



# A region-wide survey on emotional and psychological impacts of COVID-19 on public transport choices in Sicily, Italy

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**ABSTRACT:** Public transport generally addresses the evident mobility needs and offers an often-irreplaceable service, especially for captive users and other disadvantaged population groups. Public transport design and services are closely related to the physical size of modern cities, the number of people living or working in them, and the distribution and organization of work and social activities. However, public transport has been restricted with the spread of the COVID-19 pandemic in Italy, since March 2020. Public transport demand collapsed, especially during the lockdown period (March-May 2020), and adverse effects were reported even in the subsequent periods. In fact, the social distancing restrictions have highlighted numerous problems with public transport systems worldwide, primarily due to two factors. The first is related to the spread of the virus via the respiratory route, which is more likely to infect in restricted areas, and the second is associated with a transport system that by definition has high occupancy rates and low spacing throughout the journey (e.g., the positioning of seats or standing places in a train or bus). Thus, the COVID-19 pandemic has substantially impacted

the travel choices of users. The pandemic has also negatively affected the psychological state, generating specific problems of anxiety, fear, or stress among all population groups, even when choosing the means of transport to travel with.

Given the emerging pandemic challenges, the present study examines the public transport demand characteristics during the various phases of the COVID-19 pandemic in Sicily, one of the most affected regions in Italy. The study investigates the mental state of a population sample that frequently used the local urban or regional public transport to travel to work before and during the pandemic phases in the Sicilian territory. Through the administration of an online survey, it was possible to collect sociodemographic and psychological data to understand the propensity to use public transport. A series of inferential statistical tests were applied to assess the correlation of psychological aspects (i.e., fear, anxiety, and stress) with socio-demographic variables and modal choice habits (trip frequency). Results highlight and evaluate each psychological issue among population groups and their relative role in shaping public transport-related preferences. The study highlights some proposals and their implementation strategies to prevent negative emotions and encourage public transport use in Sicily and generally.

## 1. INTRODUCTION

The new coronavirus SARS-CoV-2 has been one of the most debated topics recently. The continually evolving pandemic challenges are still beyond control (Wang et al., 2020a). The context that has spread to many nations of the world has been new and unfamiliar. In this situation of uncertainty, constant change, and waiting for normality to return, people have to adapt to a new rhythm of life and behavior rules designed to prevent it (Pellegrino et al., 2020). This pandemic has also exerted profound psychological implications such as worry, fear, anxiety, anguish, sadness, boredom, and disorientation (Azim et al., 2020; Wang et al., 2020b).

The effects of recent catastrophes and pandemics have highlighted the need to analyze the urban context from the point of view of resilience and sustainability, addressing this issue from different perspectives, from transport and city planning (Moraci, et al. 2020) to the rational assessment of economic resources (Inoue & Todo, 2020) and technologies (Jaiswal et al. 2020). Numerous researchers such as De Vos (2020) and Wen et al., (2020) have also analyzed mode choice and travel behavior in response to COVID-19. Thus, to optimize the transport offer and disincentivize the use private

vehicles, it is crucial to analyze and understand the recovery of mobility during the reopening process and the period of new normality to foresee the future evolution and needs of transport policies and planning (Gkiotsalitis & Cats, 2020).

Various methods and survey models have been implemented in different European and non-European contexts to analyze public transport trends and the related effects caused by the different phases of the pandemic. Research conducted in Spain has compared public transport data from a fixed number of equivalent days in the three years preceding the pandemic (Orro et al., 2020). Some studies focused on the analysis of large-scale data from de-identified and geolocalized smartphone users to assess the impact on mobility during the lockdown in Italy (Pepe et al., 2020), in Germany (Schlosser et al., 2020) and in France (Pullano et al., 2020). Similarly, Beria and Lunkar (2021) analyzed data from social networks, such as Facebook, to investigate regional and provincial data in Italy. The use of population surveys enabled the acquisition of sociodemographic data and travel habits in Sicily (Moslem et al., 2020) and the relative impact on resilient mobility strategies (Campisi et al., 2020).

The path to sustainable mobility is highly compromised by the fear of contagion when using public transport (Gutiérrez

et al.2020). Thus, several strategies have been proposed and implemented by the Italian Government and respective policymakers to promote public transport and cater to these pandemic challenges. For instance, onboard local public transport, regional rail transport, and school buses for dedicated school transport, current regulations have allowed, given scientific evidence on the assumption of average passenger dwell times indicated by available data, an occupancy coefficient of no more than 80%, providing for a more significant reduction in standing places than in seated ones. This occupancy coefficient is also accompanied with air conditioning and ventilation inside road vehicles and underground trains. Typically, most air conditioning systems enable a percentage of air taken from outside to replace the air into passengers' cabin every time the doors are opened at stops. Besides, it is also possible to open the windows permanently on older trams. This occupancy coefficient can only be increased beyond the prescribed limit if air exchange and filtering are guaranteed by utilizing suitable ventilation equipment previously authorized by CTS, i.e. the Italian Technical Scientific Board (Comitato Tecnico Scientifico). Moreover, removable separations between seats may be installed to increase the capacity of vehicles under these restrictions.

