Palacký University Olomouc

Transactions on Transport Sciences
Peer-Reviewed Open Access Journal
Vol. 1/2023 DOI: 10.5507/tots.2022.022
journal homepage: www.tots.upol.cz

Development of public transport perception by its users during the pandemic: qualitative study from Czechia

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ABSTRACT: Since the beginning of the coronavirus pandemic in 2020, the transport sector has faced new challenges connected with decreasing use of public transport and passengers' concerns about possible contagion. Using focus groups and data collection by telephone interviews during the different phases of the pandemic, we investigated passengers' current concerns connected with public transport and what measures would help alleviate their fear of using it again.

Our findings show that the pandemic has amplified passengers' sensitivity to phenomena they perceived negatively already before the pandemic, such as overcrowded vehicles, odours, or inadequate cleaning of vehicles. An appeal to people's own responsibility, appropriate communication by key institutions, increasing sanitation standards and promotion of contactless services are crucial for a safe travel feeling during and after the pandemic. The technological solutions, such as cashless payments, real-time-information for adequate guidance of users, more sophisticated ventilation systems etc. gained even more significance during the COVID-19 pandemic.

In spite of various measures taken in the PT system, users reduced their PT trips substantially. The fear of COVID-19 contagion has been one of the reasons, although the fear of PT use has not been greater than the fear of contagion in other situations, such as shopping. One of the reasons for passengers´ decline was also the PT service reduction in frequency or number of connections. On the other hand, PT operators have been exposed to an enormous pressure to ensure sanitary requirements and had to overcome economic shortages due to a decreased demand and increased costs, so they had to find a viable balance between a necessary supply and safe operation during the COVID-19 waves.

The study brings an overview of measures and changes in PT demand and gives a complex view on the development of attitudes and experience with PT use in the Czech Republic during the different phases of the COVID-19 pandemic. Results bring recommendations to PT providers, transport authorities and other institutions dealing with mobility and public health. Implementation of such measures can minimize the risk of contagion by COVID-19 or other respiratory infections and will help further development of public transport as a sustainable transport mode in the post-pandemic era.

KEYWORDS: COVID-19 pandemic; public transport; attitudes; pandemic countermeasures

1. INTRODUCTION AND MOTIVATION

The new coronavirus was first identified in Wuhan, China in December 2019, and spread into the whole world from there within a few months (MZ ČR, 2020). The World Health Organization declared this extensive spreading of the virus a pandemic (WHO, 2020). Many governments around the world responded by introducing strict countermeasures, intended to slow down the virus spreading. The measures included restriction to movement, social isolation, closing of businesses and cancellation of social events, introduction of distance education, and recommendations to work from home (Goniewicz et al., 2020). The measures significantly affected people's movement and preferences related to performance of their everyday activities.

Logically, transport was one of the most affected sectors, particularly public transport, which had to cope with a decrease in passengers (in the Czech Republic, the amounts of persons transported by public transport (further PT) dropped to 69% of the 2019 figures in 2020, and further to 67% in 2021; see MoT, 2022), along with decreasing revenues and subsequent economic losses (Brůhová Foltýnová, 2023).

Tirachini & Cats (2020) warned already in early June 2020 against the risk people would increasingly view public transport as a potential source of contagion. It would then be difficult for PT to return to its pre-pandemic performance levels. It turns out, however, that interest in using PT was affected by other factors besides the pandemic countermeasures and fear of contagion, such as subjective perception of using public transport and alternatives to it. The change in the transport service supply also played a role. Thus, the share of using PT varied between the different pandemic waves although the same restrictive measures were in force (Brůhová Foltýnová, 2023).

The objective of this paper is to describe, using qualitative methods, perception of PT by its users for everyday travel (to work, for leisure) with a view to the different pandemic phases. The paper studies subjective perception of urban and regional public transport and main factors that affect the decisions whether to use it or not. The research questions include the main barriers to greater use of PT in the study periods during the COVID-19 pandemic, users' perceptions of measures implemented and the communication of respective institutions towards PT users. The main set of data comes from group discussions and telephone interviews with PT users.

In the end, the paper provides an overview and recommendations for transport policy makers and public transport operators towards restoring better public perception of public transport so that transport systems again perform their social role efficiently.

The paper is structured as follows: the next section brings main findings from the literature. Section 3 describes the

development of mobility and pandemic countermeasures in the Czech Republic, and Section 4 sums up the data and methodology of the study. Section 5 presents analysis results, and Section 6 contains a discussion and recommendations for further development of the public transport sector. The last section sums up the results obtained and implications for further research.

