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Analysis of Changes in Railway Passenger Mobility to the New Normal in the Post-COVID-19 Era

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Abstract

The COVID-19 pandemic posed a great challenge in railway industry, as it changed passengers' behavior towards travelling, which affected their mobility choice in turn. This paper focuses on factors influencing railway passengers' behavior in the new normal, based on 3,318 valid responses collected through an online survey. Variance analysis and exploratory factor analysis were conducted to identify key determinants of passengers' mode choice. Building on these results, a structural equation model (SEM) was developed to describe the interrelationships among passengers' personal attributes, mode characteristics, and travel intentions. The whole modelling process involved selecting latent variables, designing the initial theoretical framework, developing the questionnaire, and estimating the model using maximum likelihood in AMOS, followed by calibration and modification until acceptable parameter significance and model fit were achieved. Considering the trends and uncertainties related to railway industry, 4 development scenarios were constructed based on political, economic, and social factors. The sample data from 4 scenarios were input into the modified SEM model separately. In the end, we could obtain 4 similar SEMs adapting to different scenarios by adjustment. This will provide a scientific basis for formulating railway development strategies in the future for the new normal of post-COVID-19 era.

Keywords

mobility change; new normal; structural equation model; passenger choice behavior

1 Introduction

As the mobility mode for most people, it is difficult for the railway sector to ensure the safety from infection by SARS-CoV-2 because of closed space of carriages and stations, prompting people to pay more attention to their safety awareness in public places. Therefore, the railway industry had to take different countermeasures to reduce transmission and protect the public from the pandemic. There is no denying that passenger demand decreased significantly and railway industry was influenced extremely during the COVID-19 in these years. Additionally, online communication or working from home has made it possible for people to take care of business without actual travel, which may lead to persistent downturn on passenger volume in the next few years.

As many countries lifted restrictions on COVID-19 pandemic successively, the mobility of people has recovered gradually. In the new normal of post-COVID, virus mutation is inevitable over time. Moreover, periodic concentrated infection among the public may occur once the antibody in the human body cannot fight against the virus. We aim to explore whether railway passenger behavior has changed or not in the post-COVID-19 era. If the change really exists, will it be permanent? In this paper, we will analyze the factors affecting railway passenger mobility with SEM based on the data collected by questionnaires among the public. To cover all possibilities of the future, we build different scenarios from a variety of possible situations by the method of scenario planning. After that, the differences of railway passenger mobility across different scenarios will be discussed. The results will help railway operators to serve passengers better in the new normal, providing experience to deal with similar pandemic in the future.

2 Literature review

The strong impact of COVID-19 on public transportation systems has become an undeniable fact. Despite the variations in countermeasures taken by different countries, the effects on transportation and the public behavior have

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become the focus areas of research after COVID-19 outbreak. The research progress on the effects of pandemic on transportation systems will be reviewed in 2 periods separately: the peak of COVID-19 and the post-COVID-19.

2.1 Review of impact on transportation systems during the pandemic

During the COVID-19, strict restrictions limited the services of transportation systems and public daily behaviors. Abdullah et al. (2020) investigated the changes in travel behavior due to COVID-19. They analyzed 1,203 collected data around the world to analyze the change of travel frequency with relationship of travel purposes, mode choices and travel distances before and during COVID-19. Hintermann et al. (2023) conducted a survey involving over 1,600 individuals, observing all travels from the 8 weeks before the pandemic until May 2021. They examined the influence of COVID-19 and related measures from government on mobility choice in Switzerland. Anke et al. (2021) investigated the change in mobility and its venue distribution during the COVID-19 outbreak in Germany, focusing on comparing with lockdown federal states and non-lockdown federal states. Järv et al. (2021) studied the impact of the COVID-19 pandemic on cross-border mobility of Estonians residing in Finland, with a smartphone tracking survey. Awad-Núñez et al. (2021) conducted a nationwide online survey in Spain during the 2020 lockdown, analyzing 984 valid responses on post-COVID-19 travel behavior and willingness to use and pay for safer transport modes. Aaditya and Rahul (2021) focused on the changes in public thought regarding travel caused by lockdown policies from the psychological aspects, illustrating the impact of pandemic and lockdown on travel behavior. These studies analyzed the mobility change from a macro insight, showing the impact of pandemic specifically.

