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# Research on the Impact of COVID-19 on Micromobility Using Statistical Methods

**Vladimíra Štefancová [1], Alica Kalašová [2,*], Kristián Čulík [2], Jaroslav Mazanec [3], Martin Vojtek [4] and Jaroslav Mašek [1]**

[1] Department of Railway Transport, University of Žilina, Univerzitná 1, 01026 Žilina, Slovakia
[2] Department of Road and Urban Transport, University of Žilina, Univerzitná 1, 01026 Žilina, Slovakia
[3] Department of Quantitative Methods and Economic Informatics, University of Žilina, Univerzitná 1, 01026 Žilina, Slovakia
[4] Department of Transport Technology and Control, University of Pardubice, Studentská 95, 53210 Pardubice, Czech Republic
* Correspondence: alica.kalasova@fpedas.uniza.sk; Tel.: +421-41-513-3425

**Abstract:** The situation of the COVID-19 pandemic has had enormous social and economic impacts and has significantly affected the modal split. Many cities worldwide have adopted various blocking policies that affect how people travel. Micromobility systems, such as scooters and bicycle sharing, were among the transport systems affected by COVID-19. Electric scooters and shared bicycles provide comfortable and fast first-/last-mile connections for short-distance rides. The shared nature of these modes, together with the spread COVID-19, has contributed to the declining use of these services. The quantification of the impact of COVID-19 on shared services was demonstrated by this research through various mathematical methods. Satisfaction with the use of alternative modes of transport during the pandemic was determined based on the evaluation of a questionnaire survey. Independence tests of qualitative features and statistically significant associations that were demonstrated with a correspondence analysis were used for comparison. The main conclusion of the research was to point out the reasons for the preference for alternative modes of transport and to highlight the impacts on health and fears of contracting COVID-19 when using micromobility services.

**Keywords:** micromobility; scooter and bike sharing; COVID-19; correspondence analysis; tests of independence

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## 1. Introduction

The recent emergence of shared micromobility services (bike sharing and scooter sharing) has led to environmentally friendly ways of traveling. Micromobility services can reduce congestion and traffic-related emissions [1–3].

In particular, with the rapid development of smartphones and payment devices, micromobility services have become an effective alternative to traveling by public and private transport over short distances, such as in first- or last-mile journeys. They allow people to travel conveniently. However, urban transport faces several problems, such as its efficiency of use, accessibility, parking, etc. It is important to explore the impact of micromobility on different types of services, such as docked and undocked bicycles, electric bicycles (e-bikes), and electric scooters (e-scooters) [3].

Promoting public transport is closely linked to transport potential [1]. The detection of an urban transport regime requires relevant information on traffic redistribution [2]. Micromobility serves the more sustainable development of urban transport and has a trend of growth. The popularity of the sharing economy is constantly growing around the world. A crucial part of sustainable urban movement is cycling, which ensures active mobility [3]. The main principle is the mutual lending of scooters and bicycles without the need to own one. This mode of transport significantly saves the environment and promotes mobility and public health. In the context of the European Union's Green Plan, each ride in this system contributes to reducing emissions and carbon footprints in the transport sector. In addition, this environmentally friendly means of transport has provided a suitable alternative during COVID-19. Shared mobility is also an alternative mode that is appropriate for first-/last-mile transport. It creates competition for individual transport [4].

In the world, shared scooters and bicycles are used with a station system or as a system that does not require a station [5,6]. A public bicycle system was compared in terms of its usage and temporal characteristics with public bicycles [7]. Each of the alternatives has its advantages and disadvantages when applied to urban mobility. In the case of shared bicycles and scooters with a station, an advantage is that there is a stable place that serves as a good connection to other modes of transport or as a replacement for a cancelled public transport connection. Alternative transport systems without a station are popular, especially for young people, but they are also quite problematic, as they cause spatial pollution [8,9]. Currently, the use of passenger cars in cities is declining, and there is a growing interest in shared mobility, which also serves to overcome the so-called last mile. Public interest in micromobility has increased, as it offers affordable and fast use. During the pandemic, people showed more interest in shared bicycles and scooters as an alternative to conventional means of public transport, thus helping to avoid infection [10]. An overview of the shared mobility provided in the Slovak Republic is shown in Figure 1.

