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## Impact of Teleworking on Travel Behaviour During the COVID-19 Era: The Case Of Sicily, Italy

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### Abstract

As a result of the travel restrictions and governmental guidelines imposed on many countries during the COVID-19 crisis, a significant increase in teleworking has been observed. New policies led to major changes in the lifestyle of millions of citizens all around the world and will permanently affect their travel behaviour. This paper aims to investigate and analyse the impact of teleworking on transportation habits, focusing on walking and commuting before and during the pandemic. Data regarding the walking frequency fluctuations due to teleworking were collected through structured questionnaires in Sicily, Italy. Most respondents seem to believe that it can be a factor leading to a decrease in their walking trips and to a change in their associated walking habits and behaviour. In this study, the rebound effects of telecommuting with respect to vehicle usage are taken into consideration. Although, it can result in a smaller number of trips weekly, the net amount of distance travelled per person can be larger, as employees are more willing to commute farther considering they will not commute as often. However, for longer distances, people tend to use trains since it allows working while commuting. This can result in reduced traffic, especially at peak times and consequently have a positive social and environmental impact, less stress and less air and noise pollution from private vehicles. An increasing number of companies is announcing the decision of pivoting to teleworking even after the pandemic is over. Policy makers and urban planners can use telecommuting as a tool that contributes to relieving traffic and seek ways to introduce a more sustainable future of work and mobility in the post-pandemic world.

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### 1. Introduction

The World Health Organisation (WHO) in March 2020 characterised the new coronavirus as a pandemic and advised governments worldwide to take urgent and aggressive action (WHO, 2020). European governments implemented social distancing and other mobility restrictions as key mitigation strategies. In that context, shops,

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restaurants and educational establishments adjourned their operation. In addition, in an attempt to avoid mass gatherings in closed spaces, large companies were urged to continue their activities remotely. All these measures were implemented in most countries to reduce possible travel while allowing society to keep functioning.

Companies that were previously familiar with teleworking, as well as organisations without experience, started enacting stay-at-home strategies, contributing in one of the most extensive telework experiments in history. Several companies implemented teleworking for limited periods (e.g. one or two days a week), while others required workers to work from home full-time. It is found that the number of people implementing teleworking on a part-time or full-time basis has gradually increased over the years (Eurostat, 2018).

Teleworking has been widespread since the 1970s during the oil crisis. As the cost of fuel rose rapidly, so did the cost and hassle of the daily commute to and from work (ILO, 2016). Recently, the mobility restrictions, aiming to minimise the COVID-19 spread, have influenced the increase of information and communication technology (ICT), causing a variety of changes in activity-travel behaviour. These changes are mainly related to teleworking (Kawashima et al., 2021), teleshopping (Loo and Wang 2018), and ride-hailing (Loa et al., 2021).

Considering this, it can be assumed that traffic congestion as well as the environmental impact of mobility would decrease significantly as a consequence of reduced travel activities. However, several studies show that the benefits from teleworking could be outweighed by the unintended impacts, such as increased private travel or non-work-related energy consumption (Hook et al., 2020). The latter are commonly referred to as 'rebound effects' (Berkout and Hertin 2014, Horner et al., 2016).

Teleworking can be a deciding factor in the choice of places of residence and work as well as generate a certain leniency towards longer distance between home and workplace. In some cases, telecommuting could lead to increased work and/or non-work travel. In the case of work-travel, teleworkers might choose to live further away from their workplace and effectively increase the net amount of distance travelled, wholly or partly out-weighing the travel savings made on non-teleworking days (Ravalet, E. & Rérat, P., 2019). Recent data show an increase in the use of private vehicles (Moslem et al., 2020), as people tend to avoid public transport during pandemics out of fear of infection and/or public transport operations might be suspended as a mitigation strategy (Abdullah et al., 2020; Campisi et al., 2021). Although there is a fall in the use of public transport, the majority of longer trips to work are carried out by train (SFSO, 2018), considering it allows the individual to use the travel time alternatively (e.g., for work) instead of having to concentrate on driving when using a private vehicle.

Additionally, telework can generate secondary trips that would not occur had the worker been commuting to work daily. Those trips may be related to leisure, socialising, childcare (Ravalet, E., & Rérat, P., 2019). Therefore, it seems that due to spending more time at home in combination with not commuting, the worker has the propensity of using the additional free time available for other trips.