Since September 2020, transport companies in Italy have started specific procedures of identifying suitable material to be submitted for health certification by the CTS. It is also recommended that dispensers be installed on metros, buses, and all local public transport vehicles, to distribute hydro-alcoholic solutions for frequent hand cleansing (Gaglione, 2020). The companies that manage the service should provide forms of communication, on each means of transport, on the correct use of Individual Protection Devices. One-meter distance in local public transport is not needed between people living in the same housing unit or between relatives and people in stable interpersonal relationships (Gaglione, 2020). A self-declaration can be made in the event of a violation of the interpersonal distance requirement. Similarly, the 'IMMUNI' app has also been recommended to control the virus' spread (Falletti, 2021).

Regardless of the abovementioned measures, the COVID-19 emergency has induced behavioral changes that reflect on the use of public transport itself, which is arguably the most efficient mode of transport and the most suitable to contain road congestion and pollution (De Vos, 2020). Maintaining the physical distance inside vehicles is relatively complicated and costly (Strong & Welburn, 2020). At present, citizens seem to prefer to use private cars, which, if massive, will increase smog levels in cities, with the consequent introduction of limits on the circulation of the most polluting vehicles (Shirwani, Gulzar, Asim, Umair, & Al-Rashid, 2020). The resumption of public mobility will therefore be slow but inevitable (Gkiotsalitis & Cats, 2020). Above all, the psychological impacts are quite critical even during the post-lockdown phases that hinder public transport use and mobility (Chan et al., 2020; Singh et al.,2020). Therefore, there is an immediate need for consensus guidelines and health policies to support interventions to manage psychosocial distress and increasing people's resilience to the impending crisis (Cerami et al., 2020).

### 1.1 The public transport trend in Italy during pandemic phases

Italy, the first European country to be struck by COVID-19 in the spring of 2020, had its outbreak under control by the summer thanks to a strict two-month lockdown. However, afterwards, daily "positive" cases started to rise exponentially again leading to a new record of nearly 22,000 in October 2020. The second wave of the epidemic in Italy is heavily concentrated in big cities, including the financial capital of the

north, Milan, and Naples in the south. Realizing the pandemic trend, few Italian studies such as those of Murgante et al., (2020a) and Murgante et al., (2020b) have recently analyzed the possible triggering factors in the spread of the epidemic and implemented its data mapping. However, the impact of COVID-19 on the transport system has been, remains, and is likely to continue to be particularly significant. The crowded public transport is more of a problem in large cities than in small towns, as many local administrations have pointed out. According to the recent report published by PwC Italia (2021), there is a significant decline in mobility choices during lockdown and 3-4 months after lockdown. Table 1 shows a detailed comparison of mobility choices in Italy during these two phases.

Transport Mode	during lockdown	3-4 months after lockdown
Public transport (bus, tram and train)	-(85-90)%	-(60-80)%
Shared mobility	-(70-90)%	bike/scooter -20% car -50%
Long distance travel modes (train or plane)	-95%	-(70-80)%
Private car	-(70-80%)	±10%

Source: (PwC, 2021)

**Table 1. Comparison of trend related to mobility choices in Italy during and after the COVID-19 lockdown.**

While the use of public and shared transport was characterized by a reduction in all Italian regions, the use of private vehicles was defined by a range of +-10% from region to region, where the positive value was mostly found in Lombardy, Veneto, Lazio and Sicily. Several factors have influenced the reduction of mobility demand. Firstly, digitalization of economic, educational, and business activities (with the growth of remote working, the spread of distance learning, and the explosion of e-commerce). Secondly, regulations have reduced the transport capacity availability to respect social distancing. Finally, the persistence of an intense fear of sharing with other the experience of a journey, whether it be the daily journey to work or the long journey to - for example - places of interest or a longer trip to holiday destinations.

Accordingly, the Italian Government has mandated that masks must be worn when using all forms of public transport. In addition to this, the Italian Ministry of Health has published official advice on how to stay safe when using public transport, highlighting that the risk increases during peak hours in urban areas. The Government also set a maximum capacity of 50% on buses and subways when infection rates were still low during the summer. Even though people have started to be relatively active, in terms of mobility, after the lockdown period (from May to December 2020), as some businesses have reopened, the public transport use trend is limited, and people prefer to travel by car.

Considering the public transport modal shares, public transport authorities have published some data dealing with Mobility as a Service (MaaS). National data provided by MaaS platform made it possible to assess the different public transport use trends in the three areas of Italy, including North, Centre, and South. Figure 1 shows that in almost all regions, the public transport choice varied due to the pandemic. For all the areas investigated, except for Venice, the most responses are related to "using public transport less", with a peak value for Liguria. Particularly in Sicily, about 20% of the responses indicated "no longer using public transport". Similarly, other evidence (Google, 2021) also suggests a 58% drop in shopping and leisure trips and a 50% drop in the use of public transport

stations in Italy during January 2021. Notably, a more significant decrease in shopping and leisure trips was recorded with 70% and 64%, respectively, in Sicily. These figures reached a value close to 100% during the lockdown phase in March 2020 (Google, 2021).

