Article

What Causes Changes in Passenger Behavior in South-East Europe during the COVID-19 Pandemic?

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Abstract: The appearance of the COVID-19 virus in Europe, at the beginning of 2020, brought many challenges and changes to society. These changes affected the behavior, desires, and needs of passengers in vehicles. The change in passenger behavior has contributed to the more difficult organization of passenger transport and traffic management. For these reasons, in the countries of South-East Europe (Serbia, Montenegro, Slovenia, Bosnia and Herzegovina, Greece, the Republic of Northern Macedonia and Croatia), this survey was conducted in order to examine which demographic characteristics of respondents (age, gender, residence, education, and health) influence choice of transport, with the aim to optimize the transport system in times of crisis in this region. 786 respondents participated in the research. The results showed that the acceptability of vehicle occupancy most often differs with respect to age, education, and health conditions of the respondents. The obtained results will greatly help the organizers of public transport and the transport system in the region, since based on these results they can have an insight into the demographic factors that influence the choice of transport mode during a crisis.

Keywords: COVID-19; vehicle occupancy; traffic; demographic characteristics; human behavior

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1. Introduction

At the beginning of December 2019, a new coronavirus disease (COVID-19) appeared in the city of Wuhan, which then quickly spread to China and almost all countries of the world [1–7]. Some studies have shown that the number of infections and deaths continues to increase, which has posed major public health and governance concerns. The COVID-19 epidemic is considered the worst respiratory virus in recent history, as it has affected more than 186 countries and caused serious problems in almost every enterprise in both developed and developing countries [8]. Evidence to date suggests that the virus also affects human behavior, but these changes vary by country and region.

1.1. Transport and COVID-19

Public transportation, which for many people is the primary and sometimes the only way to travel [9], has undergone major changes during the pandemic in South-East Europe. The COVID-19 pandemic has had a major impact on the public passenger transport system [10], as it was identified as a high-risk environment for the spread of the virus [11–14]. Compared to private vehicles and other modes of transport [15–17], public transport was the most strongly affected [5,6,17,18], since conducting social distancing and providing the necessary materials for safe travel required a great deal of material and organizational resources [18].

Public transport is sensitive to the disturbances caused by COVID-19, due to the nature of mobility [19]. During the COVID-19 period, cities suffered a reduction in the occupancy of public transport vehicles due to population lockdown measures.

In Serbia, in the city of Belgrade, public transport occupancy before the COVID-19 pandemic was 90%, while during the pandemic it was 50% [20]. In Sweden, the city of Stockholm suffered a drop in vehicle occupancy of about 60% [15], while Washington suffered a drop of about 75% [19]. Different declines in vehicle occupancy between countries and cities indicate different degrees of dependence of local communities on public transport [19].

The outbreak of COVID-19 led to a change in transport usage. Passengers who once used public transport have reoriented themselves towards alternative modes of transport (cycling, electric scooters, etc.) Passenger cars, bicycles and walking have experienced an increase in use during COVID-19. Research shows that this increase was due to the fact that the respondents believe that public transport vehicles and taxis are places with an increased risk of transmission of COVID-19 [16,21,22].

1.2. Demographic Characteristics and COVID-19

In addition to the socioeconomic changes brought about by COVID-19 in different regions, various demographic factors have been observed that affect changes in human behavior during the epidemic, but also affect the spread of the COVID-19 virus. For example, in New York, an analysis of long-term positive records suggested that occupancy of public vehicles played a more important role in transmission of the disease than other factors, such as income, race, gender, and household size. In Sweden, a positive relationship has been observed between sociodemographic factors (i.e., gender, income, level of education, marital status, immigration status) and the death toll, and the spread of COVID-19 [4]. The rate of transmission depends on the mobility of people in urban areas [2], and transmission is more common in urban than in rural areas [4].

1.3. Gender Differences and COVID-19

Statistics from China, Spain and Italy regarding the COVID-19 pandemic have shown that the percentage of men who die from the disease is significantly higher than that of women. For instance, a study from China found that the mortality rate of men with the virus was approximately 65% higher than that of women [8]. However, in the research conducted by Rana et al., women perceived the risks associated with the COVID-19 pandemic as more dangerous than males did, therefore females were more active in prevention and response to the pandemic [8].