For different modes of transportation, it's also meaningful to explore the impacts of the pandemic on them. Carrese et al. (2021) analyzed statistical data on different modes of transportation during the COVID-19 pandemic. They proposed a timing policy with additional transportation services to avoid loads on different modes of transportation. Zhang et al. (2021) collected air passenger-level data from the Chinese market to explore changes in travel behavior, such as booking time for ticket, age distribution, ticket refunds and changes. Manca et al. (2023) analyzed the potential influence of future airline passenger choices with safety awareness and attitudes towards COVID-19 interventions. They also predicted the future situation of the air travel sector in the post-COVID-19 era. Shelat et al. (2022a) conducted a survey among train passengers in the Netherlands to quantify the impact of travel-specific, policy-based and pandemic-related attributes on passengers' COVID-19 risk perceptions. They evaluated the trade-off between risk perception and other travel attributes. These studies describe the operational condition of specific transportation modes during the COVID-19 outbreak, providing targeted recommendations to mitigate the impact.

2.2 Review of the public mobility change in the new normal

The growth in passenger volume lags behind the lifting of restrictions. Due to the fear of public health safety, passengers tend to observe the situation for a period of time before travelling freely. Psychological factors and lifestyle trends caused by restrictions cannot be reversed immediately. As a result, it is worthwhile to focus on the change in public mobility to the new normal. Sameni et al. (2021) focused on the consequences of COVID-19 in developing countries, studying the trend of people abandoning the subway in favor of private cars and providing policy guidance from the perspective of management. Christidis et al. (2021) analyzed key factors influencing the supply and demand of transportation systems in the post-COVID-19 era and explored how they affect the generation, distribution and mode of passenger travel. Cho and Park (2021) compared the passenger crowding impedance before and after the COVID-19 pandemic to identify behavioral differences and proposed transportation policies for society. Awad-Núñez et al. (2021) discussed the willingness to adopt a series of measures to improve the safety conditions of public transport and shared mobility services in response to COVID-19 transmission, as well as the willingness to pay for them. This can help operators develop strategies to adopt services in the new normal. Wang and Gao (2022) analyzed the changes in the internal mechanism of travel well-being to mitigate the losses for passengers in the post-COVID-19 era. They explored the internal relationships between different constructs of travel well-being and emphasized the importance of considering psychological factors in the new normal, providing a more accurate perspective. These studies examined the post-COVID evolution of the entire transportation system with great social significance and policy direction.

Different patterns of transportation have different development patterns in the new normal. Choi (2021) suggested that airport strategies should focus on revenue management, with safety and hygiene being top priorities in the post-COVID-19

era. Therefore, there is a need to change airport operational procedures. Bai et al. (2021) analyzed public transit ticketing data and focused their research on bus travel, specifically targeting suburban residents. Wang et al. (2022) collected comprehensive travel data from a ride-sharing company in China and investigated the causal impact of COVID-19 on driver behavior. They recommended that the government or company should prioritize drivers who were older, more experienced, more active before the pandemic and in higher-status jobs within the company in their post-COVID stimulus plans.