2. LITERATURE REVIEW

Due to pandemic countermeasures, mobility decreased practically all around the world in the pandemic period. Numerous researchers have focused on this fact and determined the degree of mobility decrease using data from cellphone and public transport operators or using questionnaire surveys. The studies agree that public transport (PT) has become a less preferred mode of travel than before the pandemic, especially due to fears of contagion by the new type of coronavirus (see e.g. Awad-Núñez et al., 2021; Carrese et al., 2021; Corazza et al. 2021; Corazza & Musso, 2021; Fridrisek & Janos, 2022; Gkiotsalitis & Cats, 2021, Tirachini & Cats, 2020)2020. In addition to a considerable part of trips not taking place at all and work shifting online, there was also a shift from public transport to individual travel modes, i.e., car transport, walking and cycling (Brůhová Foltýnová & Brůha, 2022; Bucsky, 2020; Das et al., 2021; Przybylowski, Stelmak, & Suchanek, 2021). Many cities have also focused on completing or expanding infrastructure for cycling and walking, which boosts the use of non-motorized transport as a safer option during the pandemic (see e.g. Combs et Pardo, 2021; Corazza et al., 2021), with the outlook that the new travel habits may be preserved by at least some of the users.

The important question therefore is what long-term changes caused by this new mobility experience and the need to change travel patterns will bring to travel behaviour after the pandemic-related restrictions are lifted, and how these long-term changes will affect public transport. Research in the first two years of the pandemic in particular suggested that many passengers would continue worrying about coronavirus contagion in PT vehicles even after the pandemic ends (see, e.g. Beck & Hensher, 2020 or Tsavdari et al., 2022).

Another important topic of many studies has been identification of factors with a great deal of influence on using PT during the pandemic and in future. Besides the aforesaid fear of illness, the literature underlines the effect of sociodemographic factors. A foremost one is the average income, which allows higher-income groups a greater flexibility in transport mode choice (Almagro et al., 2020; Almlöf et al., 2021; Finbom et al., 2021; Schaefer et al., 2021; Wielechowski et al., 2020). On an example from New York, Almagro et al. (2020) demonstrate that richer people have a lower tendency to stay in the city centre, so that their contagion risk is lower compared to people with lower incomes. At the same time, people in lower-income groups more frequently shop in retail and work in so-called frontline professions, thus increasing the risk of COVID-19 contagion for this population group. Richer people also have more options to avoid the contagion, e.g., by working from home, shopping online or substituting for PT trips (Almagro et al., 2020; Almlöf et al., 2021; Finbom et al., 2021; Schaefer et al., 2021).

Many researchers have focused on the potential of online activities and the associated impact on volumes of physical trips. It turns out frequently that more people shift to the online environment from PT than from the car, but actual estimates differ. For example, Salon et al. (2021) used stated preference data on behaviour in post-covid times to show that 26% of employees expect to work from home at least several times a week after the pandemic, which is double the share of the same group before the pandemic. Moreover, these increased numbers of distance workers may reduce the car commute mileage by about 15% and PT commute trips by 40%. A similar impact on transport is described by Javadinasr et al. (2022), who say that almost one half of employees expect to use work from home as an alternative, out of which 71% assume to work from home at least twice a week after the pandemic, which may lead to decrease in car travel (-9%) and PT travel (-31%).

Data from Czechia indicate that an increase in teleworking and online shopping and a simultaneous decrease in physical travel to work and for shopping occurred and can also be expected after the pandemic (Brůhová Foltýnová & Brůha, 2022). Kogus et al. (2022) estimate a reduction of about 8.7% in the number of commuting trips in the post-pandemic era. The highest increase is anticipated for hybrid telecommuting (a combination of working from home and in a workplace); working from home for more than 20 hours weekly is expected to increase only by 4 p.p. in the Czech Republic (Kogus et al., 2022).

3. DEVELOPMENT OF MOBILITY AND PANDEMIC COUNTERMEASURES IN CZECHIA

In the Czech Republic, a number of pandemic countermeasures have been implemented at the national level since the onset of the pandemic, i.e., since March 2020 (see Table 1). Public transport travel was affected most importantly by the compulsory wearing of nose and mouth protection in the form of a surgical mask; later on, from 25 February 2021, the obligation to wear a mask was replaced with a stricter measure: mandatory wearing of respirators.

In an effort to prevent coronavirus spreading, public transport companies implemented numerous sanitation measures (see Table 2), notably periodic disinfection of vehicles, stops and ticket machines, periodic ventilation of vehicles and no entry and exit through the front doors (Vrána el al., 2021), increased frequency of services, assurance of physical distance, including in waiting areas and stops, ability to book a place in a service to prevent high concentrations of people at specific places and times (see also for e.g. Dong et al., 2021). Some cities introduced other innovative measures, e.g., automatic door opening, contactless ticket sales, cancelling "on request" stops, driver separation from passenger using acrylic glass, or complete closure of PT system (e.g., in Mladá Boleslav).