Several data are available on this topic, including a comparison between severity and mortality between male and female patients with COVID-19 [1], morbidity and mortality of COVID-19 comparing men and women [23], and potential risk from virus exposure and biological susceptibility to infection depending on social and economic conditions [24]. Data from multiple studies suggest that men are considerably more likely than women to suffer a serious case of COVID-19, and to die from it, and old men were more susceptible to having several types of COVID-19.

Publicly available data showed that, among the 53 countries that report gender-specific cases and deaths, men account for about 51% of COVID-19 cases, but more than 58% of deaths [25]. This data involves countries where the highest number of infected cases had been observed, including Italy, USA, China, and Korea, which indicate a gender difference in fatality rates. The question is why, and whether, female biology, genetics, or behavior might contain clues as to how to treat COVID-19.

In a study published by the Consortium Center for Women's Health and Gender Biology, USA, the extent to which gender differences in COVID-19 outcomes is associated with differences in male and female hormone profiles is explored. Difference in hormone profiles contribute to different immune reactions in men and women [1]. In some studies, the authors linked this to the habits of patients, where it was shown that men were more

likely to be smokers, which contributed to rapid infection. These differences are also sometimes proposed as explanations for the relative resistance to the disease by children, as children do not smoke, and their immune system is markedly different from the adult immune system. Beyond being a pandemic infectious disease, COVID-19 also acts as a potent stressor, with millions of individuals experiencing fear and social isolation over a prolonged period. It was shown that women are more susceptible to being influenced by these factors.

Researchers across disciplines broadly agree that both social and biological factors are likely to play a dominant role in infection by COVID-19, in both genders [26].

1.4. Age and COVID-19

COVID-19 shows an increased number of cases and a greater risk of severe disease with increasing age. This age gradient in cases, which was observed in the earliest stages of the pandemic, could be the result of children having reduced susceptibility to infection, children being less likely to show infection, or a combination of both, compared to adults [27].

With age, the human immune system become weaker, so the risk of serious viral and bacterial diseases increases [7]. These excessive non-COVID-19 deaths are most evident in the 25–44 age group for women and 15–54 years for men [28]. Advanced age and pre-existing chronic diseases may affect the clinical presentation of COVID-19. Symptoms at the beginning of the disease tend to show differently depending on age. New diagnostic algorithms that take into account age and chronic conditions can facilitate the diagnosis of Covid-19 and optimize the allocation of health resources [28,29].

Based on the literature so far, there has been no evidence presented that takes into account the comprehensive demographic factors that may influence the choice of transportation in this region. For these reasons, in seven Central European countries, this study was conducted aiming to examine which demographic characteristics of respondents (age, gender, residence, education and health) influence the choice of transport mode. Besides, the goal of the study was to predict which of the aforementioned factors has a higher impact on maximum vehicle occupancy acceptance by users during COVID-19 in different countries.

2. Materials and Methods

The research was conducted using an online survey. The survey was shared to different social groups, through different networks using various social media. The survey consisted of three parts. The first part was intended to examine the demographic characteristics of respondents (country of residence, urban/rural environment, gender, age, and education). All the above variables are of the category type. The second part was related to the health of respondents.

The survey contained classic self-rated health status items with a 5-point Likert scale. The interviewers paid special attention to this issue, and based on detailed guidelines provided, the respondents could assess their health condition as accurately as possible. The third part consisted of questions regarding the occupancy of vehicles (passenger vehicles), defined as a road motor vehicle, other than a motor-cycle, intended for the carriage of passengers for private purposes, and designed to seat no more than five persons, including the driver. The other type of vehicle was the bus—define as a large motor vehicle designed to drive passengers, most often for commercial purposes. This set of questions was given to respondents to assess at which amount of occupancy of a transport mode would they cancel a trip, or safely travel, taking into account the spread of COVID-19. A separate survey was created for each country, using the official language of each. The survey was anonymous, and respondents did not receive compensation for participating.

Collecting and Processing the Data

Statistical analysis was carried out in the statistical software package IBM SPSS Statistics v.22. Normality was tested by inspection of histograms and the Kolmogorov-Smirnov

test. Since the data for all measured variables were not normally distributed, nonparametric methods were used. To assess the significance of differences, the Kruskal Wallis Test and Mann-Whitney Test were used [30]. The Kruskal Wallis Test is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable [30]. The Mann-Whitney Test is used to compare differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed [30]. Multiple Regression Analysis was used to predict the impact on acceptable vehicle occupancy. The null hypothesis (H_0) was that there would be no statistically significant differences between groups, with the alternative hypothesis (H_a) that there would be statistically significant differences between groups (with respect to gender, age, health and education). We set the threshold for statistical significance (α) at 5%.