For the railway industry, the development trajectory in the new normal has been researched extensively. Bulková et al. (2022) analyzed the impact of the pandemic and related measures on the Slovak passenger rail sector and discussed the development of rail passenger and freight transport during the pandemic, summarizing the measures adopted to limit the spread of COVID-19 in rail operations. Lu et al. (2023) established an evolutionary model based on Markov's theory to estimate the freight structure in the post-COVID-19 era. They concluded that the pandemic has made it more difficult for the railway sector to adjust the freight structure. Kong et al. (2021) conducted a quasi-natural experiment on high-speed railway (HSR) to discuss the impact of HSR accessibility on green productivity in China. Their research provided valuable references for cities to formulate reasonable green development plans in the new normal. Cui et al. (2022) considered the pedestrian dynamics during COVID-19 prevention and control in emergency evacuation processes, establishing an agent-based social force model to simulate the activities of college students at stations. They proposed policy recommendations to reduce the risk of virus transmission during train station evacuations. Shelat et al. (2022b) conducted a stated choice experiment in the Netherlands, evaluating behavior associated with 3 criteria affecting the risk of COVID-19 transmission: crowding, exposure duration and prevalent infection rate. Kroesen et al. (2023) assessed how fear of COVID-19 infection and attitudes towards working from home influence train use and attitudes, and concluded policy suggestions related to attitude change and the promotion of train use. Ton et al. (2022) studied the remote working of train passengers during and after COVID-19, supporting operators and authorities in policy formulation and design. Hensher et al. (2022) used a mixed logit choice model to describe the relationship between working from home and commuting, enabling transport planners to adjust their predicted modal shares and overall travel patterns based on the prevalence of remote work. It can be seen that the railway freight and passenger transportation have different prospects for post-COVID development and research on different targets often leads to different conclusions.

Overall, most existing studies focus on overall mobility changes or single transport modes during the pandemic, while the behavioral mechanisms of railway passengers in the post-COVID-19 era remain underexplored. Research using SEM or scenario analysis to predict future travel behavior is still limited. Moreover, as Łuczyszyn (2024) noted, post-pandemic recovery should follow sustainable development goals, yet the link between pandemic-induced behavioral changes and long-term railway sustainability has rarely been discussed. Therefore, this study combines SEM and scenario planning to bridge these gaps and provide deeper insights into post-COVID railway travel behavior and sustainable development.

3 Factors affecting railway passenger behavior

Generally, railway passenger travel behavior is influenced by both individual and environmental factors. Individual factors include passenger travel habits (PTH) and passenger travel intentions (PTI). Environmental factors mainly refer to the inherent attributes of railway (IAR). In the post-COVID-19 era, factors influencing travel behavior include not only the mentioned ones above but also government policies in response to the pandemic (GP), prevention measures from the railways (PM), passenger behavioral responses towards policies and measures (BR) and personal risk awareness (RA). In this section, we focus on the factors which are related to the pandemic.

Government policies in response to the pandemic (GP) have an impact on the development trend, speed and market share of various modes in the transportation system, as well as support or abandonment of certain travel modes from the public. For example, during the COVID-19 outbreak, governments took strict restrictions to control the spread of pneumonia, including limitations on passenger movements and so on. These policies affected railway passenger travel behavior inevitably. Furthermore, during the pandemic, many factories have halted or reduced production, leading to the decrease of railway freight volume.

To ensure the health and safety of passengers during travel, railway operators have implemented a series of preventive measures (PM), such as taking temperature, wearing mask, enhancing train disinfection, adjusting fare or train service frequency. These measures change the cost of passenger travel, which affects the passengers' willingness to travel by railway in turn. Passengers make decisions based on the effectiveness of various measures from their own opinion.

With regard to the policies and measures taken by the government and railway operators, passengers have different behavioral responses (BR) to them, which may reduce their enthusiasm for travel. In this case, passengers may tend to choose alternative modes of transportation instead of railway to avoid these policy measures.

Personal risk awareness (RA) plays a significant role in passenger travel behavior. As railway carriages need to transport a large number of people, the space is crowded and the risk lasts along the whole journey. Passengers may contact with infected individuals during rail travel. Generally, the increased number of infections in society, virus mutations and influenza outbreaks due to seasonal changes may lead passengers to avoid travel as much as possible. Even if travel is necessary, they may choose relatively enclosed modes of transportation, such as private cars.