The measures implemented during the pandemic had a considerable impact on population mobility. Comparing the mobility of Czechia's population (measured using Community Mobility Report) and degree of stringency of measures to stop COVID-19 spreading (measured using a stringency index; see Hale et al., 2021, for methodology), it is clear that both indicators are strongly correlated and inversely related – increasing numbers of measures implemented (thus higher stringency index) led to decreasing movement of people at public transport stations. The greatest decrease in mobility at public transport stations is evident in the first wave of the pandemic, in the spring of 2020. That might have been caused primarily by people's great worries about possible contagion in that period. Another significant drop in population mobility is evident in early 2021, when the coronavirus spread widely among the population, followed by one of the harshest countermeasures in Czechia – the total lockdown, which greatly restricted population movement outside their district of residence.

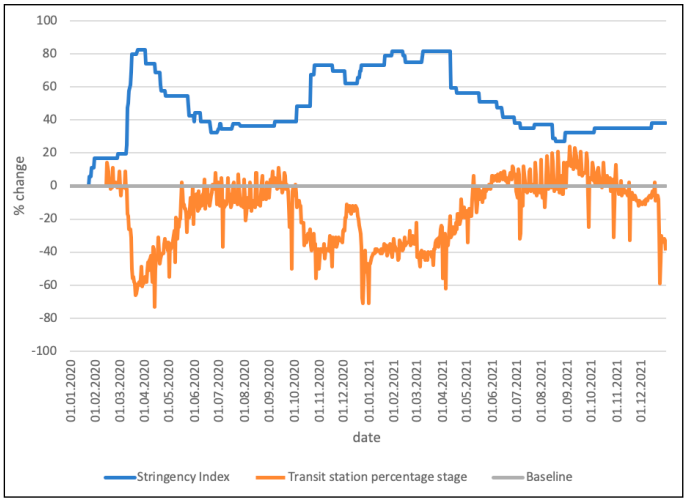
2020	2021	2022
1 March first infected person in Czechia 11 March: all schools closed until further notice (gradual return to schools from 20 November 2020) 12 March: state of emergency declared (last state of emergency during the pandemic ended on 25 December 2021) 14 March: operation of restaurants and shops banned (with exceptions) 16 March: Litovel, Uničov, Červenka and surrounding municipalities locked down for two weeks and national borders sealed (with exceptions) 19 March: mandatory covering of mouths and noses with masks, scarves, etc., outside place of residence 1 September: mandatory wearing of masks in public authority buildings, medical and social care institutions and public transport 10 September: mandatory wearing of masks in all building interiors throughout Czechia 9 October: fitness gyms and centres, indoor and outdoor swimming pools, zoological gardens, etc., locked down; restaurants and pubs open only until 8 pm, each table for max. 4 people 28 October: night time curfew from 9 pm to 5 am (until 3 December 2020); ban on retail sales on Sundays, recommendation to shift to work from home 27 December: only grocery shops, pharmacies and chemists' open; large stores banned from selling goods as in closed shops 27 December: start of vaccination against COVID-19	19 February: mandatory wearing of respirators, nanomasks or double surgical masks in places with higher concentrations of people (lifted completely on 14 April 2022) 26 February: total lockdown – movement limited to district of residence (lifted on 12 April 2021) 1 March: all schools, kindergartens and children's groups locked down, no travel between districts, all retail shops still open are closed, mandatory testing in companies with more than 50 employees 12 April: part of measures lifted – some shops open, first school pupils may return to school, ban on travel between districts and curfew between 9 pm and 5 am lifted 10 May: retail shops may open, junior high pupils may return to school 17 May: outdoor restaurant seating open (on presentation of a negative test or proof of vaccination) 31 May: indoor restaurant seating, wellness, swimming pools, saunas, etc., open (with a negative test, vaccination or proof of having had the disease) 1 June: mandatory wearing of respirators or masks outside lifted, mandatory testing in companies and schools lifted 25 November: state of emergency declared, restaurants and clubs must be closed between 10 pm and 5 am, ban on eating in shopping malls (lifted on 25 December 2021)	10 February: mandatory proving of vaccination or having had the disease in restaurants and services and at public events lifted 14 March: mandatory wearing of respirators in most interiors lifted (remained mandatory on PT, hospitals and social care institutions) 14 April: mandatory respirators in PT and almost all measures still in force lifted

Table 1. Overview of pandemic countermeasures implemented

Pandemic countermeasure	Traffic restriction
• mandatory wearing of masks/respirators vehicle disinfection, hand disinfection at selected places • periodic vehicle ventilation door opening without pressing buttons no entry and exit through first doors no tickets available from the driver • marking of a distance zone for the driver and cab separation (or no entry to driver's cab area) • electronic fare collection system • tape between first row of seats to prevent access • ticket inspection only visual • information on current changes in information centres, mobile applications, internet, media, leaflets and information on digital panels in vehicles and at stops • limited personal contact at operator information centres (business hours reduced or shifted online), station areas, platforms and stops (distance warnings), waiting rooms closed	• selected services cancelled holiday timetables activated (no school services) • limited night time service • longer headways between services • complete PT closure (Mladá Boleslav)