3. Results

3.1. Descriptive Statistics

The study included 476 respondents (41% female and 59% male). Most were between the ages of 19 and 30, the most active group of traffic participants according to the number of trips per day. According to place of residence, 76.8% of respondents were from rural areas, while 23.2% were from urban areas. Considering education, 10.6% of respondents had completed elementary school, 14.4% high school, 34.2% a bachelor's degree, 32.5% a master's degree, while 8.4% had a doctoral degree. 15.4% of respondents were from Serbia, 11.2% from Montenegro, 18.1% from Slovenia, 13.4% from Bosnia and Herzegovina, 15.8% from Greece, 12.4% from Republic of North Macedonia, and 13.6% from Croatia.

3.2. Impact of Gender, Age, Health and Education Factors on the Choice of Transport Mode during COVID-19 (Case of Passenger Vehicles)

Gender differences was examined across South-East Europe, and then ranked by country. The results of the Mann-Whitney test showed statistically significant gender differences, for vehicle occupancy, regarding the point at which respondents would give up traveling in a passenger vehicle, only for Slovenia ($\chi^2 = 1435.5$, $p < 0.001$). In Slovenia, male respondents accept a higher occupancy rate for passenger vehicles, whereas the risk of transmitting the virus was higher there (Figure 1).

Figure 1. Average acceptable occupancy of passenger vehicles—gender differences (expressed as the number of passengers per vehicle).

Another demographic factor that was analyzed was the age of passengers in different countries, and the influence of respondents' age on the acceptable levels of occupancy of a passenger vehicle in the COVID-19 pandemic. There are statistically significant differences for Serbia ($\chi^2 = 22.215$, $p < 0.001$), Montenegro ($\chi^2 = 12.925$, $p = 0.005$), Slovenia ($\chi^2 = 9.72$, $p = 0.021$), Bosnia and Herzegovina ($\chi^2 = 6.924$, $p = 0.031$) and Croatia ($\chi^2 = 13.146$, $p = 0.004$). There is the same trend for all the above mentioned countries: the older the respondents, the less occupancy in passenger vehicles they accept. The results of the Kruskal-Wallis Test show that participants' education has a statistically significant effect on acceptable occupancy in different countries. Statistically significant differences exist in the following countries: Montenegro ($\chi^2 = 20.634$, $p < 0.001$), Slovenia ($\chi^2 = 11.014$, $p = 0.026$), Bosnia and Herzegovina ($\chi^2 = 20.908$, $p < 0.001$), Greece ($\chi^2 = 20.192$, $p < 0.001$), Republic of North Macedonia ($\chi^2 = 11.211$, $p = 0.024$), and Croatia ($\chi^2 = 35.998$, $p < 0.001$). Similarity was observed in all surveyed countries; namely, if respondents had a higher level of education, they would choose less busy passenger vehicles. When analyzing human health, based on self-assessment, and the relationship between health and acceptable occupancy of passenger vehicles, statistically significant differences were obtained for Bosnia and Herzegovina ($\chi^2 = 12.641$, $p = 0.005$), the Republic of North Macedonia ($\chi^2 = 18.177$, $p < 0.001$), and Croatia ($\chi^2 = 13.674$, $p = 0.002$). Respondents who rated their health as excellent were more willing to travel in a passenger vehicle with more people.

3.3. Which Factors Affect the Acceptability of Passenger Car Occupancy during COVID-19?

Multiple regression analysis was conducted to predict which factor most influences the choice of a passenger vehicle, considering age, gender, residence, education and health. The results for each of the countries are shown in Table 1. From these results it can be concluded that acceptable occupancy of a passenger vehicle is influenced by education (Serbia, Montenegro, Bosnia and Herzegovina and Croatia), age (Serbia, Bosnia and Herzegovina and Croatia), health (Bosnia and Herzegovina and the Republic of Northern Macedonia) and in one case gender (Slovenia).

Table 1. Multiple Regression Analysis results—passenger vehicle case.

