



Investigating the social effects of Covid-19 pandemic in the passenger sector of railroad transportation (Case study: Railways of the Islamic Republic of Iran)

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ABSTRACT

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The spread of the corona virus has significantly affected human life. One of the most important sectors that has been affected by the spread of Covid-19 virus in the world is the transportation industry. Reviewing the statistics shows a 71% decrease in the number of train passengers and a loss of 414 million Dollar due to the decrease in rail travel in the first ten months of March 2020- January 2021 comparing to the same period in March 2019- January 2020. With the purpose of identifying the effective factors and the effect of variables related to the spread of Covid-19 virus on Iranian rail transportation, in this paper, meanwhile the effects of this disease on the transportation industry in worldwide scale has been reviewed briefly, its effects on the passenger transportation section of intercity trains are investigated in commuter train and long-distance categories. This study was performed by analyzing 390 questionnaires designed and distributed among people who have traveled by train during March 2017 or December 2019 (before the outbreak of the virus). The results of multivariate analysis of variance showed that there are significant differences between number of family personal vehicles ($p < 0.01$), passenger income level ($p < 0.05$), having underlying disease ($p < 0.001$), correct and accurate knowledge about corona, ($p < 0.05$) rail travel safety in terms of virus transmission ($p < 0.01$) and using train, choosing an alternative transportation system and not using rail transportation during the epidemic spread of the Covid-19 virus.

1. Introduction

The prevalence of Coronavirus in the present age is an emerging phenomenon considering its spread and the importance of its impact on human life and despite having similar experiences in the past, such as the plague epidemic and despite the great advances in medical science, the world has not been certain about how to deal with it, and there are still many unknowns in investigating this phenomenon and the extent of its impact on various aspects of human life.

Human life has been the scene of various events throughout history; events such as war,

famine, natural disasters, and the spread of incurable diseases. The human reaction to each of these phenomena, despite the fundamental similarities during different periods, has changed and had differences, so the impact of each of the above factors on other different aspects of life will be different.

Wuhan, as the capital of Hubei Province with a population of more than 11 million people, is the largest city and most important traffic hub in central China. Since December 2019, the outbreak of Covid-19 disease has occurred in Wuhan [1]. The disease outbreak coincided with the Chinese Spring Festival when the largest annual population shift began. Before the traffic

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ban was imposed on January 23, 2020, about 5 million Wuhan residents left the city [2]. During the latent period of the disease, infected people brought the virus to other cities, and the transmission of the Coronavirus from person to person caused it to spread throughout the country, such that as of February 9, there were 330 other cities in addition to Wuhan that reported confirmed Covid-19 cases in mainland China. The virus spread rapidly in many countries around the world until, in March 2020, the World Health Organization declared an epidemic.

The Covid-19 virus epidemic can be considered as the most important factor influencing human lifestyle this year and even in the 21st century. How this virus affects advanced human beings in the 21st century and the type of human behavior and reaction to this phenomenon in the present age will certainly be different from other similar cases in past centuries.

The virus has not only caused many casualties but has also imposed a huge financial load on human beings in various aspects. Therefore, addressing the various aspects of the impact of this virus on human life will be important, useful, and practical. Recent researches have investigated the social effects of the corona pandemic on the demand sector of transportation [e.g., 3-6], but the effect of the corona pandemic in the passenger sector of railroad transportation is not investigated. Therefore, in this paper, we have investigated and studied it as much as possible from different aspects by addressing one of the unknown aspects of the virus outbreak, which is its influence on the passenger sector of the rail transport industry and the factors associated with the Covid-19 virus epidemic on the Commuter train and long-distance passenger travel in Iran. The introduction presents the purpose of the study and its relationship to earlier work in the field.

2. Literature review

Research and analysis of ten-year data have shown that there is a strong correlation between the spread of infectious diseases and the amount of traffic. In particular, increased traffic increases the prevalence of infectious diseases [7 & 8]. An analysis of ten types of flu over the past

300 years has shown that there is a very close relationship between the prevalence of the disease and the amount of traffic. The outbreak of a disease, which lasted a year, 300 years ago, can now reach anywhere in the world in one day due to the increase in traffic [9].

Research shows that the purpose of the trip, the choice of the transportation system, the distance traveled, and the number of trips during the corona epidemic is significantly different from the time before the outbreak of the virus, and currently, most trips are made just for shopping [e.g., 10-12]. The change in the tendency to use private and non-motorized vehicles instead of using public transportation during this period was significant, and in addition to variables such as gender, owning a car, employment status, distance traveled, and the primary purpose of the trip, people's concern about the spread of the virus is considered as the most important factor in choosing the type of travel transport system during the corona epidemic [13].

Various studies have shown that older travelers are more likely to delay their travel than younger people (18-35 years old) during the H1N1 virus outbreak [14] and [15]. According to a survey conducted in European and Asian countries, 75% of respondents were reluctant to use public transport during the SARS virus spread [16]. According to a recent survey, 40% of respondents to a survey in Hong Kong said they had avoided using public transport during the first wave of the coronavirus epidemic [17]. In Budapest, Hungary, the demand for public transport has dropped by 80%, while the use of private cars has increased by 43% to 65% [18].

