

Changes in the Use of Passenger Rail Transport in Poland due to the COVID-19 Pandemic

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Abstract

Rail transportation in Poland has been experiencing substantial year-over-year growth, contributing significantly to the national economy. Recent investments in the rail network have enhanced its efficiency and capacity, encouraging an increasing number of individuals to opt for more sustainable modes of transportation. Nevertheless, the outbreak of the COVID-19 pandemic severely disrupted planned innovations within the sector. During the pandemic, stringent restrictions on mobility and interpersonal contact were imposed. The objective of this article is to examine the perspectives of Polish citizens regarding the impact of the coronavirus pandemic on passenger rail traffic and their travel preferences. To this end, a survey was conducted. The results indicated that the pandemic led to a 27% decline in the use of rail transportation in Poland, primarily attributed to mobility restrictions and safety concerns. The research findings suggest that the continued development and modernization of rail infrastructure could facilitate the restoration of public interest in rail travel, particularly in the context of environmental considerations and the enhancement of travel comfort.

Keywords

train, rail transport, Poland, COVID-19, pandemic

1 Introduction

Polish rail transportation has undergone significant development in recent years. The construction of new transportation routes, the modernization of existing rail lines, and investments in increasingly advanced technologies have contributed to the improved efficiency and capacity of the rail network. Many countries have prioritized developing good public rail services in order to cut down on car dependency (Ibrahim et al., 2020). Rail carriers have introduced numerous enhancements to their fleets to increase traveler comfort and expand service availability. The development of public transport is much easier in the case of areas with high population density, including in particular such areas where a considerable part of the population is less affluent, and where there is a large number of travel origins and destinations (Szczuraszek and Chmielewski, 2018). Since 2015, the number of passengers has steadily increased year over year. In 2019, passenger numbers rose by nearly 20% (Fig. 1). However, a major factor that disrupted the country's economy, including the rail transportation sector, was the COVID-19 pandemic that prevailed during 2020–2021.

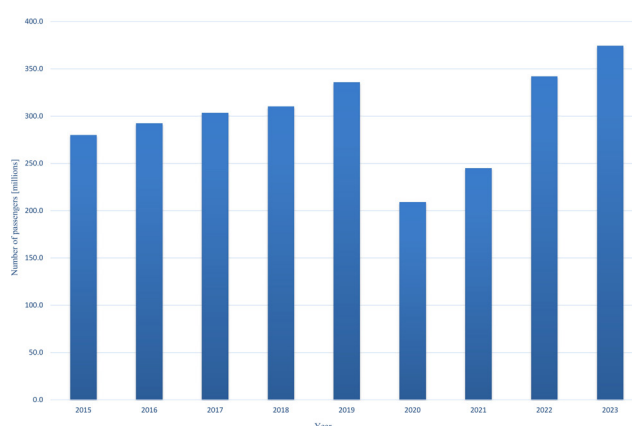


Fig. 1 Number of rail passengers

COVID-19 is an infectious disease affecting the respiratory system, caused by the SARS-CoV-2 virus (Rothan and Byrareddy, 2020). The disease is transmitted through respiratory droplets, symptoms make infected people feel symptoms like those of flu (Hadi et al., 2020). The first confirmed case of COVID-19 infection in Poland was reported on March 4, 2020.

As of March 14, 2020, a state of epidemiological emergency was declared, which was subsequently elevated to a state of epidemic on March 20, 2020. By March, 27 2020, there had been 1,389 cases of COVID-19 infections officially identified in Poland (Gujski et al., 2020). Throughout the course of the pandemic, approximately 6,500,000 confirmed cases were recorded. According to information provided by the Ministry of Health, nearly 120,000 individuals died, with the majority of deaths attributed to comorbidities.

The intensity of the sudden stop induced by the COVID-19 outbreak produced effects which were similar to those of a large-scale, extreme, natural disaster (Bonaccorsi et al., 2020). Authorities in many countries, including Poland, introduced numerous restrictions ranging from an absolute ban on all visits in all kinds of care facilities to comparatively liberal visiting policies, allowing visitors during certain circumstances (Hugelius et al., 2021). These measures primarily included home quarantine, remote education and a reduction in the use of public transportation. The impact of the pandemic on rail transportation has been the subject of extensive research. In Hungary, major implemented restriction started in the March, 17 and since then only Hungarian residents could enter into Hungary (Oszter, 2020). In Sweden, a significant number of travelers exchanged their monthly passes for single-use tickets, while demand for short-term passes declined to nearly zero (Jenelius and Cebecauer, 2020). Mobility patterns and the effects of the pandemic across Central and Southeastern European countries have also been analyzed in the literature. Fabianová et al. (2023) specifically analyzed the impact of the pandemic on public passenger rail traffic in Slovakia.