In general, the above-mentioned 7 factors influence passenger decision making regarding rail travel collectively. The travel by rail of each passenger contributes to the mobility of the railway industry. However, these 7 factors cannot be directly quantified. Therefore, we consider using SEM to describe passenger choice behavior through observable variables.

4 Passenger behavior description with SEM

The 7 factors mentioned above are selected as latent variables to construct SEM. The involved observable variables corresponding to latent variables are shown in Table 1.

Based on the latent and observable variables in Table 1, the following assumptions can be proposed for the model of railway passenger behavior, as shown in Table 2.

Based on the assumptions, the theoretical SEM describing railway passenger behavior has been obtained for the new normal, as shown in Fig. 1. Each assumption corresponds to a path in Fig.1.

According to the theoretical model, a questionnaire has been designed and given out via the Internet platform. In the end, a total of 3,318 valid samples have been collected. After conducting statistical analysis of the data and reliability and validity tests, the initial SEM of railway passenger behavior can be built, utilizing AMOS to generate a path diagram representing the relationships between latent variables. The initial SEM involves 7 latent variables, including 4 exogenous variables and 3 endogenous variables, as well as 39 observable variables. After importing the data for each observable variable, the model was fitted using maximum likelihood estimation. The goodness of fit of the model should be tested by fit indices. The initial fit of the model is shown in Table 3.

Table 1 Involved latent and observable variables

Latent variables	Observable variables
passenger travel habits (PTH)	frequency; distance; cost; mode ($pth_1 \sim pth_4$)
passenger travel intentions (PTI)	leisure; business; visiting relatives; commuting ($pti_1 \sim pti_4$)
inherent attributes of railway (IAR)	departure and arrival time, cost, punctuality, operating hours, service frequency and quality, comfort, disinfection, application of emerging technology ($iar_1 \sim iar_8$)
government policies (GP)	zero-COVID; allowing cross-border; stopping epidemiological survey; travel encouragement; increasing vaccination rate ($gp_1 \sim gp_5$)
prevention measures (PM)	regular sanitization, mask-wearing, increasing service frequency, controlling number of passengers in station; reducing price; ensuring revenue ($pm_1 \sim pm_6$)
behavioral responses (BR)	negative nucleic acid; being quarantined; nucleic acid test; limitation of daily activity; high risk area ($br_1 \sim br_5$)
risk awareness (RA)	increasing infections; fear of infection; virus mutations; low immunity; influenza outbreak; virus spreading fast; spring festival travel rush in China ($ra_1 \sim ra_7$)

Table 2 Summary of basic assumptions

Number	Assumption
H_1	IAR and PM have a positive correlation.
H_2	IAR and GP have a positive correlation.
H_3	IAR and BR have a positive correlation.
H_4	IAR and RA have a positive correlation.
H_5	PM and PTH have a negative correlation.
H_6	GP and RA have a positive correlation.
H_7	GP and BR have a positive correlation.
H_8	GP and PM have a positive correlation.
H_9	BR and PTI have a positive correlation.
H_{10}	BR and RA have a positive correlation.
H_{11}	RA and PTI have a positive correlation.
H_{12}	PTI and PTH have a positive correlation.

The fit indices of the initial SEM, except for RMSEA, do not meet the recommended value for fit. Therefore, it is necessary to make modifications to the model. The value of CMIN should be reduced after modification.

To address this, the SEM was modified using the following methods:

1. Adding new paths. During modification, 8 additional paths between latent variables were added as model assumptions, as shown in Table 4. Moreover, additional paths between observable variables and latent variables were also permitted, resulting in a total of 15 new paths.