All things considered, teleworking has led to changes in mobility patterns with possible shifts in peak hours. While there is a substantial interest in policy circles regarding the impacts of teleworking in travel behaviour there is a lack of studies using longitudinal data (de Vos et al., 2019). On this basis, this paper presents a preliminary study carried out in Sicily, in the South of Italy, one of the most affected areas by COVID-19 based on the number of infections. Through the administration of an on-line survey and the evaluation of socio-demographic parameters and longitudinal data, it was possible to gain an initial overview of the impacts of teleworking in the monitored area.

With more and more major companies announcing that teleworking will be extended as a business strategy even after the pandemic period, it is clear that remote working will be our new reality (Wang et al., 2020). Therefore, teleworking will continue shaping the demand for transport even further, generating an imbalance with the services provided. The present work aims to investigate changes in travel patterns in three different timeframes: before, during and after the lockdown.

## 2. Methodology

The acquisition of different types of data defining the demand for transport is often related to the diffusion of online surveys that allow a rapid random acquisition. The processing of variables allows a correlation between them and provides support for action planning by both local authorities and transport service operators (Campisi et al., 2020, Politis et al., 2010).

## 2.1 Case Study

The study was performed in October–November 2020 through an on-line questionnaire with participants located in Sicily, Italy. The sample was acquired through the use of email addresses and social media (Facebook and WhatsApp). The design of the questionnaire consists of three sections of data related to socio-demographic variables, travel habits and the assessment of certain factors conducive to walking. The evaluation of the sample of randomly selected users was carried out in order to assess the frequency of displacement as well as the different perceptions connected to the displacements in the three timeframes. In particular, the propensity for walking, during three pandemic phases - before, during and after the lockdown - was investigated. In addition, with the use of descriptive statistics, the study examines whether walking is perceived as a stress reliever as well as to what extent the spread of teleworking can influence the frequency of walking. A series of non-parametric tests were performed (e.g., Spearman rank correlation) in order to measure the degree of association between two variables. Finally, the variation of traffic congestion in the monitored areas was evaluated by comparing available online data, highlighting the reduction of mobility in the different phases. This study includes observations regarding travel behaviour before, during and after the imposed lockdown.

## 3. Results

### 3.1 Data analysis through the use of descriptive statistics

This study involves a questionnaire designed to acquire socio-demographic data and information from citizens of nine (9) different cities in the area of Sicily. In addition, it includes questions regarding the walking frequency in different time periods and citizens' opinion on teleworking. The main purpose of the questionnaire is to examine the walking patterns throughout the phases of the pandemic considering the appearance and extensive spread of teleworking in 2020. Section 1 of the survey focuses on the evaluation of socio-demographic data i.e., gender, age group. The total sample of the survey is 700 respondents, whereof 306 are men and 394 are women (Table 1). The majority of the respondents belong in the age groups 26–40 and 41–55 as shown in Table 2. Only 5.4% of the sample is between 18–25.

Table 1. Distribution of respondents based on gender.

Gender	Frequency	Relative frequency	Cumulative Relative Frequency
Male	306	43,7%	43,7%
Female	394	56,3%	100,0%

Table 2. Distribution of respondents based on age group.

Age	Frequency	Relative frequency	Cumulative Relative Frequency
18-25	38	5,4%	5,4%
26-40	242	34,6%	40,0%
41-55	276	39,4%	79,4%
56-70	121	17,3%	96,7%
>70	23	3,3%	100,0%
Total	700	100%	

Additionally, the nine cities of Italy, where the research took place, are categorized based on the number of their inhabitants. Cities with populations smaller than 60.000 are characterized as small towns, cities with populations between 60.000 and 300.000 as medium cities and cities with populations larger than 300.000 are considered metropolitan cities. Almost half of the respondents live in a medium-sized city as shown in Table 3.

Table 3. Distribution of respondents based on groups of cities.

Groups of cities	Frequency	Relative frequency	Cumulative Relative Frequency
metropolitan	157	22,4%	22,4%
medium	330	47,1%	69,6%
small	213	30,4%	100,0%
Total	700	100%	

Section 2 of the questionnaire examines the frequency of walking in three (3) time periods. The time periods are: “Before lockdown” (until March 2020), “During lockdown” (May to September 2020) and “After lockdown”, which extends from October to November 2020. As shown in Figure 1 (left), the green histogram shows that before the pandemic more than 30% walked from home to work several times a week, but during the lockdown this frequency increased to more than 40%, and in the post-pandemic phase the frequency was lower. The absence of frequency beyond three times a day during the lockdown period is also noticeable (blue histogram). This could be associated with the appearance of teleworking as well as possible feelings of stress while walking that occur due to the virus and encourage people to use their private car as a means of transport. Additionally, most stores and restaurants remained closed even after the lockdown and therefore, many employees lost their jobs that were previously on hold throughout the lockdown phases.