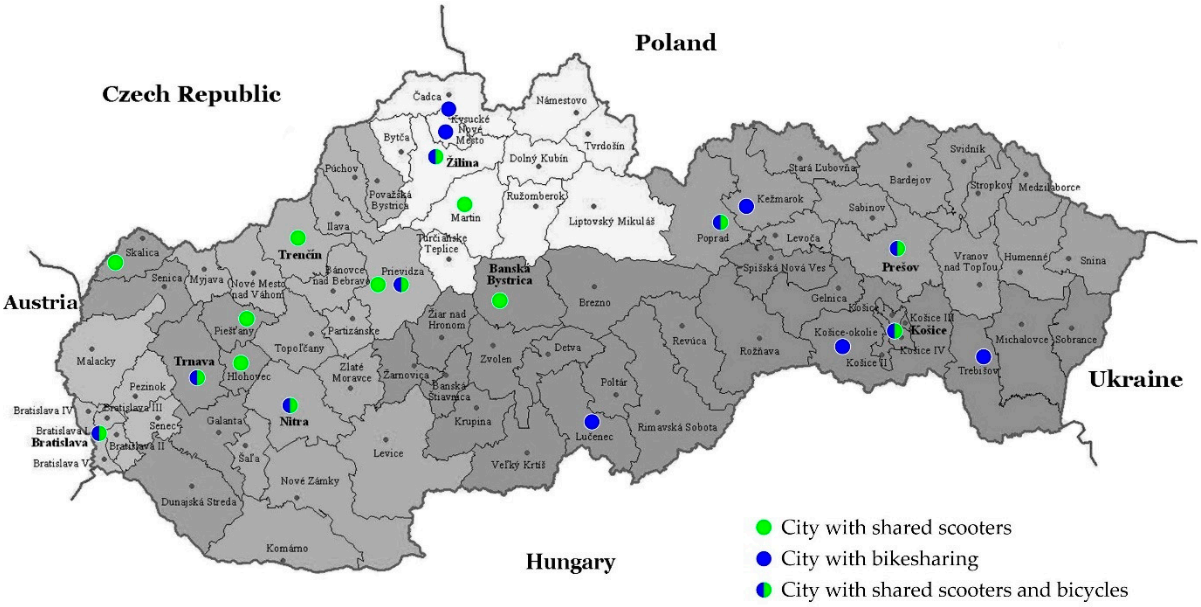


**Figure 1.** List of cities with shared mobility in Slovakia.

Several providers operate shared bicycles or scooters in large cities. They offer a portfolio of their services through an interactive application. The price of a rented vehicle varies. Some providers offer free services.

COVID-19 has had a broad impact on transport and mobility. As a factor in deciding the choice of transport mode, the risk of spreading the virus has greatly influenced travel behavior [11]. It is necessary to understand the variations in the use of micromobility before and during the period of COVID-19. Variations in micromobility behavior before and during the COVID-19 pandemic were examined by conducting a case study in Slovakia.

To solve these issues, we first applied a data processing method. We compared shared services by using independence tests and a correspondence analysis. Based on the study of the development of the COVID-19 pandemic with respect to public transport in various parts of the world, this article provides proposals for measures to increase micromobility in cities in Slovakia.

A guarantee of mobility is a fundamental right of citizens. Restrictions on public transport due to the COVID-19 pandemic provide the opportunity to highlight alternative means of transport [12]. Our micromobility case study aims to understand variations in traffic behavior before and during the COVID-19 pandemic.

## 2. Literature Review

Since the outbreak of COVID-19, several studies have described how human mobility responds to an epidemic. It has been necessary to prevent the spread of the virus since March 2020. The governments of many countries tried to slow down the spread with travel and work restrictions, quarantines, curfews, cancellations and postponements of events, and facility closures [13]. All of these measures were aimed to reduce the contact between infected and non-infected persons [14].

COVID-19 influenced human mobility and changed typical human activities. According to [15,16], mobility data are crucial for urban planning, traffic forecasting, network applications, and epidemic control [17–19]. Therefore, the topic of human mobility during a pandemic is critical. The authors of [20] stated that not only did government restrictions decrease mobility, but economic impoverishment also negatively affected mobility. For example, international tourism has plummeted. The pandemic has also resulted in changes in transport behavior, where measures and restrictions play an important role in reducing preferences for public transport and promoting shared mobility services [21].

There are many options for how mobility during a specific period can be researched. The authors of [22] used privacy-protected mobile device location data, which were integrated with COVID-19 case data and census population data. With this dataset, they made a COVID-19 impact analysis platform that can inform users about the effects of the spread of COVID-19 and government orders on mobility and social distancing.

Another opportunity is questionnaires that are fulfilled face to face, online, or during a telephone interview. For example, the authors of [23] used several unified questionnaires to examine the quality of life after social and mobility restrictions. Reference [24] used a qualitative telephone interview and a quantitative household survey. The results showed that a high share of respondents (62.6%) experienced no changes in their mobility behavior due to the COVID-19 pandemic.

In this article, we focused on micromobility during the pandemic period. Many studies have examined and analyzed patterns of human micromobility by using GPS trajectory data. Most of these studies focused on understanding bike-sharing mobility models in docked and undocked bike-sharing systems. For example, the authors of [25] examined the travel behaviors of two types of bicycle users (short term and long term) by analyzing bicycle routes between docking stations.

In the field of micromobility, the authors of [26] proposed an algorithm that returns a multi-criteria route modeled on COVID-19-modified parameters of micromobility while considering avoidance of COVID-19, as well as the shortest available safe route for user ease and shortened time of exposure to the outside environment.