As a result of the pandemic, decisions were made in several countries to suspend the operation of certain rail services. According to one study, more than 50% of all regional trains in Italy were canceled. In Poland, such occurrences were less widespread (Taczanowski and Kołoś, 2020). In countries of the Sub-Saharan Africa region, especially in Kenya, most railways are in bad condition and disrepair. The railway system requires exceptional support for its redevelopment (Wangai et al., 2020). Polregio, the leading regional rail carrier in Poland, managed to generate sufficient revenue to post a profit despite difficult local conditions. PKP Intercity, by comparison, recorded a modest loss of 2%. For both carriers, freight work declined by nearly 40% (Pomykała, 2021). Additionally, the number of passenger trains operating in

2020 was 36% lower than originally forecasted. Although train arrival waiting times increased, the punctuality of rolling stock improved due to reduced rail usage and fewer trains in operation. Overall, Poland ranked 16th among European countries in terms of rail network utilization.

2 Research

The COVID-19 pandemic has significantly affected the functioning of the rail transport sector in Poland. In order to thoroughly examine the scale and nature of these changes, surveys were conducted among rail transport users. Sections 2.1 to 2.3 present the aim of the study, the methodology used and the results obtained based on the analysis of respondents' answers.

2.1 Purpose and scope of research

The objective of this research paper is to explore and analyze the impact of the COVID-19 pandemic on passenger rail transport in Poland. Particular attention is given to changes in travel habits, the effects of sanitary and epidemiological restrictions, and the rail sector's responses to these new challenges. This study seeks not only to understand the short-term effects of the pandemic on rail traffic but also to anticipate potential long-term shifts in traveler preferences and the strategic development of the rail sector. A comprehensive analysis of these aspects will offer valuable insights into the adaptability of the rail transportation system in the face of a public health crisis and contribute to the development of effective strategies for managing passenger traffic during future emergencies.

2.2 Methodology of the research

The research was conducted using a survey method, which was distributed to a nationwide audience via social media platforms. Respondent anonymity was maintained throughout the process. The questionnaire began with four demographic questions regarding gender, age, employment status, and place of residence. In Section 2.3, participants were asked whether they used rail transportation before, during, and after the pandemic. Based on an affirmative response, respondents were then queried about their travel frequency, destinations, distance traveled per trip, and travel time. Additional questions focused on which rail carriers were most frequently used and the methods by which travel tickets were purchased. The final portion of the survey addressed economic aspects, including fare types, travel expenses, train occupancy levels, and perceptions of safety

while traveling during the pandemic. Participation in the survey was not restricted to any specific group. A total of 198 individuals completed the questionnaire correctly.

2.3 Results of tests

The subjects of the study were Polish residents, with consideration given to their age, gender, place of residence, and employment status. A total of 198 correctly completed questionnaires were analyzed. Male respondents

constituted 62% of the sample, while female respondents accounted for 38%. A significant proportion of participants were young individuals of school or university age, representing 75% of all respondents. Those aged 26 to 35 comprised 15% of the sample, while respondents over the age of 36 accounted for only 3%. Participants under the age of 16 made up 7% of the total. Among both women and men, the majority (74% and 76%, respectively) were between the ages of 16 and 25 (Table 1).