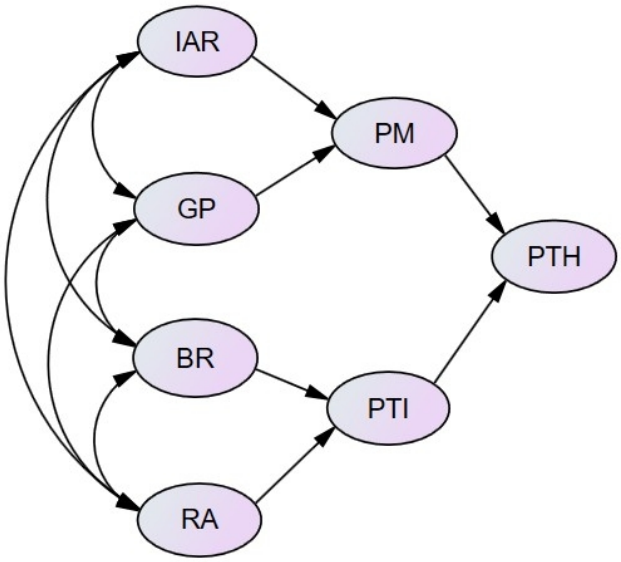

Fig. 1 Theoretical SEM of railway passenger behavior

Table 3 Result of the fit of initial SEM

Indicators	Recommended value	Fitted value	Satisfactory
CMIN	The smaller, the better	3,117.195	Unclear
CMIN/DF	<3.0	4.423	Not satisfied
AGFI	>0.8	0.738	Not satisfied
RMSEA	<0.08	0.077	Satisfied
IFI	>0.9	0.774	Not satisfied
CFI	>0.9	0.773	Not satisfied

Table 4 Summary of additional assumptions during modification

Number	Assumption
H_{13}	GP and PTI have a positive correlation.
H_{14}	IAR and PTI have a positive correlation.
H_{15}	RA and PM have a positive correlation.
H_{16}	BR and PM have a positive correlation.
H_{17}	PM and PTI have a negative correlation.
H_{18}	BR and PTH have a positive correlation.
H_{19}	GP and PTH have a positive correlation.
H_{20}	IAR and PTH have a positive correlation.

2. Removing some observable variables. Through factor loading calculations, it was found that the factor loadings of some observable variables were below 0.5 (i.e. pm_5, pm_6 and ar_7). Therefore, these observable variables were removed from the SEM.
3. Adding observable variables. After reanalyzing and integrating the result of the survey, 2 new observable variables, i.e. iar_9 (preparation in advance) and iar_{10} (convenient remote working conditions), were added to the latent variable IAR in the SEM.

The modified model was tested by fit indices and the final fit of the SEM is shown in Table 5. The value of CMIN has declined from 3,117.195 to 1,539.838, which is acceptable.

Fig. 2 shows the paths of the modified SEM and the results of the significance tests indicate that assumptions H_1, H_2, H_4, H_5, H_7, H_9, H_{10}, H_{12}, H_{13}, H_{14}, H_{15}, H_{16}, H_{18}, and H_{20} aresupported. Overall, it can be seen that in the post-COVID-19 era, railway passenger travel behavior is influenced by the inherent attributes of railway (IAR), government policies in response to the pandemic (GP) and passenger behavioral responses towards policies and measures (BR) primarily. In the pre-COVID-19 era, railway passengers may have considered factors such as travel time, purpose, punctuality, comfort and convenience, which belong to the set of IAR. However, the comparative analysis reveals that in the post-COVID-19 era, passengers are more influenced by GP and BR, leading to a decrease in the importance placed on the IAR. This indicates a significant change in railway passengers' travel behavior during the new normal.

5 Scenario planning to discuss possible future

Mobility change of railway passengers in the new normal is still unclear, so it's meaningful to design scenarios from a variety of possible situations through scenario planning. The key issue for constructing the scenarios is to find out the level of mobility change including ridership, passenger behavior and other operational characteristics of railways. Under the pandemic context, railway passenger mobility change could be influenced by the railway supply chain (including suppliers, infrastructure managers, rolling stock leasing companies, train operating companies, etc.), railway regulators and other government agencies. After a comprehensive review from political, economic and societal perspectives, the following 3 trends (T_1, T_2 and T_3) are identified as relevant, as shown in Table 6.

