avoiding the risks associated with the pandemic, in addition to making daily commuting more attractive, safe, and encouraging. Moreover, mobility choices are closely linked to the supply of transport services to which the individual has access and to the actual availability of private means of transport. These mobility "choices" are in some cases only hypothetical: students may have only one option (e.g., car) because public transport is not available for a particular route and the distance is too long to entertain any active mobility. Mobility capital (i.e., the actual set of options that can be adopted for one's mobility) is not immutable, as it is possible to buy new means of transport or to benefit from improved transport services [51].

## 2. Case Study

### 2.1. The Local Context

The sample of university students investigated belongs to the youngest university in Sicily—Enna Kore—located in the center of Sicily in the lower part of the city called Enna Bassa. Since 2004, the presence of the university has allowed the expansion of the residential area and services of Enna Bassa, and the construction of a new campus about 32 km from the main structure.

The city of Enna has about 27,000 inhabitants and is defined by three main areas called Enna Alta (offices, schools, and banks), Enna Bassa (residential and university area where the hospital is also located), and a hamlet called Pergusa, with a touristic–residential vocation near the lake. The University of Enna Kore consists of five faculties and is currently attended by 6000 students. As of 2020, 4758 students have been registered, of which 3158 are female. The university facilities are new and are in the Ferrante and Santa Lucia districts, with gymnasium areas, a large library, and parking spaces. The students mostly live near the university facilities, and a shuttle bus service has been available for a few months to drive students to the new campus (now the Faculty of Medicine and laboratories). (Figure 1). The areas around the various university facilities are rich in vegetation, and there is a swimming pool and athletics field. The infrastructures around the university do not have dedicated lanes for bicycles, but the pavement is in good condition. The new campus is connected to the other facilities by bus, it has no pavements, and is only used by public transport (shuttle bus) or private transport (car or motorbike).



**Figure 1.** Location of the main facilities of the Kore University of Enna Italy (photos by Authors and map by <https://www.openstreetmap.org/#map=15/37.5499/14.2843> (accessed on 5 March 2022)).

The city of Enna was selected as a case study since, in respect of the island, it is in a central position, and it is also the seat of the youngest university in Sicily, with a growing trend of enrolled students, and with the presence of two campus areas (the old and the new) about 3 km apart and not easily reachable on foot.

### 2.2. Data Collection

The data collection was carried out through the administration of a questionnaire to Kore University of Enna students. The number of students at the university is about 4800,

and they belong to five faculties, namely Engineering and Architecture, Economics and Law, the Faculty of Human and Social Sciences, Medicine, and the Faculty of Classical, Linguistic and Educational Studies. In the period October–November 2021, at the beginning of the academic year 2021–2022, a questionnaire was administered to the student population of the first three faculties mentioned above. The university is in the lower part of the plateau upon which the city is situated, and the areas surrounding the university are mainly residential or for tertiary activities. Approximately 60% of the university population commutes, regardless of whether they reside in Enna. In the upper part of the city, there is a university dormitory with about 70 beds.

The questionnaire lasted about 15 min and was divided into two sections. Each user had to select an answer from provided options for the first section; a Likert scale was used for most of the second section. The first section was related to socio-demographic data including:

- gender;
- education;
- monthly household income;
- city of residence before the onset of the pandemic;
- city of residence after the onset of the pandemic.

The second section investigated the possession and use of private vehicles and travel habits. In particular, the modal choices in the pre- and post-pandemic phase were stated, analyzing the degree of perceived risk and evaluating the modification of some of the activities carried out daily, such as exercising outdoors or using online shopping.

### 3. Results

#### 3.1. Descriptive Statistics

A total of 364 (67.8%) males and 173 (32.2%) females responded to the survey. Most of the participants (81.9%) are undergraduate students, whereas 13% are MSc students and 5% are PhD students.