Table 1 Respondents answers to demographic questions

Category	<i>n</i>	%	Female		Male	
			<i>n</i>	%	<i>n</i>	%
Sex						
Male	123	62.12	–	–	–	–
Female	75	37.88	–	–	–	–
Age						
Under 16 years	14	7.07	7	9.33	7	5.69
16–25 years	148	74.75	55	73.33	93	75.61
26–35 years	30	15.15	9	12.00	21	17.07
36–45 years	1	0.51	1	1.33	0	0.00
46–55 years	3	1.52	2	2.67	1	0.81
56–65 years	0	0.00	0	0.00	0	0.00
Over 65 years	2	1.01	1	1.33	1	0.81
Status on the labour market						
Pupil	116	58.59	43	57.33	73	59.35
Student	14	7.07	8	10.67	6	4.88
Working	55	27.78	19	25.33	36	29.27
Self-employed	6	3.03	2	2.67	4	3.25
Unemployed	5	2.53	2	2.67	3	2.44
Pensioner	2	1.01	1	1.33	1	0.81
Maternity/parental leave	0	0.00	0	0.00	0	0.00
Place of residence						
Lower Silesia	5	2.53	3	4.00	2	1.63
Kuyavia-Pomerania	11	5.56	5	6.67	6	4.88
Lublin	2	1.01	0	0.00	2	1.63
Lubusz	3	1.52	1	1.33	2	1.63
Lodzkie	9	4.55	3	4.00	6	4.88
Lesser Poland	5	2.53	1	1.33	4	3.25
Masovia	13	6.57	1	1.33	12	9.76
Opole	3	1.52	2	2.67	1	0.81
Subcarpathia	0	0.00	0	0.00	0	0.00
Podlaskie	1	0.51	0	0.00	1	0.81
Pomerania	6	3.03	2	2.67	4	3.25
Silesia	9	4.55	4	5.33	5	4.07
Świętokrzyskie	0	0.00	0	0.00	0	0.00
Warmia-Masuria	1	0.51	0	0.00	1	0.81
Greater Poland	119	60.10	48	64.00	71	57.72
West Pomerania	11	5.56	5	6.67	6	4.88

Table 1 Respondents answers to demographic questions (continued)

Category	<i>n</i>	%	Female		Male	
			<i>n</i>	%	<i>n</i>	%
Use of rail transport – before the pandemic						
Yes	156	78.79	56	74.67	100	81.30
No	42	21.21	19	25.33	23	18.70
Use of rail transport – during a pandemic						
Yes	103	52.02	41	54.67	62	50.41
No	95	47.98	34	45.33	61	49.59
Use of rail transport – after the pandemic						
Yes	166	83.84	67	89.33	99	80.49
No	32	16.16	8	10.67	24	19.51

In verifying labor market status, nearly 66% of respondents reported being engaged in education, either at the school or university level. Just under 31% were employed, including 3% who operated their own businesses. The remaining 3% consisted of unemployed individuals and retirees. A majority of both female (57%) and male (59%) respondents were students. None of the participants were on maternity or parental leave (Table 1).

Regarding place of residence, 60% of respondents indicated that they lived in the Wielkopolska region – accounting for 64% of female and nearly 58% of male participants. The Mazovian province ranked second (7%), followed by the Kuyavian-Pomeranian and West Pomeranian provinces, each representing 6% of the respondents. Notably, no participants were recorded from the Podkarpackie or Świętokrzyskie provinces. The remaining 21% of

respondents came from the Lower Silesian, Lublin, Lubusz, Lodzkie, Lesser Poland, Opole, Podlasie, Pomeranian, and Warmian-Masurian provinces.

A total of 79% of respondents reported traveling by rail before the pandemic. During the pandemic, this percentage dropped to 52%, but it subsequently rose to 84% after the pandemic, surpassing pre-pandemic levels. Throughout all periods examined, gender did not influence the choice of rail transportation.

Respondents were asked about the frequency of their rail travel before, during, and after the pandemic (Fig. 2). Prior to the pandemic, 9% of respondents traveled by train every day, 8% traveled several times a week, and 3% used rail transportation once a week. Seven percent traveled by train several times a month, while 12% did so only once a month. The largest group of respondents (26%) indicated