In Sicily, there are 0.4 buses in circulation for every 1,000 inhabitants (for a total of 2,490 buses), which is slightly below the national average (0.7). Of these, 936 are devoted to the local public transport services, and are broken down into 5.2% of highly polluting vehicles and 33.6% with low environmental impact. Regarding the regional public transport services, the fleet is composed only from 22.3% vehicles with an environmental class of Euro 5 or Euro 6 category. Most of the buses in operation are very old compared to those in other regions of Italy. The low environmental sustainability of the rolling stock in the Sicilian transport system has already been highlighted. According to the Istat (2017) and the Automobile Club d'Italia (2017) data, in Sicily, 12.4% of the population uses public transport for education and work purposes. The number of private cars and motorcycles against the total population is equal to 779 per 1,000 inhabitants. The data also show that local public transport plays a subordinate role for personal mobility, even when compared to the already low average of use in the south. The use of public transport is mainly related to some classes of employees which have incentives (i.e. ticket price reduction) in the use of this mode of transport for home-work trips (for example, police or primary and secondary school teachers).

The various pandemic phases were also characterized by exoduses from the northern regions to the south due to the

initial increase in infections in the northern areas of Italy. This exodus led to the massive use of public transport, especially before the lockdown began. It should also be considered that the regional context examined is not characterized by an optimal transport offer. Many cities in Sicily do not have a railway station or allow the use of efficient, high-speed trains. Therefore, for many Sicilians, using the suburban bus is one of the few transport solutions other than private transport. Moreover, the Government also issued a decree closing the connections to and from Sicily from mid-March to April 2020.

Passenger air transport to and from Sicily was only guaranteed for the imperative need of territorial connections with the mainland, exclusively in the airports of Palermo and Catania, utilizing two return flights Rome-Catania and two return flights Rome-Palermo, one meridian, and the other antimeridian, with the suspension of all other flights, including the international ones.

As far as daytime rail services are concerned, the minimum essential connections will be maintained with a daily Rome-Palermo intercity train and vice versa. After the end of April 2020, another decree was issued opening connections to and from Sicily for the period of May-September 2020, and then there was a further small restriction during the few weeks before Christmas.

### 1.2 Psychological status of citizens and possible impact on public transport

Every day people are subjected to external stimuli that can cause a series of reactions. The pandemic period has undoubtedly increased the probability of being subjected to more

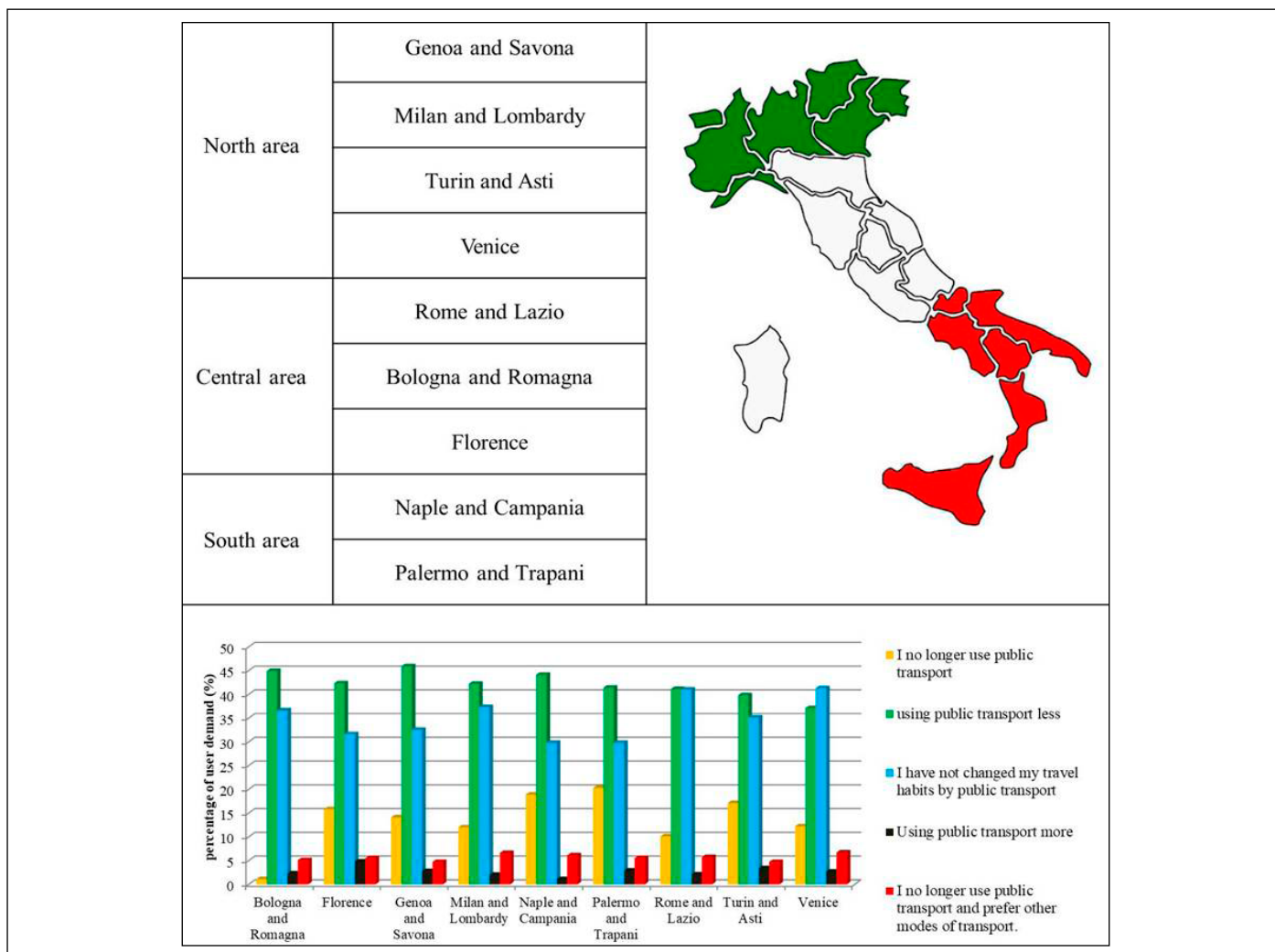


Figure 1. Public transport choice in Italy after the COVID-19 lockdown (May-December 2020)