## 3. Materials and Methods

The data needed to analyze and assess the situation were obtained through querying as a basic method of obtaining relevant information. Due to the situation of the COVID-19 pandemic, we administered a questionnaire online. The aim was to analyze the behaviors of users of alternative means of transport, such as shared bicycles and scooters, in the Slovak Republic during the COVID-19 period.

### *3.1. Independence Test*

The examination of the dependence or independence of two qualitative features was carried out through independence tests. The chi-square test of independence is suitable for comparing two categorical features. The null hypothesis in independence tests indicates that the investigated quantities are independent [27]. The basis for examining the interrelationships of statistical features is the determination of their empirical and theoretical frequency and their mutual comparison by using a contingency table. Rows correspond to groups with one character and columns to groups with the other character. The test criterion is, therefore, based on a comparison of these frequencies from the sample. The detected frequency $n_{ij}$ is mentioned in the upper left corner, and the theoretical frequency $p_{ij}$ is shown in the upper right corner of the table. The resulting value of the test criterion is determined from the entire table according to Formula (1).

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(n_{ij}-p_{ij})^2}{p^{ij}} \tag{1}$$

The test criterion is compared with the chi-square value (according to the general table value). According to the determination of the general table value, the chi-square value is determined according to the degree of freedom (r−1) (c−1). Small values thereof speak in favor of the hypothesis, which means the following: If the value of the test criterion is less than the table value of the chi-square, the null hypothesis is not rejected, and it can be argued that the observed traits are independent [28,29].

### *3.2. Correspondence Analysis*

Correspondence analysis is analogous to the principal component method and factor analysis for qualitative features. This suitable statistical technique works with numerous categories. Its assumptions include homogeneity of variance for row and column variables. The assumption of a normal distribution is not necessary when performing a correspondence analysis, but the validity of this analysis is based on the chi-square test when the association is statistically significant. The analysis assumes that the data are discrete and divided into at least three categories with non-negative values. The relationships between the examined categories can be visually expressed by using a correspondence map. This method can be applied in order to reveal the preferences and attitudes of the traveling public or evaluating the offered services.

The table of absolute frequencies $n_{ij}$ represents the basic input matrix for the determination of absolute frequencies in rows and marginal frequencies in columns in the correspondence matrix. The relative frequency is associated with the row profiles $p_{i/j}$ and the column profiles $p_{j/i}$.

$$p_{j/i} = \frac{n_{ij}}{n_{i+}} = \frac{p_{ij}}{p_{+j}} \tag{2}$$

$$p_{ij} = \frac{n_{ij}}{n_{+j}} = \frac{p_{ij}}{p_{+j}} \tag{3}$$

The mutual location of the points in the dimensional space determines the strength of the dependence. If the points cluster together in the correspondence matrix, there is a strong dependence. The total inertia I is associated with the variability of points according to Formula (4) [30–32].

$$I^2 = \sum_{i} p_{+j} d_j^2 \tag{4}$$

The methodology used in this article follows the following steps. First, the hypotheses needed to be determined based on the available data samples from the scientific questionnaire. The database was unified into categorical variables under the conditions for meeting the minimum frequency. Associations between categorical variables were gradually analyzed based on the correspondence analysis. Finally, the results were interpreted.

## 4. Results

In this article, a questionnaire survey was used to determine the use and preferences of shared mobility facilities during a pandemic situation. The survey was focused on the whole of Slovakia, but the largest portion of answers were mainly from the Žilina region. As can be seen in Table 1, most respondents were men (more than 90% of the total). Students (male) from the Žilina region represented the largest group (less than 30% of the total) in comparison with other groups when broken down by gender, social status, and region. Most respondents came from western Slovakia (almost 50%).

**Table 1.** Distribution of online survey respondents by region.

| Region | Gender | | Total |
|---|---|---|---|
| | Male | Female | |
| Western Slovakia | 431 | 62 | 493 |
| Central Slovakia | 332 | 38 | 370 |
| Eastern Slovakia | 161 | 24 | 185 |
| Total | 924 | 124 | 1048 |

The first step in the analysis of micromobility in Slovakia was a simple evaluation of the questionnaire survey. The respondents evaluated the offered services of shared mobility in the places in which they were operated. Figure 2 shows the shared scooter services and a comparison thereof from different perspectives.