7 key uncertainties that would affect the railway industry under the impact of COVID-19 are identified from political, economic and societal perspectives. As shown in Table 7, the uncertainties are grouped into COVID-19

Table 5 Result of the final fit of modified SEM

Indicators	Recommended value	Fitted value	Satisfactory
CMIN	The smaller, the better	1,539.838	Acceptable
CMIN/DF	<3.0	2.433	Satisfied
AGFI	>0.8	0.855	Satisfied
RMSEA	<0.08	0.050	Satisfied
IFI	>0.9	0.913	Satisfied
CFI	>0.9	0.912	Satisfied

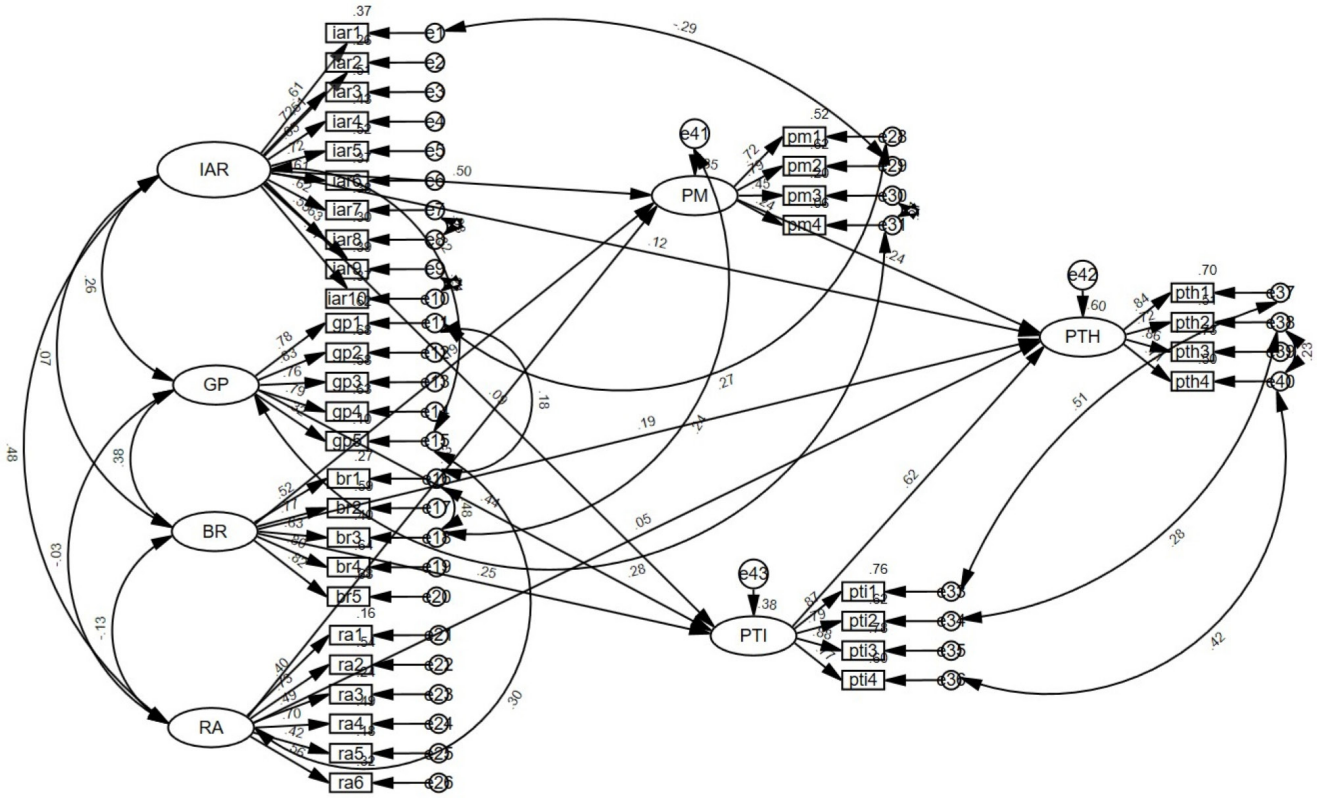

Fig. 2 SEM finally modified and fitted

Table 6 Possible trends that can be used in scenario planning

Key trends	Description
T_1	increased competition between transport modes and service providers
T_2	the society adopting new work/life pattern
T_3	increased awareness on environment and sustainability