Source: <http://moovitapp.com/>

negative feelings because of the fear of possible contagion and confinement, unemployment, and uncertainty about the future, enhancing the stress (Fofana et al., 2020). Stress, a term initially coined by Selye (1956), is defined as a non-specific response of the body to any demand for change. Typically, stress refers to how we deal with stimuli that affects us, and the way we deal with them can be defined externally by others or by our perceptions. When our resources or the ability to cope with the stimulus are under pressure, stress is generated. Thus, the greater the pressure, the greater the stress (Bystritsky & Kronemyer, 2014).

Fear and anxiety are also common and indeed fundamental emotions. They inform us of unpleasant and alarming situations and guide us to identify the most useful behavior to defend ourselves from danger or escape (Reiss, 1991). Fear is a primary emotion, a reaction to a specific threat, and has an adaptive function (Gray, 1991). In general, fear is experienced in the face of an identifiable danger because of a specific object that triggers it. On the other hand, we do not know where the danger comes from, and we do not see it (but we know it is looming everywhere). It is not identifiable as a specific object, thus generating a state of perennial trepidation and pervasive unease, leading to anxiety (DeJong et al., 2020; Fofana et al., 2020).

Anxiety is a feeling of fear, worry, or discomfort. It may be a stress reaction, or it may occur in people who cannot identify significant stressors in their lives (Reiss, 1991). Anxiety is typically human emotion that shares the same purposes and activation mechanisms with fear, but it is usually less intense and more prolonged (Lang et al., 1998). Anxiety tends to be internally generated and has to do with our perception of what will be required of us and our resources to cope with the demands. It has to do with our internal assessment of the risk of the stressful event, its potential impact on us, and above all, the feelings and emotions generated. Clinical definitions of anxiety focus on the emotional distress surrounding a potentially harmful event, not necessarily a reaction to the stimulus itself (Ingram et al., 1987).

Fear differentiates from anxiety in that in the former, the danger is immediate, while in the case of anxiety, the threat is in the future, i.e., it is as if one person continually living in expectation of imminent danger had to protect himself/herself from possible future threats. Once the danger ceases, the fear ceases. If stress and anxiety start to interfere with the daily life, they may indicate a more severe problem. If someone avoids situations because of irrational fears, constant worries, or strong anxiety about a traumatic event weeks after it happened, it might be time to seek help. Thus, stress can be triggered by an event that causes frustration and nervousness (Mahon et al., 2007).

The SARS-CoV-2 virus is undetectable, in some respects, and unpredictable, as it is still being studied. Therefore, we are not dealing with a clearly defined danger but with contagion-related risk as an unidentifiable threat that could be present anywhere (Azim et al., 2020). It is, therefore, possible to feel anxiety, alternating with fear, in situations where the virus becomes elusive and uncontrollable. In addition to the social and economic repercussions, the psychological discomfort is fueled by the condition of waiting and suspension from the normal flow of our lives: we are waiting - without knowing for sure when it will end - to resume our habits, our projects, our routines, our daily routine; even the incubation time makes us wait for the probable manifestation of symptoms (Cerami et al., 2020; Sanderson et al., 2020). All of these limit our lives, our possibilities for action and take away strength and solidity from our sense of stability, while feeding possible fears and anxieties.

The proliferation of worries is also due to the inadequacy of information: it is often the uncertainty and contradictory

nature of the information that causes anxiety rather than the fear of the disease itself. The existence of links between negative emotions and basic needs that relate primarily to the first three levels of Maslow's pyramid has been highlighted by recent studies that have shown the beginning of a significant transformation in the individual's emotional state and a shift towards negative emotions (Cerbara et al., 2020).

Furthermore, the fear of contagion, the search for immunity, the fear of falling ill, and losing loved ones can generate a sense of anguish by confronting us with the fundamental questions of the meaning of our lives and the sense of limits (Azim et al., 2020; Hardy, 2020). The pandemic has surprised us, confronting us with absolute truths, namely the possibility of dying and our limited ability to control our surroundings. Being able to control everything is one of the most incredible illusions of our time. One of the consequences of the prevention rules is the limitation of one's possibilities of action.

Given the importance of these psychological stimulations during the COVID-19 pandemic phases and the emerging challenges, recent research has also considered the psychological perspective to analyze travel behavior. The psychosocial and situational aspects can influence modal choices, often becoming a real barrier resulting from various factors such as age (Al-Rashid et al., 2021) or gender (Al-Rashid et al., 2020; Harumain et al., 2021). Transport demand from the early stages of the pandemic was also strongly influenced by these behavioral aspects (Anagnostopoulou et al., 2020; Borkowski et al., 2021). In this respect, the present work investigates the stress, anxiety, and fear that influence the transport choices in a sample of people living in Sicily.