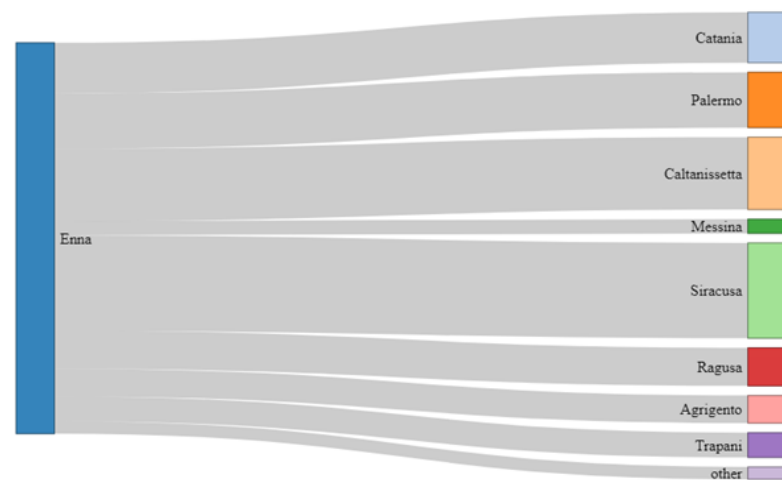
Among the respondents, 32.5% stated a middle household income class (4001–5000 EUR/month), whereas many respondents stated that they belong in the 3001–4000 EUR/month and 5001–6000 EUR/month classes (24.6% and 31.9%, respectively). Only 6.7% of the respondents belong to the lower household income class (2001–3000 EUR/month), and 4.3% of them belong to the upper class (>6000 EUR/month). A very high percentage (93.7%) of the participants hold a driving license, and approximately the same percentage of participants have regular access to a private car.

An interesting outcome is that 76.4% of the university students changed their city of residence after the onset of the pandemic. Figure 2 provides an overview of the proportion of the students that moved to each surrounding city.

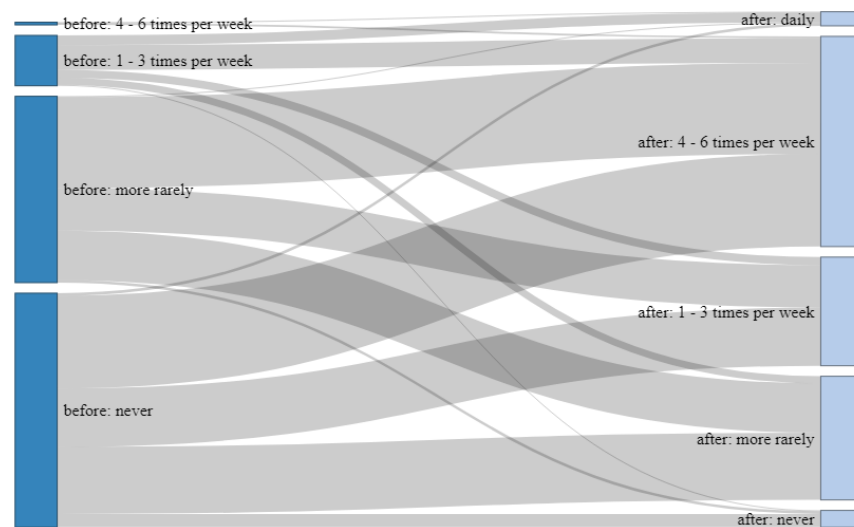
In addition to returning to their city, the participants largely changed their habits and preferences. One of these changes has to do with the physical exercise, and more specifically, with the frequency of exercising outdoors (e.g., running, cycling). It is found that 84.7% of the participants modified the frequency of exercising outdoors (Figure 3), whereas most started exercising outdoors more regularly. Figure 3 suggests that there were a great number of participants that never exercised outdoors before the pandemic, but they started to do so from 1–3 to 4–6 times per week during/after the pandemic.

Another habit that changed significantly due to the pandemic concerned shopping and the supply of goods. The frequency of shopping online was modified for 87.9% of the participants, and as in the case of the outdoor exercising, the vast majority increased the frequency of online shopping. Figure 4 suggests that many participants were shopping online only a few times per month, or even less before the pandemic, but they now do so on a weekly basis. It is apparent that the percentage of participants that now shop online less than once per month is extremely low, indicating that the purchase of basic goods is also now done online.