Source: Own processing based on BMHD (2020); DPMO(2020); DPMP (2020b, 2020a); DPO (2020a, 2020b); Liberec (2020b, 2020a); Mladá Boleslav (2020); PID (2021a, 2021b, 2021c); PMDP (2021)

Table 2. Pandemic countermeasures in PT during lockdowns in Czechia



Source: Own processing based on COVID-19 Community Mobility Report (2020) and Our World in Data (2021)

Figure 1. Stringency index and population mobility in Czechia 2020-2021

4. DATA AND METHODOLOGY

This study is based on an analysis of qualitative data from group interviews, which enables us to understand the respondents' behaviour, perceptions and attitudes. The respondents can explain their motivations in their own words and thus provide us with a better picture of their decision-making compared to quantitative approaches (Grosvenor, 2000).

The data were collected by means of focus groups (FGs) and additional collection by telephone interviews. In the groups' interviews, we specifically identified the respondents' views of PT, potential worries about COVID-19 contagion when using PT, as well as proposals for feasible tools to reduce PT passengers' worries.

Both parts of the data collection proceeded in cooperation with a professional market research agency that has an extensive database of potential respondents across the country. The respondents had to meet some criteria, particularly having used public transport for regular trips at least 3 times a week before the pandemic (and during the pandemic, depending on the FG type). Besides, we set quotas for selected socioeconomic characteristics. That retained the age, sex, education and income variability among respondents.

In total, we conducted 6 focus groups, attended by 44 respondents, and one additional data collection by telephone (N=90) (see Figure 2). The FGs took place variously during the pandemic, thus enabling us to cover the development of attitudes and experience regarding PT in time and so reflect the development of opinions and the pandemic situation. Due to the pandemic countermeasures, the first 4 FGs were conducted online, and the last two, in October 2021, physically.

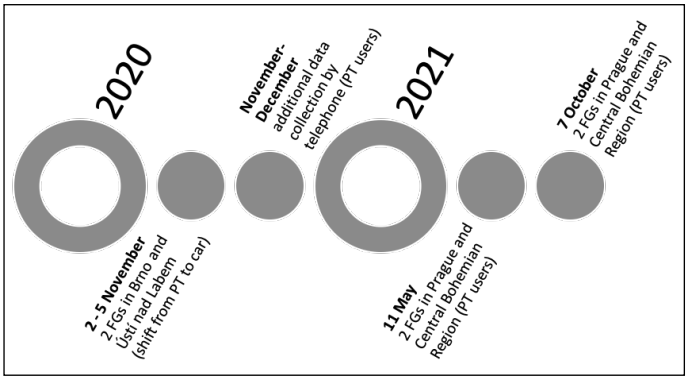


Figure 2. Data collection timetable

Two focus groups took place in 2020, namely in Brno and Ústí nad Labem. These focus groups aimed at people who had used PT regularly before the pandemic broke out (at least 3 times a week) and then avoided the transport mode during the pandemic. The primary objective of these focus groups was to identify the main reasons why the respondents had decided to abandon PT and what measures would lead to their return to PT.

Another 4 FGs were conducted in 2021, two of them focusing on inhabitants of Prague and two on inhabitants of the Central Bohemian Region who commute to Prague. These 2 groups were held in May 2021 and again in October 2021. These focus groups were attended by people who were using PT at least 3 times a week during the pandemic, enabling them to reflect on their experience of PT functioning during the pandemic.

Each FG lasted for 90 minutes. The focus groups were recorded as audio and written. The audio recordings were then transcribed completely. Before each focus group, the respondents were asked to complete summary tables, containing information about the frequency of use of different transport modes in the course of the pandemic. The first two focus groups were attended by 6 people; the number of participants was increased to 8 for all subsequent group. Table 3 summarizes respondent data.

	Males (N=22; 50 %)	Females (N=22; 50 %)	Total (N=44)
Age group			
21-29	6 (27.27 %)	6 (27.27 %)	12 (27.27 %)
30-49	13 (59.09 %)	13 (59.09 %)	26 (59.09 %)
50-69	3 (13.64 %)	3 (13.64 %)	6 (13.64 %)
Education			
No formal education	0 (0 %)	1 (4.55 %)	1 (2.27 %)
Primary	2 (9.09 %)	1 (4.55 %)	3 (6.82 %)
Secondary without exams	6 (27.27 %)	4 (18.18 %)	10 (22.73 %)
Secondary with exams	9 (40.91 %)	6 (27.27 %)	15 (34.09 %)
University	5 (22.73 %)	10 (45.45 %)	15 (34.09 %)
Focus group			
Ústí nad Labem	3 (13.64 %)	3 (13.64 %)	6 (13.64 %)
Prague	8 (36.36 %)	8 (36.36 %)	16 (36.36 %)
Central Bohemian Region	8 (36.36 %)	8 (36.36 %)	16 (36.36 %)
Brno	3 (13.64 %)	3 (13.64 %)	6 (13.64 %)

Table 3. Focus group participants

In addition to the FGs, interviews by telephone were carried out (N=90). The respondents were people who had already participated in a questionnaire survey focused on activities and transport mode choice during the COVID-19 pandemic, which made it possible to connect the information with the respondents' completed questionnaires (see Kogus et al., 2022 and Brůhová Foltýnová & Brůha, 2022 for detail on the questionnaire survey). Table 4 shows the participant breakdown by main sociodemographic characteristics.