## 2. MATERIALS AND METHODS

### 2.1 Data collection

Social networks such as Facebook and Twitter have enabled numerous surveys related to mobility and COVID-19. They have encouraged public cooperation with safety measures and appropriate risk perception, in which emotion and attention play essential roles. Signals of public emotion and attention are present in social media data, underlining the potential usefulness of social media to monitor public risk perception and guide public communication during crisis scenarios (Dyer & Kolic, 2020). Other studies have shown the usage trends of different transport modes in various urban areas such as small cities (Campisi et al., 2020) or metropolises (Harumain et al., 2021).

The calibration of a survey and its dissemination through social channels allowed us to survey a population sample of 700 individuals in a short period. This population lives in different urban areas of Sicily. The survey was disseminated from October to December 2020, investigating three (3) temporal pandemic phases, namely: (1) the period before the COVID-19 pandemic, (2) the post lockdown period (May-July 2020) and (3) the Phase II period (September-December 2020). The survey consisted of 15 questions that took less than 15 minutes to answer. The survey was implemented on the Google platform with single-answer or Likert scale questions. Dissemination was made via Facebook and WhatsApp pages. The variables which were investigated included:

- Sociodemographic characteristics, such as age, type of work, type of residential area, car ownership, etc.
- The trip frequency with local and regional bus public transport for Home-Based Work (HBW) and Home-Based Other (HBO) travel purposes during the three time periods of the pandemic
- Psycho-attitudinal variables relating to feelings of fear, stress, and anxiety when traveling by bus. Specifically, the respondents were asked to reply to the following ques-

tions: "Do you agree or disagree that you felt fear/stress/anxiety when using the bus before the pandemic (after lockdown or in Phase II)?"

Table 2 presents an overview of the collected data and the variables that were considered in this study.

The sociodemographic data of Table 2 reveals that the 700 respondents were almost divided between men (43.7%)

and women (56.3%), and they were mainly defined by the 22-25 (33.6%) and 26-30 (39.4%) age groups. The sample had a small percentage of respondents who were over 40 years old (1.43%). This probably happened because older people do generally have fewer digital competencies and they would be more reluctant to participate in an online survey (Politis et al., 2021). Moreover, people who are over 60 years old are already retired and/or rarely use public transport due to certain psy-

Variable	Options	Time-period		
		Before COVID-19	Post-Lockdown	Phase II
Gender	Male		43.71%	
	Female		56.29%	
Age	18-21 years old		5.29%	
	22-25 years old		33.57%	
	26-30 years old		39.43%	
	31-35 years old		17.00%	
	36-40 years old		3.29%	
	over 40 years old		1.43%	
Occupation	Freelancer		14.71%	
	Employee		59.71%	
	Other		25.57%	
Residential area	Small town		18.43%	
	Town (Enna and Agrigento)		28.29%	
	City (Ragusa, Siracusa, Caltanissetta and Trapani)		33.43%	
	Metropolis (Palermo, Messina and Catania)		19.86%	
Household monthly income	less than 1,000 euros		25.14%	
	1,001- 1,500 euros		31.57%	
	1,501- 2,000 euros		26.14%	
	more than 2,000 euros		17.14%	
Car Ownership	Own and drive car		90.71%	
	Access to a car but do not drive it		6.43%	
	No driving license		2.86%	
Trip frequency with local bus (HBW purpose)	never	.0%	46.9%	41.6%
	several times per week	8.0%	43.3%	44.4%
	1 or more times per day	92.0%	9.9%	14.0%
Trip frequency with local bus (HBO purpose)	never	2.1%	42.9%	82.3%
	several times per week	19.3%	43.9%	10.7%
	1 or more times per day	78.6%	13.3%	7.0%
Trip frequency with regional bus (HBW purpose)	never	.0%	45.9%	41.3%
	several times per week	7.6%	42.3%	44.9%
	1 or more times per day	92.4%	11.9%	13.9%
Trip frequency with regional bus (HBO purpose)	never	2.1%	44.0%	84.1%
	several times per week	17.0%	42.7%	8.4%
	1 or more times per day	80.9%	13.3%	7.4%
Fear sensation travelling by bus	disagree	86.3%	.0%	.1%
	neutral	13.7%	18.3%	20.9%
	agree	.0%	81.7%	79.0%
Stress sensation travelling by bus	disagree	83.6%	.0%	.0%
	neutral	16.4%	7.3%	11.0%
	agree	.0%	92.7%	89.0%
Anxiety sensation travelling by bus	disagree	87.3%	8.4%	2.7%
	neutral	12.7%	38.3%	27.1%
	agree	.0%	53.3%	70.1%

Table 2. Questionnaire survey variables and results

cho-social barriers which have been identified both in Italy (Mariotti, et al., 2021) and in other countries (Al-Rashid et al., 2021). About 60% of the sample are employees, and 15% are freelancers, while the remaining 26% carry out another type of work activity. 25.1% of the respondents have an income below 1,000 euros, and 31.6% range between 1,001-1,500 euros. More than 43% of the sample earns more than 1,501 euros per month. Regarding the area of residence, 20% are related to metropolitan areas and 33% to cities. Similarly, 18% and 28% respectively reside in areas with populations below 60 thousand inhabitants or in small rural centres.