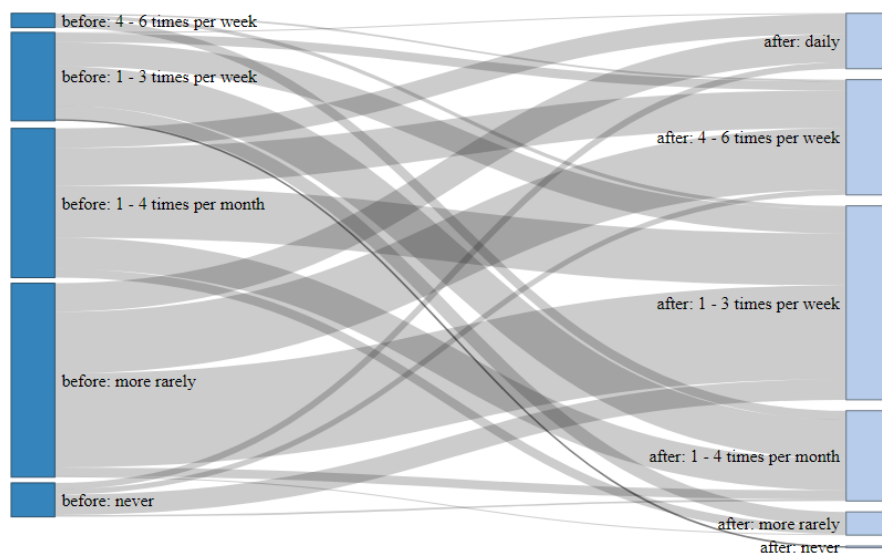




**Figure 2.** City of residence before and after the onset of the pandemic.

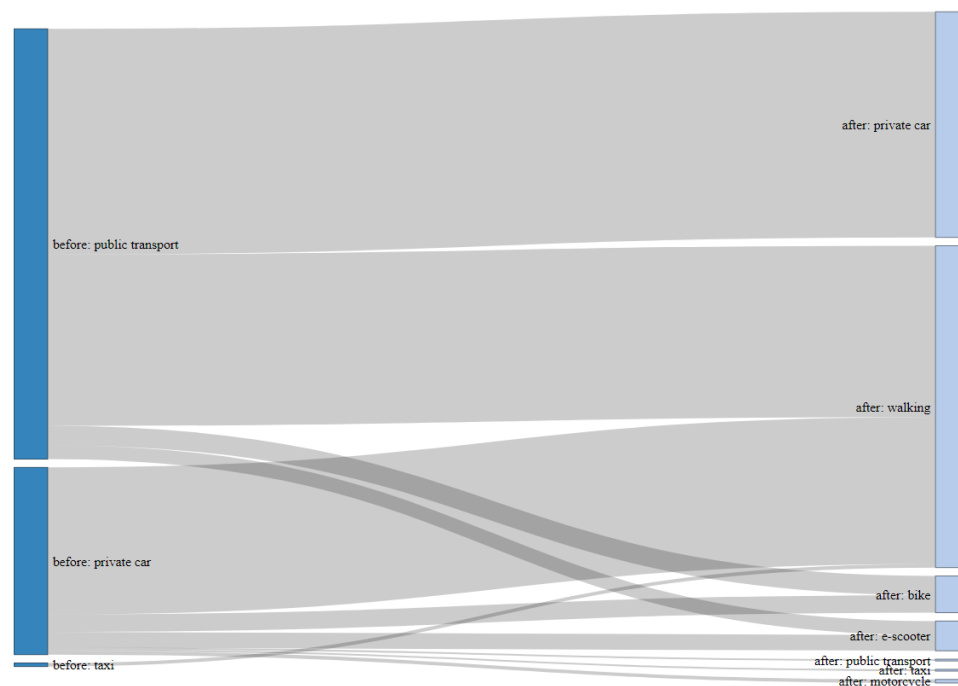


**Figure 3.** Frequency of exercising outdoors before and after the onset of the pandemic.



**Figure 4.** Frequency of shopping online before and after the pandemic.

The pandemic has also resulted in a substantial modal shift, since the daily mobility needs have been altered. Most participants (66.1%) stated that the transport mode they now use more regularly is different from the transport mode they regularly used before the pandemic. Figure 5 shows that public transport was the mode that experienced the biggest loss. Private car use lost many users who shifted mainly to walking, but at the same time, it gained many users from public transport, resulting in a similar percentage of participants that chose to use a private car for their trips. Obviously, the big “winner” of this modal shift was active mobility and micromobility, but walking claimed an important percentage of participants that were previously opting to use public transport and private cars.