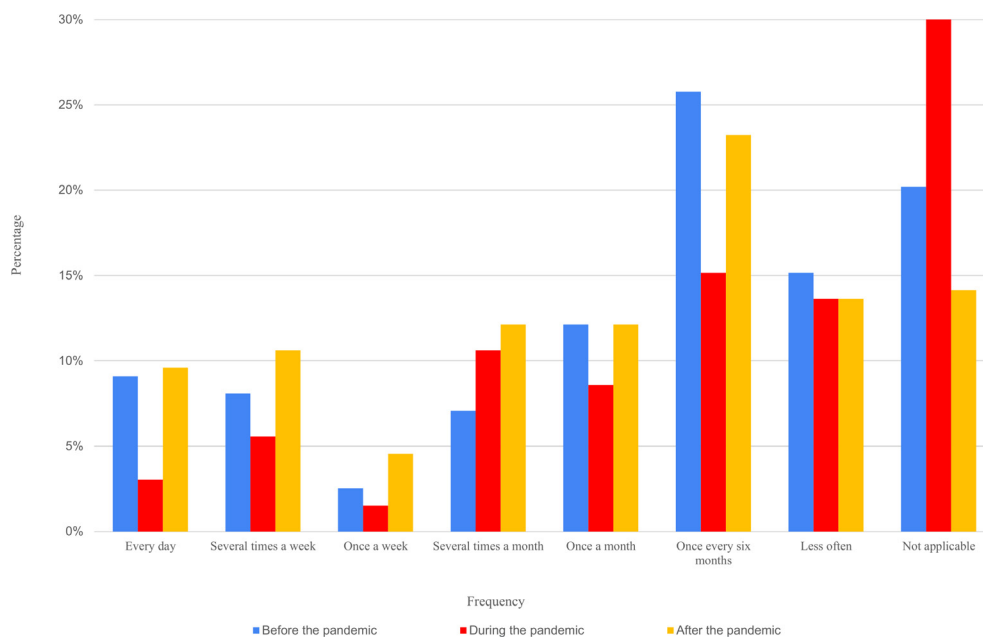


Fig. 2 Frequency of use of rail transport

that they traveled by train once a year. Fifteen percent of respondents used rail transportation even less frequently. Additionally, 20% of participants stated that they did not use rail transportation at all before the pandemic. Among women, 23% traveled by train only once every six months, while 28% of men did the same (Table 2).

During the pandemic, the situation changed dramatically due to the restrictions that were imposed. A total of 42% of respondents reported giving up rail travel during this period. Fifteen percent of participants still traveled by train once a year, while 14% did so even less frequently.

Only 3% of respondents opted for daily train trips. Nineteen percent of respondents traveled by train one to several times a month during the pandemic, and 7% used rail transportation several times a week (Table 3).

Following the end of the pandemic, more people began traveling by train than before its outbreak. The frequency of rail travel notably increased (Table 4).

While 37% of respondents continued to use rail transportation only once a year or less frequently, there was a clear positive trend in the other frequency categories. Nearly 10% of respondents reported using rail transportation on a daily

Table 2 Frequency of use of rail transport – before the pandemic

Category	<i>n</i>	%	Female		Male	
			<i>n</i>	%	<i>n</i>	%
Every day	18	9.09	9	12.00	9	7.32
Several times a week	16	8.08	6	8.00	10	8.13
Once a week	5	2.53	2	2.67	3	2.44
Several times a month	14	7.07	7	9.33	7	5.69
Once a month	24	12.12	7	9.33	17	13.82
Once every six months	51	25.76	17	22.67	34	27.64
Less often	30	15.15	11	14.67	19	15.45
Not applicable	40	20.20	16	21.33	24	19.51

Table 3 Frequency of use of rail transport – during the pandemic

Category	<i>n</i>	%	Female		Male	
			<i>n</i>	%	<i>n</i>	%
Every day	6	3.03	2	2.67	4	3.25
Several times a week	11	5.56	5	6.67	6	4.88
Once a week	3	1.52	2	2.67	1	0.81
Several times a month	21	10.61	8	10.67	13	10.57
Once a month	17	8.59	5	6.67	12	9.76
Once every six months	30	15.15	12	16.00	18	14.63
Less often	27	13.64	10	13.33	17	13.82
Not applicable	83	41.92	31	41.33	52	42.28

Table 4 Frequency of use of rail transport – post-pandemic

Category	<i>n</i>	%	Female		Male	
			<i>n</i>	%	<i>n</i>	%
Every day	19	9.60	8	10.67	11	8.94
Several times a week	21	10.61	8	10.67	13	10.57
Once a week	9	4.55	2	2.67	7	5.69
Several times a month	24	12.12	16	21.33	8	6.50
Once a month	24	12.12	6	8.00	18	14.63
Once every six months	46	23.23	16	21.33	30	24.39
Less often	27	13.64	10	13.33	17	13.82
Not applicable	28	14.14	9	12.00	19	15.45

basis, and 11% limited their use to a few times a week. As many as 24% of participants traveled by train several times a month, while 5% traveled by train once a week.

Only 14% of respondents stated that they no longer use rail transportation, which represents a 6% improvement over pre-pandemic usage levels. There was no correlation observed between the frequency of travel and gender.

In the following question, respondents were asked about the destinations they traveled to using rail transportation. Before the pandemic, the most common travel purposes among respondents were leisure and socializing, followed by school, family visits, and work (Table 5).

During the pandemic, the situation changed dramatically. Nearly half of the respondents did not select any of the typical destinations, with social integration emerging as the most common, despite being severely limited during periods of restrictions. School and leisure followed as the next most chosen destinations (Table 6).