Table 2 shows that almost all of our respondents used to travel one or more times per day by local (92%) or regional bus (92.4%) for commuting (HBW) purposes before the COVID-19 outbreak. These percentages significantly dropped in the post-lockdown period, where approximately one out of ten respondents continued to use local (9.9%) and regional (11.9%) buses at the same frequency. In the same period, we observe that almost half of the sample stopped using local (46.9%) or regional (45.9%) buses for HBW purposes. These frequency rates remained relatively unchanged in Phase II. A similar demand pattern also exists for both the periods before COVID-19 and post-lockdown regarding HBO trip purposes. However, in contrast to HBW purposes, Table 2 shows that most users stopped using local (82.3%) and regional (84.1%) buses for HBO purposes during Phase II.

The above sociodemographic and travel behavior data indicate that, in practice, the present study analyzes a sample of state workers who have a reduction in the cost of the public transport ticket which is preferred to the private car. Although that almost the 90% of the respondents have a car (Table 2), they prefer to use public transport because they often have a reduction in the cost of business trips and therefore a general saving. In addition, a large part of the sample prefers not to use a private car because of parking problems near the workplace. Furthermore, if we consider the fact that the average monthly income of more than 50% of the sample is below 1,500 euros, we can understand how the use of public transport can be an economic advantage in a medium or low salary lifestyle.

Regarding the psycho-attitudinal variables of Table 2, before COVID-19, no respondent expressed fear, stress, or anxiety while traveling by bus. The dominant emotions in both the post-lockdown and Phase II period are stress and fear. Specifically, 92.7% and 89.0% of the respondents were under stress during their bus trips in post-lockdown and Phase II. Fear also has similar ratings to the stress ones, but they are slightly lower (81.7% in post lockdown and 79% in Phase II). In general, the post-lockdown phase is related to higher expressions of stress and fear when compared to Phase II. In the case of anxiety, the results follow a differentiated

pattern. The peak of anxiety is observed in Phase II (70.1%). In the post-lockdown phase, the anxiety levels (53.3%) are much lower than the fear and stress ones.

The trend in the use of local and regional public transport differed, although, for both networks, the journeys were characterized by negative emotional perceptions at different times. For the regional services, the examined population sample preferred public transport over the use of private vehicles. Some motivations given by the sample are summarized as:

- Making trips without delays related to police checkpoints during periods of travel restrictions controlled many private vehicles.
- A reduction of the use of shared mobility, so the use of the suburban bus increased in some periods
- The concept of home-visit travel in the pandemic period has changed, becoming closely related to primary activities such as shopping or going to a doctor's appointment and not as before related to a real place of recreation.

## 2.2 Data analysis

The descriptive statistics of all the questionnaire items are presented in Table 2. We further carried out statistical inferential methods to determine whether the fear, stress, and anxiety emotions are significantly correlated with: (a) local/regional bus trip frequency rates during the three examined periods of the pandemic and (b) certain sociodemographic attributes. Table 3 reports our initial hypotheses on the sign of the correlations among these variables considering past research findings and common sense (e.g. Adeel et al., 2017; Cheng et al., 2019; Soria-Lara et al., 2017).

Regarding the bus public transport use rates, we expect that as fear, stress, and anxiety are increasing, the demand for local and regional bus trips would be decreasing for all periods and travel purposes. Additionally, we hypothesized that older people and residents of larger cities would feel more vulnerable to COVID-19. Thus fear, stress, and anxiety would be comparatively higher among them.

The same also applies to women (Al-Rashid et al., 2020; Campisi et al., 2020; Harumain et al., 2021) and it is indicated in Table 3 by a hypothesized positive correlation between gender (i.e., male:1, female:2) and fear/stress/anxiety emotions. Car owners and drivers are also expected to be under lower levels of fear, stress, and anxiety since they are not public transport captive users and have alternative traveling options. For the occupation and monthly income, which have been relatively less explored in the previous related research, we intentionally preferred not to hypothesize the relationship direction.

Trip Frequency and Sociodemographic Variables	Psycho-attitudinal Variables			Test Statistic
	Fear (all 3 phases)	Stress (all 3 phases)	Anxiety (all 3 phases)	
Local Bus Trip Frequency (all 3 phases and 2 trip purposes)	Negative	Negative	Negative	Goodman and Kruskal's gamma
Regional Bus Trip Frequency (all 3 phases and 2 trip purposes)	Negative	Negative	Negative	
Age	Positive	Positive	Positive	Spearman's Rank-Order Correlation
Residential Area	Positive	Positive	Positive	
Household Monthly Income	Ambiguous	Ambiguous	Ambiguous	
Gender	Positive	Positive	Positive	Mann-Whitney U
Occupation	Ambiguous	Ambiguous	Ambiguous	Kruskal-Wallis H
Car Ownership	Positive	Positive	Positive	

**Table 3. Initial hypotheses and test statistics used for investigating the relationships between psycho-attitudinal variables and bus trip frequency/sociodemographic characteristics.**

The last column of Table 3 shows the test statistics that were used in each case. These were determined by the type of variables that were investigated. We used either Goodman and Kruskal's gamma statistical test or Spearman's rank correlation test for ordinal variables. The Goodman and Kruskal's gamma statistical test was selected for bus trip frequency variables because we had many tied ranks in our dataset. It is evident that both emotions and trip frequencies were rated against a 3-point scale, and in certain periods of the pandemic, very high percentages of responses were concentrated in specific options (see Table 2).