The group and individual interviews were transcribed and analyzed. First, the main research themes and respective questions were set. Relevant texts from interviews were then identified, extracted and categorized and arranged in chronological order. The analysis compared different opinions and statements of different individuals in different time points during the pandemic to see their frequency and differences among individuals, conditions (FGs/phone interviews, time) and other circumstances. The research themes include barriers of PT usage, acceptance of measures against the virus

spread, preferred perception of new mobility services during the pandemic or experience with communication and information of passengers by PT operators and relevant public institutions.

	Males (N=38; 42.22 %)	Females (N=52; 57.78 %)	Total (N=90)
Age group			
18-20	0 (0 %)	3 (5.77 %)	3 (3.33 %)
21-29	4 (10.53 %)	7 (13.46 %)	11 (12.22 %)
30-49	25 (65.79 %)	23 (44.23 %)	48 (53.33 %)
50-69	8 (21.05 %)	19 (36.54 %)	27 (30 %)
70-79	1 (2.63 %)	0 (0 %)	1 (1.11 %)
Education			
No formal education	1 (2.63 %)	0 (0 %)	1 (1.11 %)
Primary	1 (2.63 %)	2 (3.85 %)	3 (3.33 %)
Secondary without exams	10 (26.32 %)	9 (17.21 %)	19 (21.11 %)
Secondary with exams	18 (47.37 %)	22 (42.31 %)	40 (44.44 %)
Higher vocational	1 (2.63 %)	3 (5.77 %)	4 (4.44 %)
University	7 (18.42 %)	16 (30.77 %)	23 (25.56 %)
Place of residence			
South Bohemian Region	1 (2.63 %)	3 (5.77 %)	4 (4.44 %)
South Moravian Region	6 (15.79 %)	5 (9.62 %)	11 (12.22 %)
Karlovy Vary Region	1 (2.63 %)	0 (0 %)	1 (1.11 %)
Liberec Region	1 (2.63 %)	2 (3.85 %)	3 (3.33 %)
Moravian-Silesian Region	5 (13.16 %)	4 (7.69 %)	9 (10 %)
Olomouc Region	0 (0 %)	2 (3.85 %)	1 (1.11 %)
Plzeň Region	0 (0 %)	1 (1.92 %)	1 (1.11 %)
Prague	14 (36.84 %)	21 (40.38 %)	35 (38.89 %)
Central Bohemian Region	10 (26.32 %)	12 (23.08 %)	22 (24.44 %)
Ústí nad Labem Region	0 (0 %)	1 (1.92 %)	1 (1.11 %)
Zlín Region	0 (0 %)	1 (1.92 %)	1 (1.11 %)
Primary employment at present			
Self-employed person	1 (2.63 %)	4 (7.69 %)	5 (5.55 %)
Student	1 (2.63 %)	3 (5.77 %)	4 (4.44 %)
Employee	36 (94.74 %)	44 (84.62 %)	80 (88.89 %)
Other	0 (0 %)	1 (1.92 %)	1 (1.11 %)
Marital status			
Single	16 (42.11 %)	20 (38.46 %)	36 (40 %)
Married/living in partnership	16 (42.11 %)	22 (42.31 %)	38 (42.22 %)
Divorced	4 (10.53 %)	9 (17.31 %)	13 (14.44 %)
Widowed	2 (5.26 %)	1 (1.92 %)	3 (3.33 %)
Driving licence owner			
Yes	31 (81.58 %)	40 (76.92 %)	71 (78.89 %)
No	7 (18.42 %)	12 (23.08 %)	19 (21.11 %)
Car available			
Yes, always	17 (44.74 %)	14 (26.92 %)	31 (34.44 %)
Often	4 (10.53 %)	5 (9.62 %)	9 (10 %)
Sometimes	4 (10.53 %)	5 (9.62 %)	9 (10 %)
Rarely	3 (7.89 %)	7 (13.46 %)	10 (11.11 %)
Never	10 (26.32 %)	21 (40.38 %)	31 (34.44 %)

Table 4. Telephone survey participants

5. RESULTS AND THEIR DISCUSSION

5.1 PT travel during pandemic from passenger perspective

The participants of the first FGs in early November 2020 had shifted from PT to other transport modes during the pandemic. Their main argument for shifting to the car was greater comfort and travel time reduction without the risk of coronavirus contagion. The same reasons for greater car use, particularly for travel to/from work, were later confirmed in the subsequent focus groups that took place in October 2021.