**Figure 5.** Most frequently used transport mode before and after the onset of the pandemic (modal shift).

The changes that the pandemic caused in terms of transportation-related issues are obvious. The important question is to what extent these changes will remain when the risk of COVID-19 will be much lower or non-existent in the future. Table 2 shows the likelihood (as stated by the participants) of retaining the changes, in terms of the frequency of exercising outdoors and shopping online, as well as in terms of the most frequently used transport mode. It is noted that these questions were asked only to those that stated a change between the pre- and post-COVID-19 eras. The results show that the likelihood of retaining all the changes is very high, which also demonstrates a willingness from the participants.

### 3.2. Modelling the Likelihood of Retaining the New Transport Mode in the Post-COVID-19 Era

Placing more emphasis upon the modal shift, an ordinal regression model was developed to identify which participants are more likely to retain the new transport mode, and also which transport modes are more likely to be affected in the long-term. The specific variable was selected among those presented in Table 2 for further examination, for two reasons:

- (1) mode choice is one of the key parameters in transport planning, and thus, it would be interesting to investigate the long-term effect of the pandemic in this parameter, and
- (2) the descriptive statistics of Table 2 show that the responses are more balanced between the low and high likelihood levels, compared with the other two variables, and it is, therefore, more meaningful to attempt to understand who belongs at each level.

**Table 2.** Likelihood of retaining changes when the risk of COVID-19 is much lower.

Variable	Category	Frequency (%)
How likely is it that you will consider continuing to exercise outdoors?	1: unlikely	1:3 (0.6%)
	2	2:28 (6.2%)
	3	3:60 (13.2%)
	4	4:363 (79.8%)
	5: very likely	5:1 (0.2%)
How likely is it that you will consider retaining the habit of shopping online?	1: unlikely	1:1 (0.2%)
	2	2:14 (3.0%)
	3	3:67 (14.2%)
	4	4:179 (37.9%)
	5: very likely	5:211 (44.7%)
How likely is it that you will consider retaining your new choice of transport mode?	1: unlikely	1:8 (2.3%)
	2	2:79 (22.2%)
	3	3:117 (33.0%)
	4	4:87 (24.5%)
	5: very likely	5:64 (18.0%)

The ordinal regression model is considered appropriate due to the ordinal nature of the dependent variable, which is a Likert-scale variable, with 1 expressing that it is very unlikely that the respondent will retain the new transport mode and 5 expressing that it is very likely that he/she will retain the new transport mode in the post-COVID-19 era.

Many different combinations of independent variables were tested. The variable selection focused on including only statistically significant variables (at a 5% significance level) and capturing the highest possible variation in the dependent variable. The final model is shown in Table 3, where the independent variables, along with their coefficient, standard error, *p*-value, limits of the confidence interval for the coefficient, and odds ratios, are presented. The selected model explains approximately 24% of the variance of the dependent variable, as McFadden's Pseudo- $R^2$  suggests. It should be noted that in all cases, a reference category was defined that collects many responses in order to have valid comparisons and results.

**Table 3.** Model parameter estimates.

[illegible]

The following conclusions can mainly be drawn, based on the results presented in Table 3:

- Female participants are much more likely to retain the new transport mode when the risk of infection is much lower, compared with their male counterparts.
- The probability of retaining the new transport mode is increased for undergraduate participants compared with PhD participants.
- Participants coming from middle-income households (4001–5000 EUR/month) are more likely to retain the new transport mode compared with participants coming from high-income households (>6000 EUR/month).
- Participants that were mainly using public transport before the pandemic are more likely to retain the new transport mode as compared with those that were mostly using private cars. The existing literature has already proven that public transport lost an important number of users during the pandemic, and the results of this model are really interesting for public transport authorities and policymakers, since it indicates that public transport has increased the probability of being negatively affected by the pandemic at a long-term.
- Participants that shifted to the use of a bike or to walking after the onset of the pandemic are much more likely to retain this new way of travelling as compared with those that shifted to the use of a private car. This result can be also valuable for policymakers since it indicates that bicycling and walking have increased the probability of being positively affected by the pandemic in the long-term, and therefore, the pandemic can involuntarily contribute to the promotion of sustainable urban mobility goals in the post-COVID-19 era. Regarding those that shifted to the use of a motorcycle, no conclusions can be drawn, since the proportion of the sample that belongs in this category is too limited.