We employed the Kruskal-Wallis test for nominal variables, but we performed the Mann-Whitney U test for the gender variable since this method is more suitable for nominal variables with only two categories. In all these test statistics, the null hypothesis ( $H_0$ ) proposed no relationship between trip frequency/sociodemographic variables and psycho-attitudinal variables. The alternative hypothesis ( $H_1$ ) is that there is a statistically significant relationship between them.  $H_0$  hypothesis was rejected for p-values lower than 0.05. All calculations were carried out in an SPSS environment (IBM, 2017).

### 3. RESULTS AND DISCUSSION

#### 3.1 Fear sensation

Table 4 presents the correlation coefficients between fear emotion levels and bus public transport use in Sicily for the three examined periods. In contrast to our initial hypotheses, fear is not correlated to bus public transport travel before COVID-19 and during the post-lock down phase. However, in Phase II, our

hypotheses are partially confirmed since Table 4 shows that the frequency of HBW trips by regional and local buses is negatively associated with fear levels at a statistically significant level. Moreover, there is a positive correlation between frequency of regional bus use for HBO purposes and fear emotion in Phase II, which is also statistically significant. The latter is possibly explained by the fact that some workers prefer public transport due to its reduced travel cost to reach their workplace. So, it is not convenient for them to use a private vehicle. Some workers were also unable to benefit from teleworking, so public transport was still the most suitable for their travel needs. Regarding the rest of the variables in Table 4, age, residential area, and income do not generally play a statistically important role in determining fear levels during the three phases of the pandemic. The only exception appears for income and fear before the COVID-19 pandemic, but this finding should be treated with caution since almost all respondents agreed that they felt no fear before the disease's outbreak.

The Kruskal-Wallis H tests showed that there was a statistically significant difference in fear emotions between the different car ownership statuses in the post-lockdown phase ( $\chi^2(2) = 7.074, p = 0.029$ ), with a mean rank fear score of 346.15 for the car owners and drivers, 391.17 for those who could access a car without being drivers and 397.00 for the respondents without driving license. Similar statistically significant results also appear in the period before COVID-19, but they do not apply for Phase II. This finding is in line with our initial hypotheses (for the first two periods) and shows that those with access to a car experienced comparatively less fear when traveling by bus. Finally, no significant relationships were identified between fear and gender or occupation.

Trip Frequency and Sociodemographic Variables	Fear Emotion Levels		
	Before COVID-19	Post-Lockdown	Phase II
Goodman and Kruskal's gamma correlation coefficients			
Local Bus Trip Frequency (HBW)	0.032 (0.801)	0.077 (0.372)	-0.167 (0.036*)
Local Bus Trip Frequency (HBO)	0.006 (0.939)	0.007 (0.938)	0.094 (0.413)
Regional Bus Trip Frequency (HBW)	0.076 (0.564)	0.098 (0.248)	-0.164 (0.040*)
Regional Bus Trip Frequency (HBO)	0.105 (0.215)	0.023 (0.787)	0.250 (0.038*)
Spearman's rank order correlation coefficients			
Age	-0.039 (0.307)	0.004 (0.909)	0.007 (0.843)
Residential Area	0.033 (0.384)	0.059 (0.121)	0.021 (0.581)
Household Monthly Income	-0.142 (<0.0001**)	-0.023 (0.539)	0.028 (0.466)

\*Significance at 5%, \*\*Significance at 1%

**Table 4. Correlation coefficients and p-values (in parentheses) for the fear emotion variables**

Trip Frequency and Sociodemographic Variables	Stress Emotion Levels		
	Before COVID-19	Post-Lockdown	Phase II
Goodman and Kruskal's gamma correlation coefficients			
Local Bus Trip Frequency (HBW)	-0.119 (0.527)	0.175 (0.152)	0.058 (0.584)
Local Bus Trip Frequency (HBO)	-0.037 (0.763)	-0.039 (0.763)	-0.295 (0.045*)
Regional Bus Trip Frequency (HBW)	-0.155 (0.418)	0.198 (0.109)	0.096 (0.364)
Regional Bus Trip Frequency (HBO)	0.070 (0.583)	-0.074 (0.571)	0.112 (0.487)
Spearman's rank order correlation coefficients			
Age	-0.041 (0.284)	-0.048 (0.209)	-0.006 (0.871)
Residential Area	0.008 (0.838)	0.106 (0.005**)	-0.130 (0.001**)
Household Monthly Income	-0.015 (0.693)	-0.018 (0.627)	0.091 (0.016*)

\*Significance at 5%; \*\*Significance at 1%

**Table 5: Correlation coefficients and p-values (in parentheses) for the stress emotion variables**

### 3.2 Stress sensation

Table 5 indicates a negative correlation, of moderate strength, between the frequency of local bus use for HBO purposes and stress emotion in Phase II, which is statistically significant ( $G = -0.295$ ,  $p = 0.045 < 0.050$ ). Against our initial assumptions, no other statistically significant relationships were found between bus public transport use and stress. However, the intensity of stress emotions was related to the income and size of the residential area. During the post-lockdown phase, Table 5 shows that stress was comparatively higher among residents of larger cities, while in Phase II, the opposite happens, i.e., stress levels were relatively increased among the citizens of smaller cities. In terms of income, the results highlight a positive correlation between monthly household income and stress emotions in Phase II, which is statistically significant ( $r_s = 0.091$ ,  $p = 0.016 < 0.050$ ). According to our results, age, gender, occupation, and car ownership were not explanatory factors of stress levels.