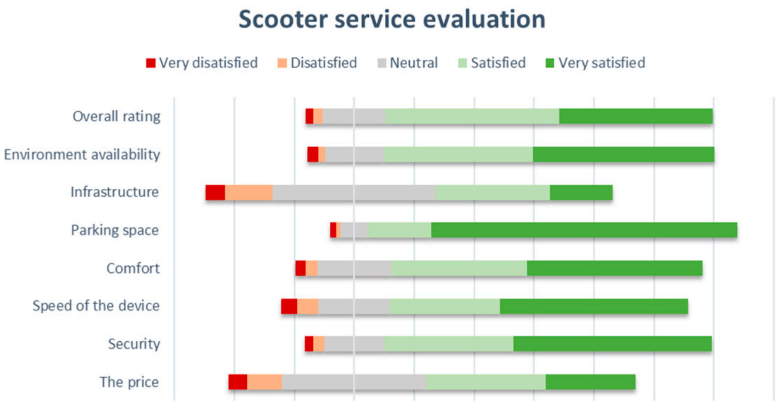


**Figure 2.** Evaluation of scooter services in Slovakia.

An evaluation of a survey on satisfaction with shared bicycle services is presented in in Figure 3.

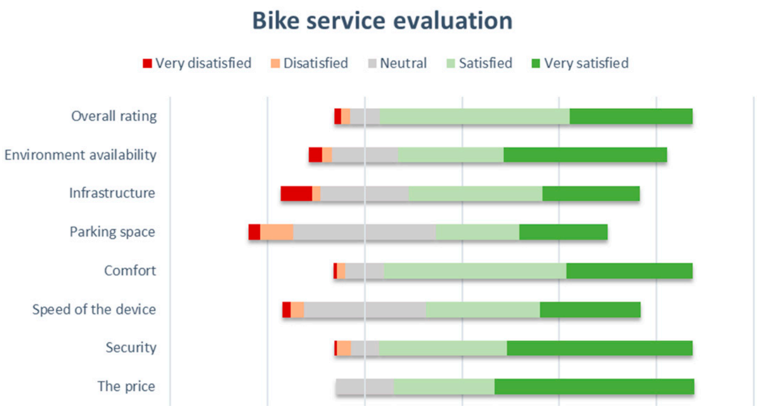


**Figure 3.** Evaluation of bike services in Slovakia.

Globally, the respondents were satisfied with the shared scooter and bicycle services. After comparing the two means of micromobility, it could be stated that they differed in some parts. The main contributions of the questionnaire survey were the determination of satisfaction with the means of shared mobility, the mutual comparison of these means, and the identification of their main advantages. Users of shared bicycles were satisfied with the price of the service provided, while in the case of shared scooters, the situation was the opposite due to the much higher fees for using the service. Common disagreements and dissatisfaction could be seen in the transport infrastructure.

### *4.1. Independence Test for Alternative Modes of Public Transport*

We performed an analysis and compared two alternative modes of transport, namely, shared bicycles and scooters, through independence tests. In the contingency table, the rows represented the two groups according to mode of transport (bicycle or scooter), and the columns were divided according to their use. At the significance level of 0.01, we tested the following dependencies.

The dependence of the frequency of use on the mode of transport is shown in Table 2. We tested whether the frequency of using the application depended on the type of transport (shared scooters and shared bicycles). The respondents were divided according to the use of the application and its frequency. Using the chi-square test of independence, we tested hypothesis $H_0$ (that the application type and frequency are independent) and the alternative $H_1$ (application type and frequency are dependent). The calculation was performed in the form of a contingency table, where the rows corresponded to two applications and the columns to the five groups according to the frequency of use. The value of the test criterion obtained by adding the values from the whole table (T = 14.32) was compared with the table value for the respective chi-square ($\chi^2(4) = 13.28$). Since the table value of the chi-square was smaller than the calculated value of the test criterion, we state that we accept hypothesis $H_1$ (the observed characters were dependent). Therefore, we claim that there is a relationship between the variables in our research sample.

**Table 2.** Dependence of frequency of use on the mode of transport.

| Mode of Transport | Only Once | | Occasionally | | 1–3 Times a Week | | 4–6 Times a Week | | Every Day | | $n_i$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Shared scooters | 99 | 82.93<br>3.11 | 284 | 282.48<br>0.01 | 100 | 114.68<br>1.88 | 171 | 173.64<br>0.04 | 25 | 25.27<br>0.00 | 679 |
| Shared bicycles | 29 | 45.07<br>5.73 | 152 | 153.52<br>0.01 | 77 | 62.32<br>3.46 | 97 | 94.36<br>0.07 | 14 | 13.73<br>0.01 | 369 |
| $n_j$ | 128 | | 436 | | 177 | | 268 | | 39 | | 1048 |

In another case, we determined the dependence of the reason for the journey on the type of transport. We tested hypothesis $H_0$, where the type of application and frequency were independent, in comparison with the alternative $H_1$, in which they were dependent. The value of the test criterion was higher than the table value of the chi-square (T = 182.86; $\chi^2$ (4) = 13.28). It follows that we accept hypothesis $H_1$ and claim that the observed features are dependent. The results are in Table 3.