Participants of the first FGs in November 2020 also mentioned financial support by the employer (in the form of a fuel allowance) among the other factors of car use. In the subsequent focus groups in May 2021, respondents mentioned only the employer's recommendation to avoid taking PT in "morning peaks" and to wear a respirator (one participant mentioned free respirators given out by her employer), but not the financial motivation anymore.

PT use also decreased as a consequence of cancellation and reduction of some PT services, which made changing lines (transfer) more difficult. The respondents had a particularly negative perception of cancelled evening services, which often made returning from work difficult. Respondents of all the FGs mentioned these problems. Participants of the focus groups in May 2021 also complained about the reduced numbers of tram or train carriages and reduced escalator capacity in Prague metro, leading to increased cumulation of people and their increasing worries about coronavirus contagion. *"In the morning rush hours the intervals were terribly long, there used to be two cars and they extended it and there was only one car, so it was difficult to get on the tram at all, I was standing on one leg."* (man, 49 y. o., FG 11th May 2021).

In all the focus groups and in the telephone survey, respondents mentioned decreasing frequency of trips to culture, entertainment and restaurants, primarily due to government regulations and closed establishments. Some of them took the opportunity to work from home – the main reasons were concerns about their health or that of their nearest and dearest, and the need to take care of minor children as kindergartens were closed and schools provided distance education. The telephone survey data (November-December 2020) indicate that the frequency of work from home gradually decreased compared to the first wave (March-May 2020); conversely, more respondents were only working from home partly or had returned to the workplace. In the focus groups in October 2021, all the respondents declared in unison that the number of their trips to work had decreased overall. Participants of these focus groups also mentioned a decrease in trips for shopping (5 respondents), the primary reason being online shopping during the pandemic and the preference of this way of shopping even after the pandemic ended. The main perceived advantage was time saving.

The greatest change in PT use perceived by most of the respondents from the first two focus groups in November 2020 and the additional telephone survey in late 2020 was the need to wear masks and other protective equipment and the increased sanitation standard (vehicle disinfection). Almost none of the respondents mentioned any increased concerns about contagion in PT vehicles compared to other everyday activities (such as shopping). However, the respondents were trying to minimize the need to touch the handles and buttons and keep a safe distance from other passengers.

The behaviour of fellow PT passengers was viewed positively: according to participants in the first FGs in November 2020, they tried to act with consideration; they themselves avoided using PT when ill (partly due to a fear of the others' reactions to symptoms of illness). Opinions of other passengers' behaviour varied in the following focus groups. In the FGs held in May 2021, people voiced the opinion that

people act nicely in PT vehicles and adhere to sanitary and governmental regulations, but also that people act more aggressively, are unpleasant and irritated. Respondents also stated that they had repeatedly been in situations where people not observing the current measures (wearing the mask in particular) were attacked in Prague metro. At the same time, the respondents mentioned observing a gradual returning to the "normal" state of things, as before the pandemic, and gradually increasing numbers of people in PT vehicles. Besides, 4 participants in the October FGs stated that the increasing vaccination rates had reduced their worries in PT vehicles.

5.2 Barriers to using PT from passenger perspective

For the entire study period, reduction of PT services was mentioned as the greatest barrier to using PT, which made travel seriously difficult for respondents and led to increased cumulation of people in vehicles. In a later period (from the end of 2020), respondents viewed the wearing of masks as one of the obstacles to using PT, as it reduced their travel comfort, particularly in summer months. At the same time, respondents viewed it negatively if some of the passengers did not wear masks, thus ignoring the governmental regulation.

In the last focus group in October 2021, respondents mentioned dodging the safety precautions as one of the barriers to using PT (wearing of respirators, safe distances and hand disinfection), as well as insufficient inspection and distrust in adequate vehicle disinfection. Respondents would have welcomed information about frequency of disinfection and cleaning of the vehicles (such as a sign stating the frequency of disinfection and cleaning).

5.3 Suitable measures to reduce concerns about using PT

Respondents discussed the current measures implemented in PT that they viewed positively. In the first wave of the pandemic in 2020, the most effective measures perceived was the acrylic glass partition separating the driver from PT passengers and the new capability of contactless fare payment and ticket purchasing. They also viewed positively the automatic opening of vehicle doors without having to touch the buttons.

When asked which measures to prevent coronavirus spreading they consider effective, respondents stated observance of distances, using of protective equipment and its inspection /by the driver) and increased appeal for own responsibility (e.g., by providing information by means of leaflets and posters). Respondents also said they would welcome disinfection points inside PT vehicles or next to ticket vending machines, which would help increase the sanitation standard without having their own disinfectant, as well as the ability to buy a respirator in the PT vehicle or at the stop. They also mentioned an interest in more frequent disinfection of vehicles, which should be accompanied by information to passengers about the vehicle being disinfected and the time of last disinfection. *"To have confirmation somewhere, this train has been sanitized, or this train is sanitized three times a day, that would be reassuring to me."* (women, 47 y. o., FG 7th October 2021)

Respondents also debated the sanitary condition of seats in vehicles, preferring more sanitary seats in the vehicles – they viewed fabric-covered seats as the least sanitary, and plastic or leatherette seats as the most sanitary. Besides, they were interested in increased numbers of vehicles or shorter headways between services in the busiest times, which would help reduce the cumulation of passengers in vehicles.