Country	Statistical Results	Variables that Statistically Significantly Predict Acceptable Occupancy of Passenger Vehicles
Serbia	$F = 3.282, p = 0.008, R^2 = 0.28$	Age Education
Montenegro	$F = 4.778, p = 0.002, R^2 = 0.23$	Education
Slovenia	$F = 5.169, p < 0.001, R^2 = 0.163$	Gender
Bosna and Hercegovina	$F = 6.993, p < 0.001, R^2 = 0.273$	Age Education Health
Greece	/	/
Republic of North Macedonia	$F = 2.728, p = 0.024, R^2 = 0.133$	Health
Croatia	$F = 11.356, p < 0.001, R^2 = 0.374$	Age Education

3.4. Influence of Gender, Age, Health and Education Factors on the Choice of Transport Mode during COVID-19 in the Case of Public Buses

The results of the Mann-Whitney Test show statistically significant gender differences for vehicle occupancy regarding the point at which respondents would give up, or safely travel by, bus, for Serbia ($\chi^2 = 1029, p = 0.011$), Slovenia ($\chi^2 = 1801, p = 0.009$), and the Republic of North Macedonia ($\chi^2 = 793, p = 0.012$). In Serbia and Macedonia, male respondents would accept a higher amount of bus occupancy, while in Slovenia females accept a higher occupancy on public buses (Figure 2).

Figure 2. Average acceptable occupancy of bus—gender differences (expressed as a percentage of vehicle occupancy).

The results of the Kruskal-Wallis Test show statistically significant differences regarding acceptable occupancy levels on buses for respondents of different ages; in the period of

the COVID-19 pandemic, this was true only for Serbia ($\chi^2 = 10,007$, $p = 0.019$). Younger respondents accept higher bus occupancy.

When analyzing the impact of education on acceptable bus occupancy, statistically significant differences are obtained for Serbia ($\chi^2 = 18.304$, $p < 0.001$), Montenegro ($\chi^2 = 24.013$, $p < 0.001$), Bosnia and Herzegovina ($\chi^2 = 36.327$, $p < 0.001$), Republic of North Macedonia ($\chi^2 = 13.826$, $p = 0.008$), and Croatia ($\chi^2 = 11.678$, $p = 0.024$). In all these countries, people with higher education accept less bus occupancy.

Considering the self-assessment of the health condition of the respondents and acceptable bus occupancy, the results of the Kruskal-Wallis Test show statistically significant differences for Montenegro ($\chi^2 = 8.723$, $p = 0.013$), Bosnia and Herzegovina ($\chi^2 = 15.733$, $p = 0.002$), and the Republic of North Macedonia ($\chi^2 = 25.942$, $p < 0.001$). Respondents who rated their health as good were less afraid to travel on a bus with higher occupancy levels during the COVID-19 period.

3.5. Which Factors Affect the Acceptable Occupancy of Public Buses during the COVID-19 Pandemic?

Multiple Regression Analysis was conducted to predict which factors affect acceptable bus occupancy, considering gender, age, education, and both urban and rural residence, as well as health rate. From these results it can be concluded that acceptable bus occupancy is influenced by education (Montenegro, Bosnia and Herzegovina and Croatia), age (Serbia and Montenegro), health (Slovenia and the Republic of Northern Macedonia), gender (Slovenia) and residence (Greece) (Table 2).

Table 2. Multiple Regression Analysis results—buses.

Country	Statistical Results	Variables that Statistically Significantly Predict Acceptable Occupancy of Bus
Serbia	$F = 3.078$, $p = 0.012$, $R^2 = 0.21$	Age
Montenegro	$F = 9.094$, $p < 0.001$, $R^2 = 0.362$	Age Education
Slovenia	$F = 4.216$, $p = 0.002$, $R^2 = 0.137$	Gender Health
Bosna and Hercegovina	$F = 5.058$, $p < 0.001$, $R^2 = 0.214$	Education
Greece	$F = 2.503$, $p = 0.034$, $R^2 = 0.099$	Residence
Republic of North Macedonia	$F = 7.091$, $p < 0.001$, $R^2 = 0.285$	Health
Croatia	$F = 2.317$, $p = 0.049$, $R^2 = 0.106$	Education

3.6. Acceptability of Vehicle Occupancy

Figure 3 shows the acceptability of vehicle occupancy on public transport during the COVID-19 virus pandemic. For public buses, the highest occupancy is accepted by respondents from Serbia, (75% of passengers will cancel trip, or will not use public transport if occupancy is 50%) while the lowest occupancy is accepted by respondents from Croatia (98% of passengers will cancel trip, or will not use public transport if occupancy is 50%), and Bosnia and Herzegovina (almost all passengers would cancel trip, or will not use public transport, if occupancy is 50% or more).