**Table 3.** Dependence of the reason for the journey on the mode of transport.

| Mode of Transport | Transfer to Employment (Work/School) | | Transfer to the Stop | | Transfer to Personal Needs | | Transfer for Entertainment | | Other | | $n_i$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Shared scooters | 153 | 227.41<br>24.35 | 108 | 123.10<br>1.85 | 252 | 181.41<br>27.47 | 157 | 128.93<br>6.11 | 9 | 18.14<br>4.61 | 679 |
| Shared bicycles | 198 | 123.59<br>44.81 | 82 | 66.90<br>3.41 | 28 | 98.59<br>50.54 | 42 | 70.07<br>11.24 | 19 | 9.86<br>8.48 | 369 |
| $n_j$ | 351 | | 190 | | 280 | | 199 | | 28 | | 1048 |

The following comparison concerned the testing of the null hypothesis and, thus, the independence of the type of application of the mode of transport from the reason for use (entertainment, health, speed of transport, price, and availability). The calculated value of the test criterion was significantly higher than the table value of the chi-square (T = 171.79; $\chi^2$ (4) = 13.28). Again, it can be stated that hypothesis $H_1$ was accepted. The detailed results are in Table 4.

**Table 4.** Dependence of the reason for using the application on the type of transport.

| Mode of Transport | Entertainment | | Health | | Transport Speed | | The Price | | Availability | | $n_i$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Shared scooters | 157 | 130.88<br>5.21 | 69 | 114.03<br>17.78 | 226 | 198.26<br>3.88 | 80 | 128.93<br>18.57 | 147 | 106.90<br>15.04 | 679 |
| Shared bicycles | 45 | 71.12<br>9.60 | 107 | 61.97<br>32.72 | 80 | 107.74<br>7.14 | 119 | 70.07<br>34.17 | 18 | 58.10<br>27.67 | 369 |
| $n_j$ | 202 | | 176 | | 306 | | 199 | | 165 | | 1048 |

The main conclusion resulting from the method of performing independence tests was the comparison of attributes depending on the type of shared mobility. The dependence of the frequency, the reason for the journey, and the reason for using the mode of transport were compared. The dependence of the selected characteristics that were compared on the type of transport (shared scooters and shared bicycles) was demonstrated.

### *4.2. Correspondence Analysis for Alternative Modes of Public Transport*

We also evaluated the obtained data using a correspondence analysis. This was performed by using the SPSS 25 statistical analysis tool. The range of data in the questionnaire was wide, but only a subset of statistically significant associations is shown in the results. In this article, we set out the following three hypotheses.

Table 5 demonstrates that there were statistically significant associations (dependences) between the purposes of use (the reasons of the choice) of shared scooters and the region, as opposed to with shared bicycles. In addition, we found that there was a statistically significant association (dependence) between the purposes of use and the reasons for the choice for both alternative means based on the Pearson chi-square test ($p < 0.001$). Correspondence maps were used show these statistically significant associations.

**Table 5.** Pearson chi-square test.

| No. | Hypothesis | *p*-Value | |
|---|---|---|---|
| | | Bike | Scooter |
| $H_1$ | There is no significant association between the purpose for using the chosen alternative means of transport (shared bicycle or scooter) and the Slovak region. | >0.05 | 0.018 |
| $H_2$ | There is no significant association between the reason for choosing the chosen alternative means of transport (shared bicycle or scooter) and the Slovak region. | >0.05 | 0.000 |
| $H_3$ | There is no significant association between the purpose of using and the reason for the selected alternative transport mode (shared bicycle or scooter). | 0.000 | 0.000 |

Figure 4 shows that residents of Bratislava mainly used shared scooters to commute to school or work. On the other hand, entertainment and moving to bus or rail stations were the main reasons for using a shared scooter in the Nitra, Košice, and Trenčín regions. The residents in Žilina used shared scooters for personal needs, such as visiting the theatre, cinema, library, and others, unlike in other regions.

Figure 5 reveals that the regions differed in terms of the preferred reasons for choosing a shared scooter. As can be seen, speed and health were typical as the preferred reasons in the Žilina and Nitra regions. Relaxation was important as a factor in choosing a shared scooter in several regions, such as the Trnava, Prešov, and Trenčín regions. On the other hand, Košice considered shared scooters as a good choice of an alternative mode of transport to select due to their easy availability in the city. On the other hand, residents in the Slovak capital chose scooters for their price.