After the pandemic, social integration once again became the primary reason for rail travel, followed by commuting to school, which continued without restrictions, and leisure, chosen by nearly 12% of respondents (Table 7). The data correlates with variables such as age and labor market status (Fig. 3).

Table 5 Destination – pre-pandemic

Category	<i>n</i>	%	Female		Male	
			<i>n</i>	%	<i>n</i>	%
School	30	15.15	12	16.00	18	14.63
Work	13	6.57	3	4.00	10	8.13
Family	22	11.11	9	12.00	13	10.57
Social integration	36	18.18	9	12.00	27	21.95
Leisure	37	18.69	14	18.67	23	18.70
Shopping	10	5.05	8	10.67	2	1.63
Doctor's visit	4	2.02	1	1.33	3	2.44
Not applicable	46	23.23	19	25.33	27	21.95

Table 6 Destination – during the pandemic

Category	<i>n</i>	%	Female		Male	
			<i>n</i>	%	<i>n</i>	%
School	22	11.11	12	16.00	10	8.13
Work	7	3.54	2	2.67	5	4.07
Family	14	7.07	10	13.33	4	3.25
Social integration	31	15.66	8	10.67	23	18.70
Leisure	19	9.60	7	9.33	12	9.76
Shopping	4	2.02	2	2.67	2	1.63
Doctor's visit	3	1.52	0	0.00	3	2.44
Not applicable	98	49.49	34	45.33	64	52.03

Table 7 Destination – post-pandemic

Category	<i>n</i>	%	Female		Male	
			<i>n</i>	%	<i>n</i>	%
School	35	17.68	16	21.33	19	15.45
Work	20	10.10	5	6.67	15	12.20
Family	21	10.61	13	17.33	8	6.50
Social integration	49	24.75	18	24.00	31	25.20
Leisure	23	11.62	5	6.67	18	14.63
Shopping	9	4.55	2	2.67	7	5.69
Doctor's visit	4	2.02	2	2.67	2	1.63
Not applicable	37	18.69	14	18.67	23	18.70

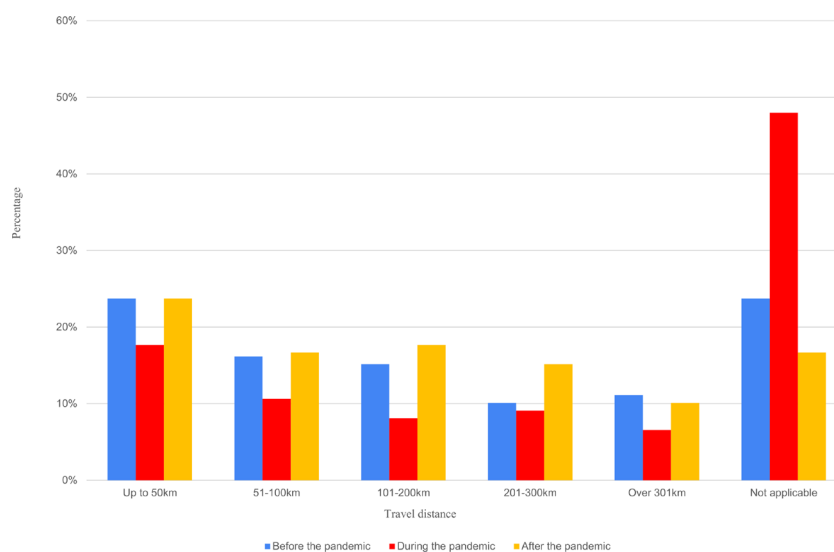


Fig. 3 Purpose of passenger travel

The most common destination for women before the pandemic was leisure (19%), while during the pandemic, it was school (16%). After the pandemic, social integration became the leading destination for women (24%). For men, social integration was the most frequent destination in all three periods – 22% before the pandemic, 19% during the pandemic, and 25% after the pandemic.

The next question inquired about the distance passengers traveled per train service before, during, and after the pandemic. Before the pandemic, the largest proportion of respondents (24%) indicated that they typically traveled up to 50 km, primarily for commuting to school or work. The fewest respondents (10%) traveled distances between 201 and 300 km by train. During the pandemic, as many as 48% of respondents did not use rail transportation. However, the most frequently traveled distance during this

period (18% of respondents) was still up to 50 km, predominantly for trips to work or medical appointments, as schools were conducting remote learning at home. Many respondents also refrained from visiting family members to avoid the risk of infection. After the pandemic, the most popular distance remained up to 50 km (24%). However, longer routes, particularly those between 201 and 300 km, became much more common (15%).