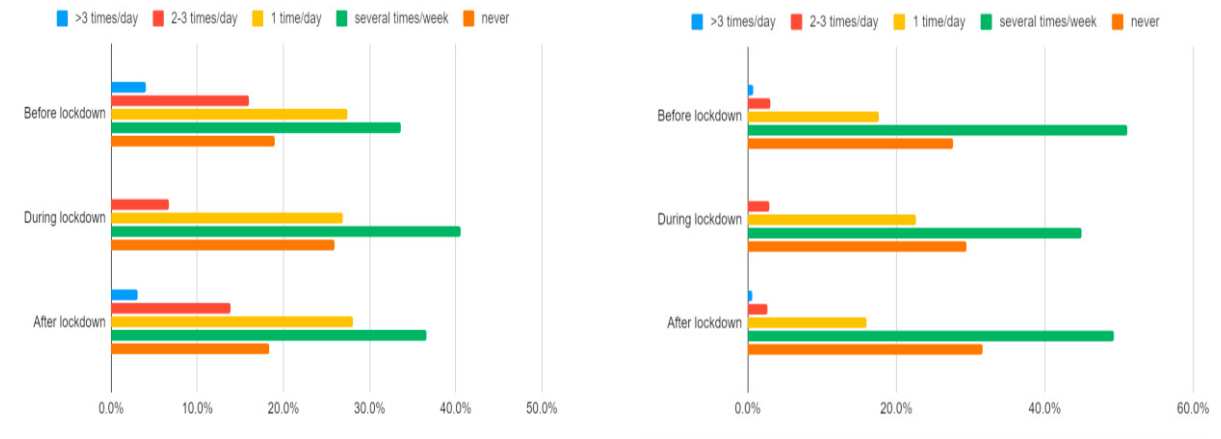


Fig. 1. Frequency of walking from home to workplace (left) and frequency of walking for leisure (right)

Figure 1 (right) indicates that there was a constant increase of people never walking for recreational purposes that stretches even after the lockdown. Before the lockdown, 21.3% of the sample used to walk for leisure at least once per day. This percentage increased during the lockdown, which could be associated with the fact that people were no longer going to work regularly and felt the need to walk and socialise. On the other hand, after the lockdown only 19.1% of the sample continued walking at least once per day.

The last section of the questionnaire gathers key information regarding teleworking, walking and feelings associated with the respondent’s psychology. It uses a Likert scale from 1 to 5, with 1 being “strongly disagree” and 5 “strongly agree”. Citizens were asked if they think walking is an anti-stress method. Table 4 shows that the vast majority (89.6%) of the sample considers walking as a stress reliever. People have generally felt an increased sense of stress due to the pandemic and related issues. Travel restrictions have also contributed to this increase in stress. Especially for adults, walking proved to be not only helpful in getting to their destination but one of the methods to be able to reduce stress (Kawamoto et al.,2017). At the same time, Table 5 shows that almost 50% of the sample believes that teleworking can have a negative impact on the frequency of walking. This shows that citizens feel that teleworking could play an important role in their travel behaviour and more specifically, lower their walking frequency, which can have a negative effect on their mental health. Table 5 shows that only 6% of the respondents believe that smart working will not have a negative impact on their walking habits.

Table 4. Walking as an anti-stress method.

Walking is an anti-stress method	Frequency	Relative frequency	Cumulative Relative Frequency
Strongly disagree	1	0,1%	0,1%
Disagree	15	2,1%	2,3%
Neither agree nor disagree	57	8,1%	10,4%
Agree	241	34,4%	44,9%
Strongly agree	386	55,1%	100%
Total	700	100%	

Table 5. Teleworking leads to less walking.

Less walking due to teleworking	Frequency	Relative frequency	Cumulative Relative Frequency
Strongly disagree	42	6,0%	6,0%
Disagree	158	22,6%	28,6%
Neither agree nor disagree	179	25,6%	54,1%
Agree	202	28,9%	83,0%
Strongly agree	119	17,0%	100%
Total	700	100%	

### 3.2 Statistical analysis through the use of SPSS

This study aims to investigate if major parameters of the research are correlated. More specifically, the SPSS software was used in order to find any possible correlations between the respondents' opinion concerning the impact of teleworking in the walking frequency and the frequency of walking from home to the workplace during the Phase II. For this purpose, a «Spearman» correlation was run ( $N=700$ ,  $p<0,05$ ). Based on the results of the analysis, the two parameters seem to be totally non-correlated.