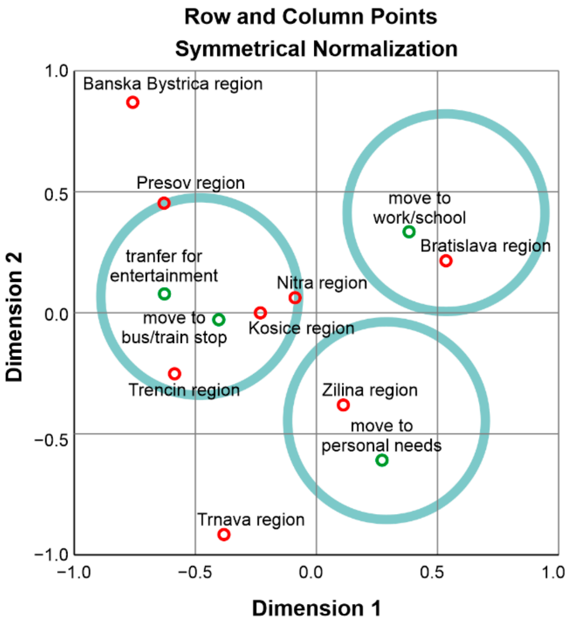


**Figure 4.** Correspondence map I.

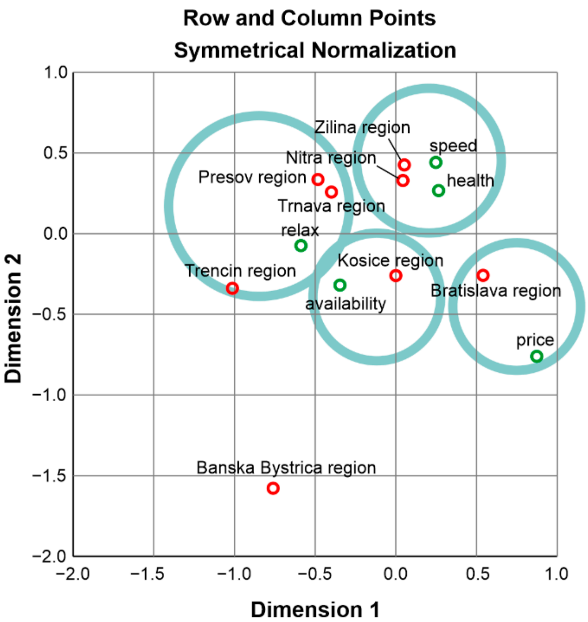


**Figure 5.** Correspondence map II.

Figure 6 shows that speed was typical as a selection factor for users of shared scooters in order to move for personal needs, such as to visit the theatre, cinema, libraries, and others. In other words, users preferred shared scooters for a quick move to the city center. On the other hand, the availability of a shared scooter was important for users going to work or school. We found that health and price were important factors for users who used shared scooters as a secondary means of transport to bus and train stations. Moreover, health was probably an important factor for passengers who avoided personal contact in other means of transport during the current COVID-19 pandemic. The price for using a shared bicycle was comparable to that of public transport. Finally, the results showed that many respondents used shared scooters for fun and relaxation.

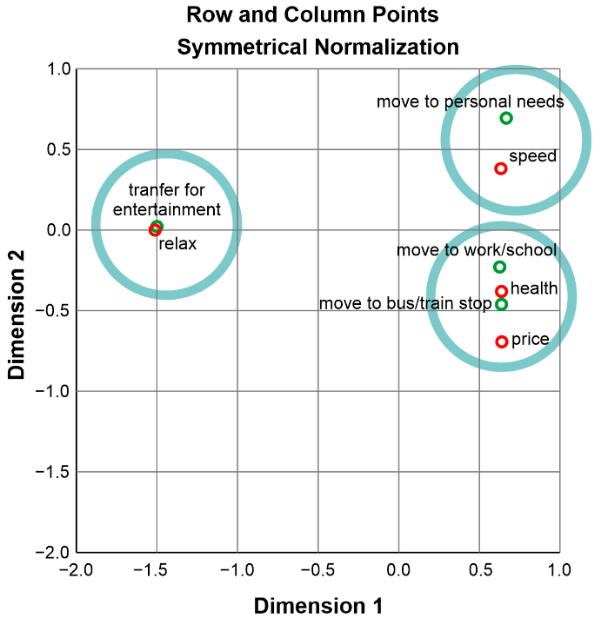


**Figure 6.** Correspondence map III.

Figure 7 shows that students and staff preferred shared bicycles for three reasons: availability, speed, and price. As can be seen, shared bicycles were alternative means of transport that combined several key factors in the choice thereof. These results showed that the shared bicycles were in busy places in the city center. Moreover, shared bicycles were offered free of charge for 15 min. Many students attended a school and staff commuted to work at their own pace and for free. On the other hand, users of shared bicycles used them to move for personal needs, such as visiting theatres, cinemas, libraries, and others, and to move to rail or bus stations for health reasons. The bicycle is a suitable means of transport that helps keep one's body and mind in good shape. Finally, the results showed that many respondents used shared bikes for transportation for entertainment in their leisure time.