The longest routes (over 301 km) were taken by 10% of respondents (Fig. 4).

In the following question, respondents were asked how long it typically took them to travel to their destination before, during, and after the pandemic. Before the pandemic, the majority of respondents (24%) indicated that they usually reached their destination typically a place of rest or social integration within 1 to 2 h. During the

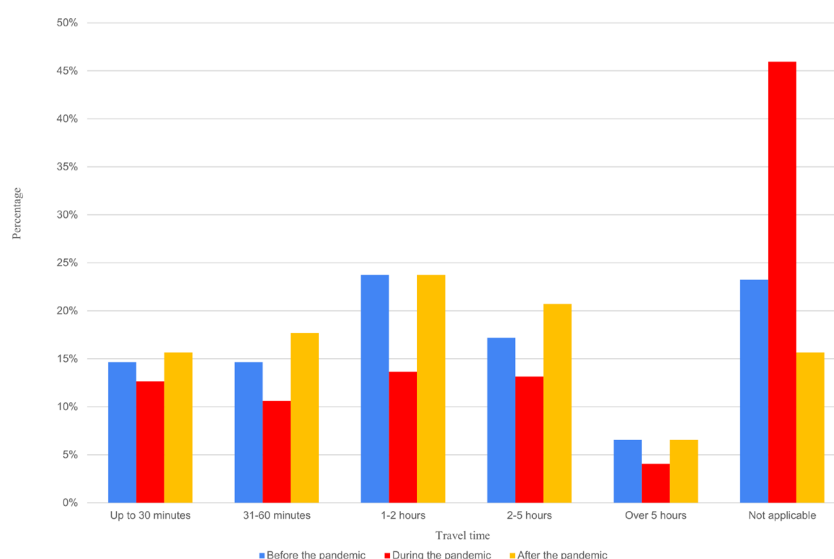


Fig. 4 Distance traveled per connection

pandemic, despite restrictions and limited mobility, 31% of respondents chose to travel for more than 1 h. Additionally, 46% of respondents did not travel by train at all. After the pandemic, travel times between 1 and 2 h once again became the most common (24%). This question was analyzed in conjunction with a question regarding the distance of a single train journey (Fig. 5).

Another question asked respondents which carrier they used most often. The vast majority (75%) selected PKP Intercity S.A., the leading provider of long-distance and international rail connections (Fig. 6). This carrier is known for its high standard of passenger service and fast transit times at relatively competitive prices. It also offers coaches with reclining seats as well as sleeping cars. Rail passenger

wagons are a key part of rail operations, having an irreplaceable function in both national and international rail passenger transport. Wagons are designed to provide safety and comfort for passengers. However, regular inspection and maintenance may not prevent faults and defects arising from its operation (Nedeliaková et al., 2024).

Additionally, 47% of respondents indicated that they used Polregio S.A., the largest operator of national and regional transport. Polregio offers time-efficient connections at affordable prices. In 2023, this carrier accounted for 26% of all connections made on Polish rail routes – the highest figure recorded since the beginning of the 21st century.

With 60% of all respondents coming from the Wielkopolska region, Koleje Wielkopolskie sp. z o.o. ranked