Figure 3. Percentage of travel cancellations, depending on public bus occupancy, by country (A) Serbia, (B) Montenegro, (C) Slovenia, (D) Bosnia and Herzegovina, (E) Greece, (F) Republic of North Macedonia, and (G) Croatia.

4. Discussion

Although many studies point out that men are more prone to infection with the COVID-19 virus and have more serious consequences [23,24], statistically gender differences in acceptable occupancy vehicle rate exist only in Serbia (bus), Slovenia (passenger vehicle and bus) and the Republic of Northern Macedonia (bus). In Serbia and Macedonia

(bus), as well as in Slovenia (passenger vehicle), men accept a higher acceptable occupancy rate, while in Slovenia (bus) respondents accept higher vehicle occupancy.

As in other areas of life, age also affects passenger behavior. Age and education have the highest impact on acceptable vehicle occupancy. Younger respondents and respondents with a lower level of education accept higher vehicle occupancy than older respondents and respondents with a higher level of education. This is to be expected because most of the younger respondents had a lower level of education. The results are also consistent with the literature, as most studies show that younger people have milder symptoms, or even no symptoms of COVID-19 [7,29].

Another important factor influencing the acceptability of vehicle occupancy is self-assessment of health. Health status or condition seems to influence the most acceptable levels of vehicle occupancy in the countries of Bosnia and Herzegovina (passenger vehicle), the Republic of Northern Macedonia (passenger vehicle and bus) and Slovenia (bus). As expected, passengers who rate their health as weaker are at greater risk of infections, and only accept vehicles with fewer occupants.

As in many studies [5,6,17,18], the choice of transport mode and acceptable levels of vehicle occupancy are also influenced by the country of origin. Although the respondents who participated in this research belong to countries that are geographically close to each other, in each country different demographic factors affect this aspect differently. Although a significantly smaller number of passengers can be transported in a passenger vehicle than in a public transport bus, some examined demographic factors have shown that they have the same impact on acceptable occupancy levels of both types of tested vehicle. The most influential factors were education in the case of Montenegro, Bosnia and Herzegovina and Croatia, while age was the most important demographic factor influencing acceptable vehicle occupancy in Serbia, health in the Republic of Northern Macedonia, and gender in Slovenia. These results confirm that respondents with certain demographic characteristics (factors) have a clearly formed attitude and behavior regarding the acceptable occupancy level of these vehicle categories during COVID-19.

Common to all countries, regardless of which demographic factors affect acceptable occupancy levels on public transport, is that a large number of potential passengers would not use public transport if the occupancy of vehicles was over 40%. If vehicle occupancy exceeded 70%, almost all respondents would not use public transport.

5. Conclusions

From the results of this study, it can be concluded that age, education, health, residence and gender have the highest impact on predicting acceptable vehicle occupancy levels during COVID-19 in South-East Europe. The study showed that these factors differ depending on the type of transport (passenger vehicle and bus). On the other hand, these factors affect the acceptable occupancy of transport modes in different countries. These differences probably stem from differences in the development of public transport, economic strength, the behavior, needs and habits of passengers, and the measures taken to prevent COVID-19 transmission. The results of the study will significantly help the organizers of public transport and the transport system in the region, who, based on the obtained results, will gain an insight into the factors that influence the choice of transport mode. Based on the presented results, public transport organizers can predict the number of passengers in relation to a predetermined occupancy of the vehicle, to find the optimal occupancy level for passengers who are willing to use public transport during COVID-19.

Although many countries have different strategic measures in place during the fight against COVID-19, they all have one thing in common, i.e., a change in the behavior of the population in all areas, even in the field of transport. The results of this study show differences in the demographic characteristics of the respondents that affect the acceptable occupancy levels for vehicles. The differences vary from country to country, and this article systematizes the results for the analyzed countries and provides a basis for improvement during the COVID-19 pandemic.

Future research should be conducted based on the results of this study to anticipate further aspects, optimize transportation systems in the region, and prevent the spread of COVID-19. It is necessary, even after the COVID-19 pandemic, to conduct similar research and examine the behavior and needs of passengers, since the habits acquired during the COVID-19 period will remain in society beyond that.

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