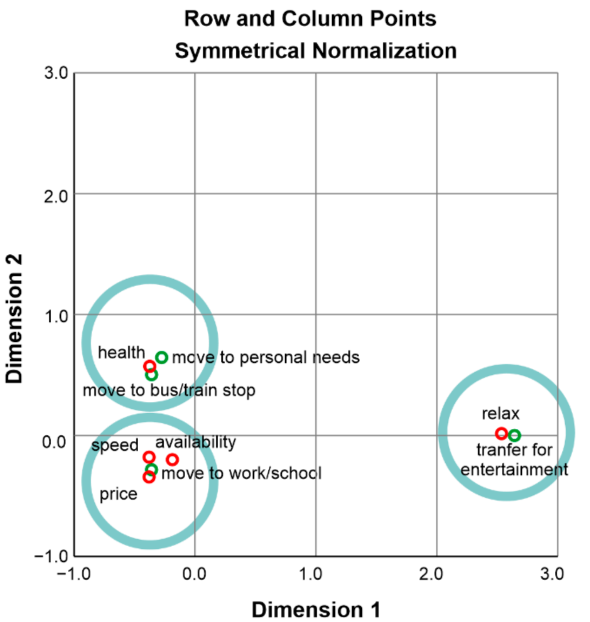


**Figure 7.** Correspondence map IV.

Finally, we summarized the main differences between the selected reasons and the purposes of using alternative modes of transport, such as shared scooters and bicycles. We found that scooters were used as a fast means of transportation to move for personal needs, such as visiting a theatre, cinema, or library, as opposed to shared bicycles, which were probably used for more comfort. The speed of shared bicycles played an important role in commuting to school and work, along with other factors, such as price and affordability. As we can see, health was important for respondents who went to the bus and train stations. We assumed that the respondents lived an active life for every minute of their lives. In addition, alternative transport offers passenger transport without other passengers in order to limit social contacts and the spread of COVID-19.

Based on a questionnaire survey and data provided by real practices, two types of shared mobility were assessed from the point of view of use during a pandemic situation. Tables 6 and 7 compare the reasons for use from the point of view of both means of micromobility.

**Table 6.** The reason for using shared scooters.

| Purpose | Reason for Riding by Shared Scooter | | | | | Total |
|---|---|---|---|---|---|---|
| | Relax | Health | Speed | Price | Availability | |
| Transfer for entertainment | 150 | 2 | 4 | 1 | 1 | 158 |
| Move to bus/train stop | 1 | 12 | 41 | 23 | 32 | 110 |
| Move to personal needs | 0 | 16 | 84 | 17 | 39 | 156 |
| Move to work/school | 6 | 19 | 97 | 39 | 74 | 255 |
| Total | 157 | 69 | 226 | 80 | 147 | 679 |

**Table 7.** The reason for using shared bikes.

| Purpose | Reason for Riding by Shared Scooter | | | | | Total |
|---|---|---|---|---|---|---|
| | Relax | Health | Speed | Price | Availability | |
| Transfer for entertainment | 41 | 0 | 0 | 0 | 1 | 42 |
| Move to bus/train stop | 1 | 33 | 21 | 32 | 3 | 90 |
| Move to personal needs | 1 | 12 | 4 | 9 | 2 | 28 |
| Move to work/school | 2 | 62 | 55 | 78 | 12 | 209 |
| Total | 45 | 107 | 80 | 119 | 18 | 369 |

While the use of a scooter was associated with relaxation, shared bicycles mainly served as transportation to work during the COVID-19 pandemic, as an alternative to public transport.

The evaluation of the data through the correspondence analysis offered the possibility of comparing the statistically significant associations in more detail. Based on the chi-square test and graphic representation, the means of micromobility were evaluated for the Slovak regions. Depending on the analyzed regions, the preferred reasons for using shared mobility slightly differed. The factor of health during the pandemic situation was also taken into account. However, this factor is a globally important criterion that affects the choice of means of transport.