Another debated topic was an annual PT pass. Respondents from the Central Bohemian Region said they would welcome the option to suspend the validity their annual PT passes during the pandemic, particularly when the schools were closed and when they could not travel to work, so their annual passes strayed unused.

5.4 PT operator and authority communication towards passenger

In the first wave of the pandemic, respondents said that their primary sources of information about the governmental measures related to transport were social media (Facebook and Instagram). In the next wave (2021), respondents mentioned more frequently using of transport companies' mobile applications (e.g., PID Lítačka, IDOS, etc.).

In connection with communication from transport companies and authorities, information at the regional level and information from the national railway operator ČD on cancelled services and unforeseen situations were viewed negatively. Respondents also described information from the government as inadequate and confusing. *"As for the Czech Railways, I would say that this is the opposite of communication from transport companies. There I have noticed an alibist information for me that connections can be cancelled and you have to check it on the website or idos.cz before you go somewhere."* (man, 27 y. o., FG 4th November, 2020)

No change in the perception of communication from the different actors was identified in the course of the investigation. Conversely, the focus groups in 2021 expressed increasingly negative perceptions of communication from public health authorities and the Ministry of Health, particularly regarding unclear information and frequent changes in the information.

Respondents mentioned notably the following proposals for improving the information for the population and PT users: distribution of leaflets or information by means of pictograms, which would assist particularly elderly people who do not use the internet, and posting of information on public transport and current changes in PT vehicles well in advance.

5.5 Role of new mobility services and their perception during pandemic

In the first focus group, respondents mentioned their experience of new mobility services, such as shared mobility (car sharing, ride sharing, bike sharing) or micromobility (scooters, including electric) before the pandemic. After the pandemic broke out, respondents did not perceive this mode of transport as safer compared to PT. In ride sharing or ride hailing in particular, they mentioned the absence of acrylic glass partitions separating the driver from passengers. Respondents in this group perceived shared bicycles or scooters as safer, because they exclude contact with other people. On the contrary, some respondents in the later focus groups in 2021 mentioned ride hailing in particular, which they used partly to substitute for missing PT services particularly in the evenings.

In connection with car sharing, the sanitary aspects of vehicles were discussed in the focus group in May 2021. Respondents perceived negatively not having adequate information about previous users of the vehicle and whether the vehicle has been disinfected. This increased the respondents' concerns about contagion with the SARS-CoV-2 virus when using shared cars. To help reduce these concerns, signs with the disinfection frequency could be placed on the vehicles.

6. DISCUSSION AND IMPLICATIONS FOR PUBLIC TRANSPORT

Based on the data from the focus groups, it can be concluded that there was a shift in the perception of PT in the course of the pandemic. While passengers in Czechia felt more concerns about the unknown at the beginning of the pandemic,

a gradual decrease in these concerns could be observed, along with a returning of passengers to PT and more frequent dodging of safety precautions. At the same time, it can be said that people felt safer on PT in light of the growing vaccination rates in the population. .

It also turned out that the pandemic increased PT passengers' sensitivity to phenomena which they had perceived as negative about PT even before the pandemic, such overcrowded vehicles, odours, inadequate cleaning of vehicles, etc.

The most frequently mentioned shortcomings of public transport in direct connection with the coronavirus include missing information about vehicle disinfection frequency and cancellation of services during the lockdown (notably in evenings), which made travel from work more difficult for some respondents and increased their worries about using PT. In light of this situation, respondents perceived particularly negatively the insufficient communication about the changes; they would have welcomed if information about planned changes were presented well in advance, e.g., on digital information panels and signs in PT vehicles.

On the contrary, respondents viewed positively the door opening without having to push the button, separation of the driver from passengers with acrylic glass, the capability of contactless fare payment, and communication about measures in force via mobile applications and social media.

Respondents viewed new mobility services differently in light of experience of their use. Regarding car sharing, respondents most frequently expressed concerns about technical and sanitary condition of vehicles. Posting information about vehicle maintenance would partly alleviate their concerns. Nearly none of the respondents had any experience of bike sharing; the most common reason for not using it was missing cycling infrastructure on their way to work. Alternative taxi services were mostly perceived by respondents as a substitute for other modes of transport at times when no other mode was available. During the pandemic, they considered missing information about measure in force when taking a taxi as the greatest shortcoming.