This shows that there is no relationship between the differentiation of the answers in these two specific questions.

### 3.3 Statistics related to congestion level and traffic in the area of Sicily

It is interesting to examine the difference in congestion levels during the year 2019 and 2020 in Italy, before and after the massive implementation of teleworking. During the first time period, as shown in Figure 2 “Before lockdown”, in January 2020 the congestion level was increased in 11 cities, did not change in 2 and decreased in 12. During March, April and May 2020, congestion levels decreased in all Italian cities. During the lockdown, which lasted until mid-September, in August there was an increase in congestion in 9 cities and a decrease in 16. During the rest of the months, a decrease was observed in 24 cities, while only in 1 city there was a slight increase. The pattern follows after the lockdown and until the end of the year.

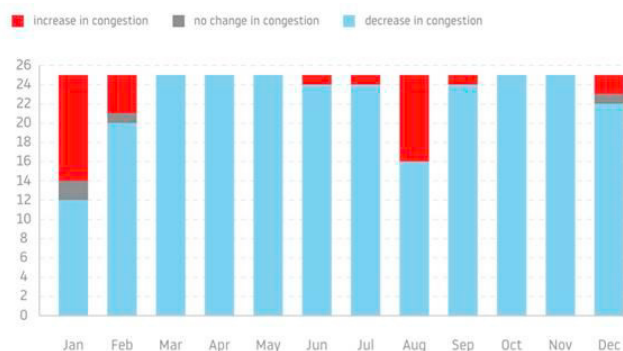


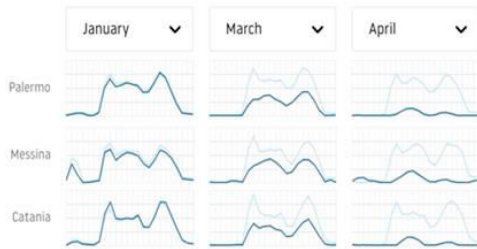
Fig. 2. Changes in congestion level month by month (source: source: [https://www.tomtom.com/en\\_gb/traffic-index/italy-country-traffic/](https://www.tomtom.com/en_gb/traffic-index/italy-country-traffic/))

Furthermore, it is relevant to examine how the peak hours have changed in 2020 compared to the same month in 2019. Real-time data collected through navigation devices, in-dash systems and smartphones through the TomTom platform show that in three (3) different cities in Sicily, the peak hours in January remained approximately the same during the day ([https://www.tomtom.com/en\\_gb/traffic-index/](https://www.tomtom.com/en_gb/traffic-index/)).

When the lockdown was first imposed in March, there was a significant decrease in the level of congestion during peak hours. The following month, the decrease is even more evident in Palermo, Catania and Messina. There is an overall decrease in the level of congestion during peak hours throughout the year compared to 2019 that remains even after the government eased travel restrictions as shown in Figure 3.

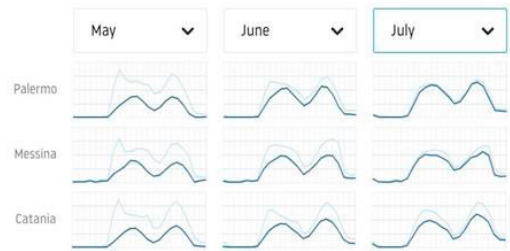
**WORKING DAYS TRAVEL PATTERNS**

Pick a month and compare how the peak hours have changed in 2020 in different cities in comparison to the same month in 2019.



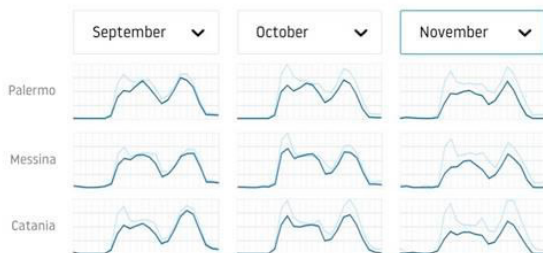
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Pick a month and compare how the peak hours have changed in 2020 in different cities in comparison to the same month in 2019.