#### 4. Discussion and Conclusions

The COVID-19 pandemic greatly impacted people's daily routines. The impact was even greater in the case of university students, since this extremely active group of people had to interrupt many social activities, and also had to adjust to a new way of studying, due to the fact that lectures were online and interactions were based on virtual platforms.

Firstly, the analysis conducted in this paper identifies the changes that were provoked by the pandemic in terms of students' commuting and daily activities. It is apparent that the discontinuation of team sport or indoor sport activities pushed many university students to other types of activities, such as outdoor exercise. Moreover, to a large extent, participants shifted to an online way of shopping and procuring daily necessities.

Even though people were forced to change their habits and activities due to pandemic restrictions, it is expected that many changes, including travel patterns, will not recover to their pre-COVID-19 state [52]. This study shows that this seems to be the case for university students, since they are willing to maintain many of their emerging habits. As participants stated, there is a very high likelihood that they will keep shopping online and exercising outdoors, even if the risk of being infected is much lower. This suggests that people identified some important benefits in the new habits and activities that they were forced to adopt; therefore, appropriate measures for supporting these habits should be taken, and the changes should not be treated as temporary.

Another conclusion to be drawn here is that for this group of participants, it is very likely to maintain their new transport mode. Motivating modal shift is truly a tough process, especially in countries and cities with high levels of private car ownership and car-oriented transportation systems. The results of the ordinal regression model show that in the case of Enna, it is very likely that the participants that shifted to the use of a bicycle or walking will maintain this new way of commuting. This is a truly remarkable finding, as it shows what many modal shift campaigns/strategies were not able to achieve, is likely to be achieved by the pandemic. This result also reveals that in the process of the modal shift, the most difficult process is to motivate a traveler to try the use of a new mode of transport.

In this case, the travelers were forced to try bicycling and walking, and after months of getting used to them, they are now willing to adopt them as part of their daily mobility. This finding also enhances the opinion that the pandemic created a great opportunity for creating more sustainable and resilient cities, as well as for reaching sustainable mobility goals [53–55]. In contrast with the active modes, it seems that public transport ridership will be negatively affected in the long-term. This finding supports the estimations of other studies that have been previously carried out in Australia [56] and India [57].

Of course, in order to maintain the modal shift in favor of cycling and walking, and to make progress in terms of sustainable mobility, it is essential to provide the appropriate urban environment to the users of these modes [58]. In most cities around the world, the traffic volumes during the periods of restrictions were significantly lower compared with pre-pandemic volumes. In many cities, temporary bicycle lanes and additional areas for pedestrians were implemented for encouraging active mobility and social distancing. These interventions had a really positive impact on active mobility, since they contributed to an environment that was more bicycling and walking-friendly; however, when cities recover from the pandemic, it is expected that transport demand will significantly increase, and if the responsible authorities do not retain the bicycling and walking-friendly urban environment, many of those that shifted to active mobility will return to the mobility habits they had before the pandemic. Measures such as implementation and maintenance of bicycle lanes, speed restrictions for motorized vehicles, and implementation of pedestrian areas or shared spaces, can play a beneficial role in achieving the desired results.

This requires local governments to proactively act and take strategic decisions on urban mobility, land use, and pertaining infrastructure, that capture the transformational mobility behavior that this study unearths. The results of this study are going to be a guiding pathway for other cities across the world to design a post-pandemic mobility infrastructure that is effective, adaptive, and responsive to changing mobility behavior. This study made a critical contribution in exposing some of the unexplored benefits of the pandemic that would help re-build future (green) cities in the post-pandemic era. Future studies along this line should note the nature of dynamics and strength of this fact.

The abovementioned conclusions are subject to some limitations. Firstly, all the responses were gathered from students at a specific university, and therefore, the conclusions are not necessarily representative of the whole Sicily region. Moreover, the responses show a great willingness for retaining the habits that were formed within the pandemic; however, in many cases, the preferences that are stated in questionnaire surveys do not necessarily correspond to the actual behavior.

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