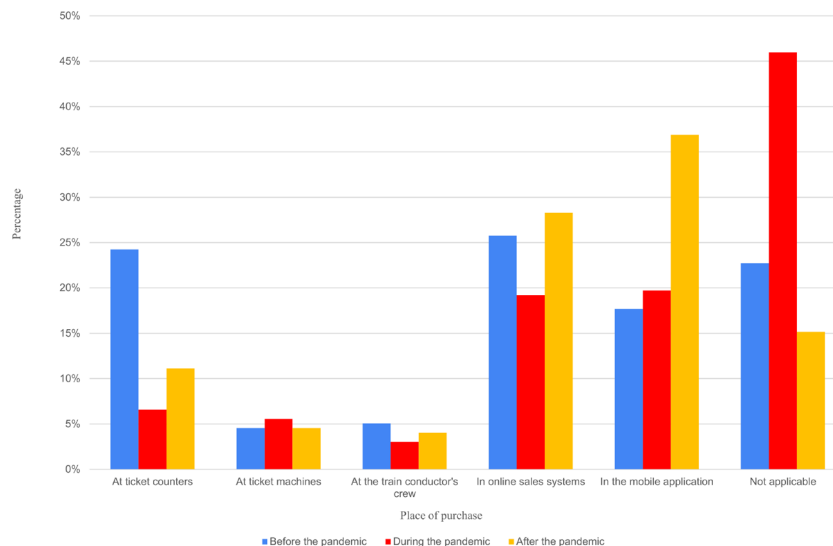


Fig. 5 Travel time per connection

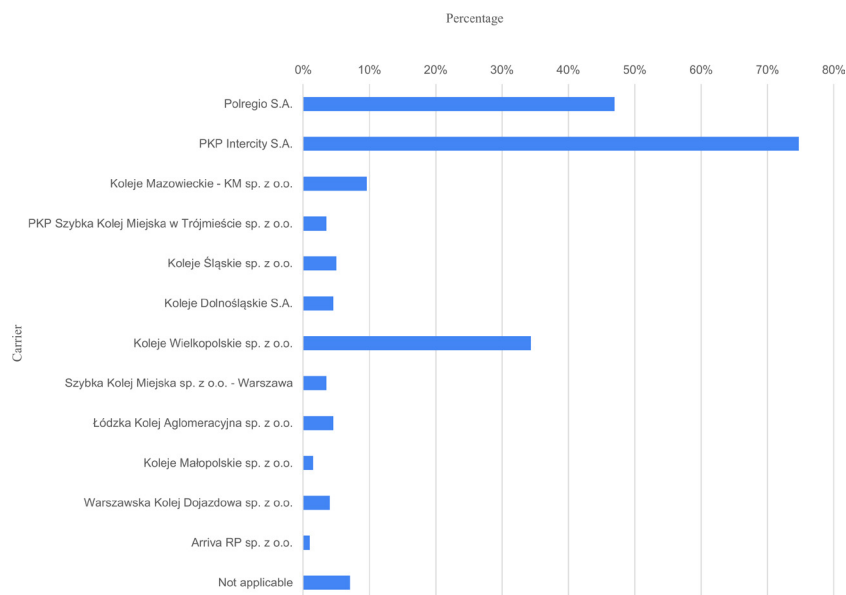


Fig. 6 The most popular carrier of choice

third, chosen by 34% of participants. This regional carrier, established by the provincial government, operates services primarily within the Wielkopolska region.

In the next question, respondents were asked how they most frequently purchased rail travel tickets before, during, and after the pandemic. Before the outbreak of the pandemic, the largest share of respondents (26%) purchased their tickets through online sales platforms available on the websites of the respective carriers. Slightly fewer, 24%, obtained their tickets from traditional ticket offices located at train stations. Meanwhile, 18% of respondents bought their tickets through mobile applications, either those offered by the carrier itself (such as Polregio) or through publicly available apps like KOLEO.

During the pandemic, travelers' preferences changed significantly. As many as 46% of respondents stopped traveling by train altogether. To minimize contact with people and shared surfaces and reduce the risk of infection, 20% of those surveyed purchased tickets using mobile apps on their phones, while 19% used online sales systems through the carriers' websites.

After the pandemic ended, the use of mobile apps for ticket purchases nearly doubled, reaching 37% of all respondents. Online sales systems remained the second most popular method, chosen by 28%. The number of respondents buying tickets at traditional ticket offices dropped to just 11%, in favor of the previously mentioned digital methods. In all periods analyzed, purchasing tickets at stationary ticket machines or directly from train conductors remained the least popular options, chosen by only 3–5% of respondents. The data are illustrated in Fig. 7.

The final questions focused on economic aspects, such as the type of fare respondents used, their views on travel safety during the pandemic, and how the pandemic affected their travel expenses and the congestion experienced on trains (Table 8). A total of 68% of respondents reported using a concessionary fare, mainly because 75% of all respondents were between the ages of 16 and 25. The regular fare was used by 26% of respondents.

When asked about the level of safety provided by carriers and rail infrastructure managers during the pandemic, nearly 52% of respondents stated they had no opinion likely because they did not pay close attention to this issue. Meanwhile, 33% of respondents felt that travel safety was maintained at an adequate level.

When asked about their spending on rail travel, 46% of respondents felt that their expenses had increased during the pandemic. This may be attributed to the country's disrupted financial economy and rising inflation. For 36% of respondents, these expenses remained the same, while only 7% reported a decrease in spending due to the pandemic.

The final question addressed the issue of congestion on trains after the pandemic. Nearly 54% of respondents noticed no significant change in train congestion. However, 39% observed that trains were more crowded than before the pandemic, possibly due to shifts in traveler preferences and the rising costs of alternative modes of transportation.