**How to read these charts?**

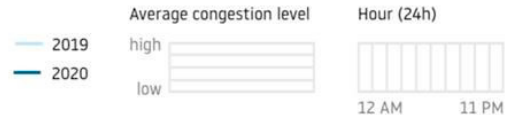


Fig. 3. Working days travel patterns (source: [https://www.tomtom.com/en\\_gb/traffic-index/italy-country-traffic/](https://www.tomtom.com/en_gb/traffic-index/italy-country-traffic/))

It is important to note that throughout the year, congestion during peak hours has always remained lower than in 2019 illustrated in Figure 4. In particular, during March, morning congestion is 55% lower and afternoon congestion 48% lower. For a 30-minute trip, 55% higher congestion means  $0.55 \times 30$  minutes = 16.5 minutes of extra average travel time  $30$  minutes +  $16.5$  minutes = 46.5 minutes of total average travel time.

The highest decrease is found in April, where congestion in the morning was 78% lower and 88% lower in the evening. The decrease persists even after the measures have been relaxed.

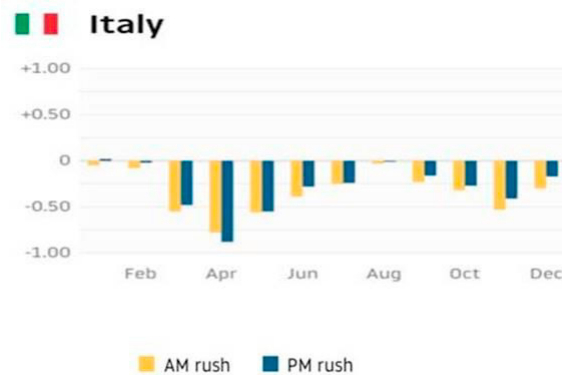


Fig. 4. Cities average congestion levels during morning and evening rush hours in Italy 2019-2020 (source: [https://www.tomtom.com/en\\_gb/traffic-index/](https://www.tomtom.com/en_gb/traffic-index/))

During the working days the peak hours have shifted and generally decreased. However, during the weekends in multiple European countries there is a significant increase in congestion. This means that people who no longer commute due to teleworking or choose to stay at home most of the time, tend to travel for leisure during the weekends more than ever before. This creates significant differences in mobility patterns that need to be thoroughly investigated and taken into consideration from urban developers and policy makers in the future.

#### 4. Conclusion and Discussion

The COVID-19 pandemic has radically changed the way we live, work and move. Remote working and movement restrictions have transformed mobility patterns and reduced traffic congestion in most cities around the world. Realising and quantifying the impact of teleworking on citizens' travel behaviour and consequently on traffic can be useful to policy makers and urban planners when reassessing and redesigning cities in a post-pandemic era. With in-depth studies and accurate predictions of changes in travel patterns we can co-create a future suited to our changing needs. This research examined how the walking patterns of the sample changed throughout the timeframes of the pandemic as well as if teleworking can be a possible causation for less walking. At the same time, travel data through literature and data provided by platforms such as TomTom were gathered and analysed.

It was found that the data acquired through the survey show a propensity towards less walking, especially for leisure, even after the lockdown was lifted. This can be related both to the spread of teleworking and the fear of contagion, which led to a reduction in travel. The results also showed that walking is considered a stress-reliever. The percentage that “strongly believes” walking can help with feelings of stress might not be representative. During lockdowns, people could feel trapped, become less resilient to distress and exaggerate reality. Furthermore, the sample did not perceive the introduction of teleworking as a factor that can lead to reduced walking trips in a homogeneous way. It is true that teleworking can lead to less walking trips related to home-work travel since walking to the office on a daily basis is replaced with telecommuting for most working days. On the other hand, it can contribute to increasing the walking frequency for leisure purposes.

The data on traffic congestion during the three time periods show that people who no longer commute due to teleworking or choose to stay at home, have the propensity to travel for leisure during the weekends more than they would if they were still commuting. This creates significant differences in mobility patterns that need to be studied and taken into consideration when restructuring the city. Given the results presented in this paper, it is clear that observing changes exclusively in daily travel behaviour is not sufficient. Travel patterns need to be studied with a systemic approach consisting of both daily and residential movements along with longitudinal data. This approach is necessary considering the potential rebound effects of teleworking that are not taken into consideration in all studies, possibly skewing data and observations. Future research steps will focus on a more in-depth evaluation of the different types of work related to the sample to be examined, as well as the inclusion of new economic and social factors.

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