In general, focus group respondents felt safe on PT if safety precautions in force were observed and preferably if the PT vehicle was not overcrowded. Potential recommendations for improving safety in terms of contagion include offering disinfectants in vehicles, cashless payment options, and posting of information (and photographs as the case may be) on vehicle disinfection frequency. Respondents would also welcome the ability to buy a respirator in PT vehicles or have it offered free of charge. Very similar results were reached by a study in Spain (Awad-Núñez et al., 2021), where users consider adequate cleaning and disinfection of PT vehicles, an offer of respirators, gloves or disinfection gels and especially increasing supply to avoid overcrowding as very important measures that would convince them of reduced risk of contagion on public transport. To increase the use of shared mobility during the pandemic, they suggested using protective film on handlebars of public bicycles or scooters, or steering wheels of shared cars, but the majority of respondents did not wish any increase in user costs.

It turns out that a number of these measures can be implemented in very short time. In the longer run, strategic transport planners can consider to further minimize the virus transmission, e.g., through new bus and other vehicle design or as Gkiotsalitis and Cats (2021) recommend - to tackle overcrowding through real-time guidance of users. Even before the pandemic, public transport in Czechia featured technologies installed directly in PT vehicles that proved to be useful during the pandemic; for instance, the city of Ústí nad Labem shifted to a fully electronic fare collection system during the pandemic (the implementation was precipitated by the pandemic).

Other research teams from other countries have reached identical conclusions concerning the technologies (e. g. Corazza et al., 2021; Tirachini & Cats, 2020). Existing technologies serve well in fighting COVID-19 with minor innovations. Before the pandemic, technological improvements in PT had concentrated primarily on ecological fuels, energy savings and eco-driving, as well as electronic fare collection systems; however, COVID-19 necessitated greater flexibility. Besides the aforesaid contactless fare collection, priorities included more advanced heating, ventilation and air-conditioning (HVAC) systems, spatial adjustments in vehicles, etc. Crucial roles for competitiveness with cars (not only during the pandemic) were played by quality, speed, frequency and diversification of PT supply, and, as Caballini et al. (2021) stressed, it should be based on multimodality, intermodal connections with non-motorized transports and shared vehicles and on good communication and real-time information (Mobility-as-aService = MaaS platform). Thus, alternatives to cars are stronger and if properly harmonized, will become a better choice in cities in particular in future and will see increased demand.

7. CONCLUSION

This study focuses on the development of attitudes and experience regarding using PT in the Czech Republic during the different phases of the COVID-19 pandemic, aiming at identification of the main barriers to using this mode of transport, possible solutions to making PT more attractive and boost the return of passengers to public transport.

Moreover, findings from this research serve as recommendations for the public sector and public transport providers for reflecting the subjective experience of users during the COVID-19 pandemic and transforming them into measures that will make PT more attractive in the post-pandemic era and are welcomed and positively viewed by PT users. Implementation of such measures is important for further development of public transport as a sustainable transport mode in the post-pandemic era. A fundamental prerequisite is adequate financing of counter-epidemic innovations, expansion of PT supply and new sustainable mobility services, which is not an easy task given the market losses (associated with the decreased demand during the pandemic). Successful models of financing for PT and associated pandemic countermeasures are a desirable topic for further research, not only in the Czech context.

The effect of concerns about illness may linger in the population (not necessarily only in relation to COVID-19, but viral diseases in general). Better perception of the sanitary conditions in public transport requires a greater emphasis on sanitation, together with information for both passengers and employees about epidemic countermeasures implemented (disinfection, more frequent vehicle ventilation, etc.) both in writing and in other ways, such as through fragrance and visual perception. Healthcare institutions should play their medical prevention role, developing in cooperation with transport companies or transport departments of municipal authorities concrete, concise and highly conducive instructions on how to behave in PT vehicles and stations and stops, what to notice, bear in mind and what conduct reduces the risk of contagion.

It is no less important to provide passengers with sufficient information, including real-time data about vehicle movements and occupancy rates. Further reduction of contact with drivers and other public transport company staff and among passengers can be achieved, e.g., by contactless fare payments, which is being offered by many companies already.

In the longer run, PT companies should routinely reflect on lessons learnt and implement preventive measures

against viral and bacterial diseases, which may spread in public transport vehicles and public spaces, in transport and spatial planning (changes to street areas, functional uses, preference to short-distance travel in city centres to walk and bike more, etc.).

The key is to connect the various planning sectors and seek integrated solutions, including practical instructions and foreseeable impacts. Readiness of authorities, planners and transport companies will greatly help alleviate negative trends in both health and mobility. Besides technological changes that should improve the functioning of public transport and make its use even smoother (vehicle development and modifications and sustainable fuels), there are factors such as energy savings and other organizational pandemic countermeasures (including educational activities, strengthening of human resources, etc.). This will lead to a potential for sustainable conduct in both transport and medical contexts.

ACKNOWLEDGEMENTS

This paper is enabled by support from a grant of the Technology Agency of the Czech Republic titled "Changes in travel behaviour caused by COVID-19 and their social impacts" (no. TL04000094).

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