3 Conclusion

The COVID-19 pandemic has greatly affected the rail market. It resulted in a significant decline in the number of travelers using rail transportation. Restrictions related to

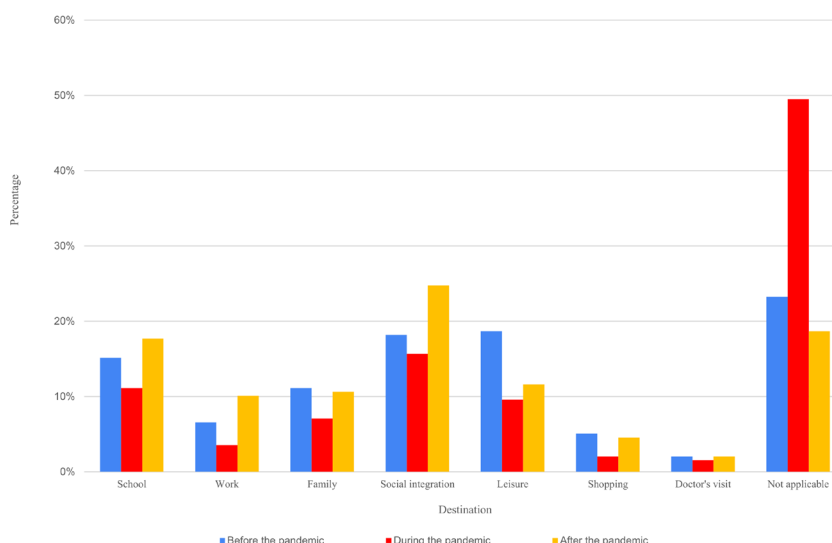


Fig. 7 The way to buy a train ticket

Table 8 Respondents' answers to economic questions

Category	<i>n</i>	%	Female		Male	
			<i>n</i>	%	<i>n</i>	%
Fare						
Normal	51	25.76	16	21.33	35	28.46
Reduced	135	68.18	55	73.33	80	65.04
Not applicable	12	6.06	4	5.33	8	6.50
COVID-19 time travel safety						
Yes	66	33.33	23	30.67	43	34.96
No	30	15.15	15	20.00	15	12.20
I have no opinion	102	51.52	37	49.33	65	52.85
Travel expenses						
Yes, they have increased	91	45.96	40	53.33	51	41.46
Yes, they have decreased	14	7.07	4	5.33	10	8.13
No, they have remained similar	71	35.86	23	30.67	48	39.02
I do not travel by rail	22	11.11	8	10.67	14	11.38
Train congestion						
Yes, now trains are more crowded	78	39.39	35	46.67	43	34.96
Yes, now the trains are less crowded	14	7.07	4	5.33	10	8.13
I did not feel a significant change	106	53.54	36	48.00	70	56.91

sanitary restrictions, lockdowns and security concerns contributed to a decrease in demand for rail travel. The mobility of Poland's residents was significantly reduced. The survey indicated that during the pandemic, respondents' use of rail transportation fell by as much as 27%, to then increase by 32%, thus piercing the pre-pandemic state. The growing number of rail passengers on an annual basis indicates that Poles prefer cheaper and more environmentally friendly means of transportation, such as the train, in favor of at least personal vehicles. Further expansions and upgrades to the rail network will have a positive impact on comfort and travel time, which may determine the choice of transport mode when covering longer distances.

The pandemic has changed the way people use transport; not only their modal choice, but also the frequency and purpose of travel have changed. Many passengers have limited their trips to the bare minimum, focusing on everyday needs such as commuting to work or handling administrative matters. Leisure and tourist trips have been significantly reduced or suspended.

The increase in the number of people working remotely has led to a decrease in the demand for daily travel. The increase in economic uncertainty caused by the economic crisis caused by the pandemic has forced many people to reduce their spending, including travel-related expenses. Fears of losing their jobs, lower wages and rising living costs have led some people to choose cheaper forms of transport or to completely give up some trips. In addition, social changes, such as the growing importance of remote work, the digitalization of services and changes in lifestyle, have contributed to the transformation of mobility habits into more local and less intensive ones.

The growing number of rail passengers per year after the end of the most severe restrictions indicates that Poles prefer cheaper and more ecological means of transport, such as trains, over personal vehicles. The growth of ecological awareness and rising fuel prices additionally encourage people to choose rail transport. Good transport connections, a higher standard of services and activities promoting public transport are key to maintaining and further increasing interest in rail transport among passengers.

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