Table 7 Key uncertainties that affect the railway industry

Uncertainties	Description
U_1	COVID-19 cases and deaths
U_2	COVID-19 control and management (vaccination, testing, tracing, treatment etc.)
U_3	level of health risk (contracting the COVID-19 from daily activities) perceived by the public
U_4	global economic situation
U_5	business/commercial activities compared to pre-COVID
U_6	restriction on national and international mobility
U_7	level of political focus in railway compared to other transport modes

specific (U_1, U_2 and U_3), economy and business (U_4 and U_5) and transport specific (U_6 and U_7) ones.

Each uncertainty factor may lead to different outcomes in the future. For example, for U_1, the possible outcomes include: complete eradication of COVID-19; continued presence and spread of the virus with a low fatality rate; emergence of more infectious and deadly variants. By assigning three possible outcomes to each uncertainty, a cross-impact matrix analysis was conducted to examine all possible combinations. The unrealistic combinations were excluded, and similar scenarios were merged. Following the systems-theoretical approach of Roth et al. (2024), 4 possible scenarios for the new normal of the post-COVID-19 era have been defined. The 4 possible scenarios range from the most optimistic about the virus being eradicated (S_1), through 2 different scenarios where COVID-19 is present but controllable (S_2 and S_3) and a final scenario that is the most pessimistic, where new variants are not contained by control measures (S_4). The descriptions of the 4 possible scenarios are as follows.

- S_1: COVID-19 nearly disappears. All the measures taken to manage COVID-19 pandemic including mass vaccination, testing, track-and-trace are effective. The coronavirus is temporarily eliminated from human civilization. Physical business and commercial activities are fully resumed, contributing to a thriving economy. There are no more restrictions on national and international mobility. People do not worry about any risk of contracting the coronavirus in their daily lives. Increasing social

awareness on sustainable lifestyles leads to more political focus on the development of railways compared to other modes of transport.

- S_2: Order restoration with the virus still in circulation. Measures taken to manage COVID-19 pandemic including mass vaccination, testing, track-and-trace are somewhat effective. The coronavirus is still infecting people in some areas, but the scale of its spread is controlled and the death rate is low. Physical business and commercial activities are resumed, but with limited capacity. The world economy is steady but only recovers to its state before the pandemic slowly. National and international trips are permitted with compulsory safety measures in place. People are somewhat aware of the risk of contracting the coronavirus in their daily lives, but most people are not worried. Considering the public health risks and the variety of alternative transport modes available, although all modes are permitted, the government does not promote or increase funding for public transport, so the railway does not stand out in the competition among the transport modes.
- S_3: Cautious existence. Measures taken to manage the COVID-19 pandemic including mass vaccination, testing, track-and-trace are somewhat effective. The coronavirus is still infecting people in some areas, but the scale of its spread is controlled and the death rate is low. Physical business and commercial activities are resumed, but with limited capacity. The world economy is steady but has not recovered to its state before the pandemic. National and international trips are permitted with compulsory safety measures in place. People are aware of and somewhat worried about the risk of contracting the coronavirus in their daily lives. The perception of health risk, together with the social trend towards virtual interactions, makes railway travel a less popular choice over time.
- S_4: Crisis spread. All the measures taken to manage the COVID-19 pandemic including mass vaccination, testing and track-and-trace, have failed. New variants of the coronavirus are widespread and more deadly. People live in fear of contracting the virus, being reluctant to go outside. Physical business and commercial activities are closed, and everything is conducted online if possible. The world economy is in deep crisis. Most parts of the world go into complete lockdown. The social trend towards virtual interactions reduces physical travel need. Railway and some other public transport modes are only providing very limited service or have stopped operations following government requirements.