### 3.3 Anxiety sensation

In a similar manner to the stress emotions, anxiety does not seem to have played an essential role in public transport decisions during the three phases of the COVID-19 pandemic in Sicily. The only exception applies to the regional bus trip frequency for HBO purposes. In a similar manner to fear, Table 6 shows that the number of HBO trips by regional bus during the post-lockdown period is positively associated with anxiety levels at a statistically significant level. Additionally, in Phase II, a statistically important negative relationship exists between anxiety levels and the size of the residential area. It reveals that the anxiety emotions in smaller cities were comparatively higher.

Regarding the other sociodemographic variables, statistically significant correlations were found only for occupation and gender during the phase before COVID-19. More specifically, the Kruskal-Wallis H test results indicated significantly higher levels of anxiety before COVID-19 ( $\chi^2(2) = 9.371$ ,  $p = 0.009$ ) among freelancers (mean score of 370.56) when compared to employees (mean score of 354.56) and other occupations (mean score of 329.46). For the same period, in line with our hypothesis, the Mann-Whitney U test highlighted statistically significant ( $p=0.001$ ) higher anxiety emotions for female respondents (mean rank= 363.74) against their male counterparts (mean rank=333.45).

## 4. CONCLUSION

The health emergency, which emerged from the pandemic, has placed local administrations and public transport service companies in need of redesigning the future of travel with

new paradigms and new strategies. From the point of view of the land transport offer, the buses, trams, trains, and metro services have been characterized by a 50% capacity reduction of onboard users. The travel restriction has also led to a reduction in the number of journeys and left some areas relatively inaccessible. Social distancing and constant sanitation measures characterized the presence on board and in the terminal areas. The current situation confronts us with a new choice of public transport services design based on specific mobility needs, which have changed considerably in recent years. There is, therefore, a need to update public services to take account of the complexity and articulation of phenomena in urban, suburban, and extra-urban areas with the emergence of new regions of weak demand. These are no longer the peripheral areas but those with a reduced transport supply due to the pandemic.

Empirical findings showed that users' emotional perceptions led them to restrict certain travel choices. Feelings of anxiety, fear, and stress were correlated to the different periods by considering variables characterizing the users' sociodemographic aspects and parameters linked to the frequency of use of urban or regional public transport. The sample of users had implemented smart working and selected public transport to get to work, eliminating private vehicles. The empirical results obtained from the first step of the survey carried out through the present research show weak or moderate correlations between people's emotions (fear, stress, anxiety) and the frequency of use of public transport. This means that even if these negative emotions were intense during the pandemic phases, people continued to use public transport either because they remained captive users or because they had certain incentives to do so or because specific conditions in Sicily created a more favourable environment for PT use during the pandemic. Our results also showed that the intensity of fear, stress and anxiety may also be associated with specific socio-demographic characteristics, but overall, all these correlation coefficients were particularly low and cannot demonstrate a robust trend. An enlargement of the sample, and specifically the sufficient incorporation of older age group categories, along with a comparison with samples from other Italian regions might further confirm these findings.

From the point of view of transport supply, it is useful for the regions to provide incentives for forms of mobility such as Demand Responsive Transport (DRT) services. In particular it is necessary to define forms of public transport complementary to the traditional ones and based on the logic of flexibility in the choice of routes, in the sequence of stops, in timing (timetables and frequencies), and the dimension of transport demand. Today more than ever, DRT services, which are flexible in terms of territory and time, are the answer to the

Trip Frequency and Sociodemographic Variables	Anxiety Emotion Levels		
	Before COVID-19	Post-Lockdown	Phase II
Goodman and Kruskal's gamma correlation coefficients			
Local Bus Trip Frequency (HBW)	0.011 (0.960)	0.009 (0.883)	-0.037 (0.597)
Local Bus Trip Frequency (HBO)	0.224 (0.102)	0.093 (0.121)	0.124 (0.231)
Regional Bus Trip Frequency (HBW)	-0.024 (0.912)	0.045 (0.459)	0.011 (0.878)
Regional Bus Trip Frequency (HBO)	0.249 (0.081)	0.155 (0.009*)	0.034 (0.748)
Spearman's rank order correlation coefficients			
Age	-0.034 (0.375)	-0.021 (0.572)	-0.008 (0.833)
Residential Area	-0.037 (0.324)	0.072 (0.056)	-0.074 (0.050*)
Household Monthly Income	0.043 (0.257)	0.008 (0.831)	-0.026 (0.496)

\*Significance at 5%

**Table 6: Correlation coefficients and p-values (in parentheses) for the anxiety emotion variables**



needs expressed in full respect of social distancing. Besides, implementing participatory planning with feedback from the population can improve the transport supply and highlight travel discomfort in psychosocial terms. Furthermore, real-time platforms for selecting services and monitoring travel mode choices can exemplify travel. This study, therefore, emphasizes the following critical recommendations to promote public transport use. Firstly, there is a need to investigate changes in travel habits during pandemic periods related to public transport. Secondly, the policymakers should realize the importance of the psychological and emotional aspects of travel and further investigate these characteristics in their local settings. Thirdly, there is an urgent need to consider sustainable and resilient mobility initiatives to reduce private transport use. Fourth, the usefulness of MaaS platforms should be recognized by local administrations and agencies for better analysis, planning, and improvement of public transport services in cities. Finally, the users' direct involvement in the data acquisition can be useful for devising targeted strategies. Moreover, it can help optimize public transport systems during emergencies and their recovery after periods of restricted mobility.

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