## 5. Discussion

Many studies focused on improving and further promoting the effective integration of micromobility (shared bicycles and scooters) with public transport services [33–35]. The promotion of cycling as a part of micromobility inspires and helps to create a new mobility paradigm [36]. The travel behavior in Germany during the first wave of the COVID-19 pandemic was analyzed. The research confirmed that the public health crisis affected the transport sector and that the use of public transport significantly decreased in favor of bicycles and individual transport [37]. The evaluation of the efficiency of city bicycles within a program for the University of Chile was also analyzed [38]. A comparable survey for the evaluation of shared scooters was also carried out in Portugal, where it was confirmed that shared scooters supported social distancing during the COVID-19 pandemic and replaced short-distance individual transport [39]. In the Czech Republic, various studies on the development of mobility were carried out in terms of, for example, the requirements of rapid mobility [40]. Another article focused on the assessment of regional public transport and an overview of mobility during the COVID-19 pandemic [41]. The characteristics of travel behavior among users of shared scooters and bicycles were also carried out in Poland, where the results showed that the public preferred shared bicycles as a mode of transport in terms of price and safety [42]. In the Gdansk–Gdynia–Sopot metropolitan area, shared bicycles were analyzed, and it was concluded that they were quite likely to be competitive against carsharing and taxis, as well as public transport services [43]. The impact of shared scooters on health and the environment was also analyzed in France [44]. In Italy, a study of shared scooters during the COVID-19 pandemic focused mainly on their legislative integration into public transport [45]. A study demonstrating the impact of COVID-19 on passenger perceptions of a shared bicycle system was also conducted in Greece. Bike sharing has proven to be an increasingly attractive and convenient option for individual transport [46]. The preferences for micromobility from the perspective of gender were also analyzed in Barcelona. According to this study, mainly men used the means of micromobility, while women used public transport and walked more often. Due to the impact of the pandemic, travel behavior has changed overall and has given women the alternative of using cargo bikes [47]. The London bike-sharing system was also affected during the pandemic, and it was pointed out that bicycles were used on longer journeys, partly due to the shift from public transport [48]. Another study addressed the return of public transport to normal after the pandemic situation in the United Kingdom, which highlighted the need for private and societal standards for interacting in order to provide an efficient and effective transport system [49]. Aversion to using public transport due to the outbreak of the COVID-19 pandemic also appeared in France. Electric scooters have come to the fore as an alternative means in Paris [50]. To limit daily movement under the influence of COVID-19, trends in human mobility during the pandemic in the United States were identified, and the spatial and temporal heterogeneity was captured [51]. COVID-19 affected travel demand, and the use of electric bicycles in terms of safety was studied in China [52]. In Japan, the change in travel behavior was assessed at the individual level while considering the increased perceived risk due to COVID-19 [53]. In the case of COVID-19, changes in mobility also appeared in New York City due to social distancing measures, which changed people's travel behavior [54]. In another study, it was possible to record an accurate estimate of human mobility based on mobile location data [55]. Public transport (suburban bus transport) in Slovakia had a declining character due to COVID-19 [56]. However, passengers were forced to switch to another mode of transport. In addition to individual transport, there was increased use of alternative modes of transport. Public bicycles are a useful tool for both recreation and transport. As an appropriate alternative mode of transport, they should continue to be promoted and developed [57].

As the territory of the Slovak Republic is not fully flat, the construction of a bicycle escalator is one of the ways to increase the number of people using shared bicycles, even on more demanding terrain. This innovative device works on the principle of the cooperation of a bicycle with an automated platform (overcoming the height difference). The mentioned field-improvement tool was originally designed in France. This increases the potential of using micromobility [58].

Safe and smart navigation when using micromobility during the COVID-19 pandemic is particularly important. It is possible to objectively identify the shortest safe routes by using a multi-criteria route-planning technique and, thus, prevent the risk of infection [26]. Technological innovations took place during the pandemic and replaced the old techniques of personal interactions between people. Urban micromobility systems represent new ways of traveling, and there is a need to improve interactions in transport planning and organization. To promote alternative modes of transport across the board, it is essential to support the demand for these services—for example, by making dedicated lanes for micromobility facilities and, thus, making better transport infrastructure available to users of shared bicycles and scooters [59,60]. The emergence of transport technology with related applications is closely related to the sharing economy [61]. Because several companies with separate applications currently operate the micromobility services in Slovakia, we propose the creation of a joint, interconnected application. In addition to the unification of micromobility operators, other types of transport (rail, suburban bus, public transport) could also supplement such an application.

## 6. Conclusions

The aim of this article was to point out the impact of COVID-19 on use and satisfaction based on requested data and the evaluation of the obtained data through mathematical and statistical methods. A test of the independence of qualitative features was used to compare alternative modes of transport (bicycles and scooters) in this article. In all cases, hypothesis $H_1$ was accepted, which resulted from the independence of the type of transport application and the frequency of use, the reason for the journey, and the reason for use. The survey also reflected the traffic situation during the COVID-19 pandemic. One of the most numerous answers about the reason for using an alternative mode of public transport was health, especially when using bicycles. This statement is closely related to the COVID-19 pandemic, where passengers resorted to alternative modes of transport instead of urban public transport to protect their health.

One of the proposals for increasing the use of shared mobility is the improvement of the transport infrastructure for micromobility devices. In the case of shared mobility, it is also necessary to pay attention to the daily variations that are related to the demand allocated to parking spaces [62]. The creation of reserved areas and their own designated transport routes for the means of shared mobility will make it possible to increase their competitiveness compared to individual transport.

The use of an alternative mode of transport seems to be the right step toward achieving safe mobility during the pandemic caused by COVID-19. It should be noted that the correct identification and implementation of technological measures lead to the fulfillment of this direction. In this case, one of the options is the promotion and development of a common application for the use of safe modes of transport in shared mobility.

Since this area offers wide possibilities for analyzing the impact of micromobility, especially after the experiences during the pandemic, we would also like to focus on the evaluation of services from the point of view of the operators of the mentioned micromobility services in further research. The focus will be on comparing the perspectives of the users, the intermediaries of shared mobility services, and the consideration of legislative measures from the points of view of city governments.

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