6 Railway passenger mobility under different scenarios

While designing the questionnaire, some questions required respondents to answer based on a specific scenario. 4 scenarios were assigned to the respondents with equal probability and the specific description of each scenario was presented on the questionnaire. As a result, data samples could be collected for 4 different scenarios. The modified SEM could be adjusted specifically based on the sample from each scenario, resulting in 4 SEMs that reflected the characteristics of the different scenarios. Since the modified SEM had already passed the goodness-of-fit parameter test and significance test, only a few adjustments were enough in the process of modification based on specific scenario, generally by adding some additional paths.

Estimated results that differ significantly and have interpretability across the 4 scenarios are listed in Table 8.

Based on the model under different scenarios, it can be seen that as the pandemic situation gradually worsens, GP and BR will become greater influence on railway passenger travel, while the influence of IAR will decrease. There is no longer a significant correlation between these factors and passengers' propensity to travel.

In S_1, the standardized coefficient of the path between BR and PTI is low compared with that in other scenarios. BR refers to some troubles that may concern during the journey, influencing railway passengers' choices. In S_1, the disappearance of COVID-19 diminishes the impact of BR on passenger behavior. However, in other scenarios, the standardized coefficients gradually increase with the severity of COVID-19, indicating that BR's influence on passenger travel choices grows as the pandemic spreads.

The standardized coefficients between GP and PTI are similar within the 4 scenarios, with relatively higher

Table 8 Estimated results of path in different scenarios

Path	Estimate under S_1	Estimate under S_2	Estimate under S_3	Estimate under S_4
PM ← IAR	0.617	0.577	0.541	0.473
PM ← RA	0.215	0.193	0.192	0.294
PTI ← BR	0.225	0.411	0.432	0.451
PTI ← IAR	0.389	0.124	0.246	0.018
PTI ← GP	0.297	0.391	0.372	0.311
PTH ← PTI	0.528	0.581	0.552	0.709
GP ↔ RA	0.286	0.132	−0.053	0.064

coefficients observed in S_2 and S_3. Considering that S_2 and S_3 represent a moderate severity of pandemic, the railway passenger travel choices are likely to be influenced by that. Passengers may decide to choose railway or not based on GP. In S_1 and S_4, representing extreme conditions, GP have less impact on their decision. In S1, passengers do not need to consider much when making decisions. While in S_4, a majority of passengers would prefer to stay at home, resulting in a comparatively lower influence of GP on travel choices compared to S_2 and S_3.

With the absence of impact from the COVID-19 pandemic on passengers' daily lives in S_1, passengers may be more concerned with the convenience and comfort of the travel. However, due to the outbreak of the pandemic and severe symptoms after infection in S_4, most social activities have been suspended and railway might be shut down at any time. Consequently, the influence of IAR on passenger travel behavior has progressively diminished, with model testing indicating that this path is no longer significant.

7 Conclusion

This paper analyzes the factors which influence railway passenger mobility from various perspectives based on existing research and data, proposing a theoretical SEM model and constructing potential scenarios in the future. At the same time, an online survey was conducted to collect data on this issue.

After modifying SEM combined with 4 scenarios, it was determined that latent variables GP, BR and IAR have a significant influence on railway passenger travel behavior in the new normal. The remaining latent variables, such as PM, are directly influenced by RA and IAR, thus influencing passenger travel behavior indirectly.

The disadvantage of this research is that the observable variables corresponding to each latent variable need to be designed more comprehensively. In future research, the questionnaire could be improved further. Moreover, it would be beneficial to include additional observed variables that describe passengers' psychological changes, providing a more objective description of railway passengers' mobility changes.

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