Zheng et al. Showed in their research that there is a positive and significant relationship between the number of flights, trains, and buses from Wuhan, China, to six other major cities in this country and the total daily number of covid-19 cases. This relation is closer with the number of trains and buses, and the distance between Wuhan and other cities is inversely related to the number of Covid-19 cases in those cities and people who have been transported by public transportation have played an important role in the prevalence of Covid-19 disease [19]. There is a significant relationship between traveling by train and the prevalence of the Covid-19 virus, which is not the case for traveling by car and plane [20].

Globally, restrictions on the provision of services and the movement of people, along with authorities' advice about not traveling, have resulted in an almost 80% reduction in passenger volume for all rail services in the member countries of the UIC at the time of the restrictions. In the case of rail and international passenger services, with the closure of international borders for passengers, the volume of passengers has decreased by almost 100% for all operators. The losses to the member states of the UIC in 2020 and 2021 in the passenger transport sector are estimated to be 60 and 22 billion dollars, respectively [21]. The share of effects and consequences resulting from the elimination of activities related to rail transportation due to the prevalence of corona will be 0.2% of the total Iranian economy [22].

3. Method

3.1. Research data

As noted in the previous section, the coronavirus epidemic has had significant effects on travel-related variables. In this section, we examine these effects on rail travel. It should be noted that the aim of the rail travel phrase is short-distance intercity train travel (Commuter train) and long-distance train travel and does not include rail travel within the city (metro or tram). The extracted data from the statistics of the number of rail passengers in the first ten months from March 2020 to January 2021 (at the time of the outbreak of Coronavirus) compared to the same period in last year (pre-epidemic time) shows a 71% decrease in the number of passengers [23]. Figure 1 shows the comparison between the number of train passengers in three different months in three years 2018, 2019, and 2020, the peak of this decrease in the number of passengers was in April 2020 such that in this month, we have seen a decrease of almost 95% in the number of rail passengers, while over time, the use of trains has increased in the next months.

As shown in figure 2, passengers tend to use commuter trains which travel between one or more cities and a metropolis and usually travel a distance of up to 150 km, a little more compared to the long-distance trains, so that the rate of reduction in the number of passengers of long-

distance trains has increased from -96 percent in April to -48 percent in January, while these numbers have been -91 and -44 for commuter trains, respectively. Diagram 2 also shows that the average decrease in the number of rail passengers during the outbreak of the Coronavirus is decreasing over time and has reached from about -95 percent in April to about -47 percent in January compared to the same period in the previous year.

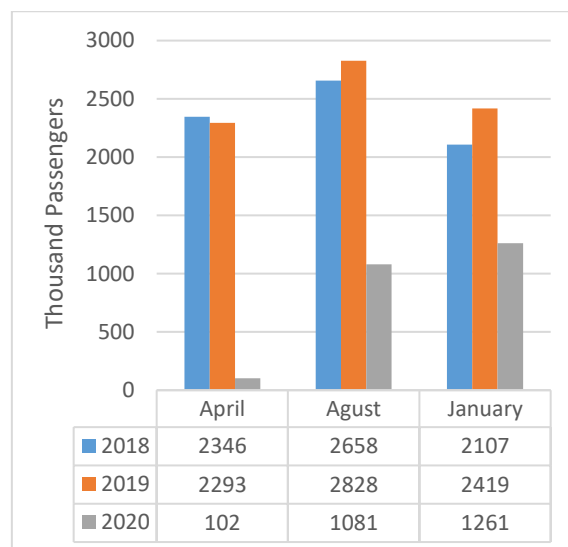


Figure 1- The comparison between the Number of train passengers in three different months in 2018 to 2020.

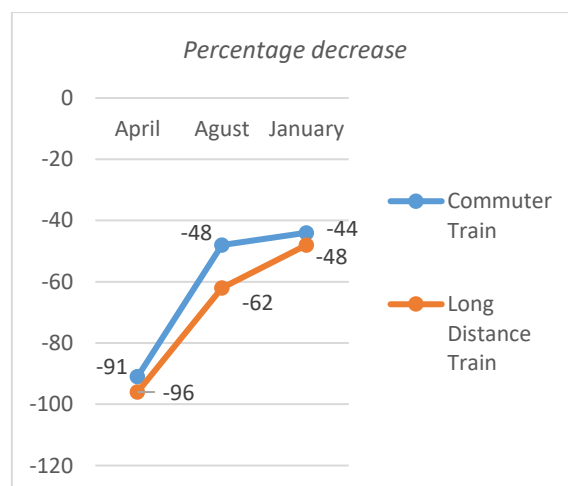


Figure 2:Percentage decrease in the number of passengers in the first three different months in 2019 compared to the same period in 2020 by train type

In this paper, in order to investigate the impact of the Covid-19 virus epidemic on rail passenger travel, a random sample of passengers who traveled by train before the outbreak of the

Coronavirus was selected, In order to make the variables and factors affecting travel demand compatible, this sample was limited to passengers who traveled by train during April 2017 and March 2019 (before the outbreak of the virus), Due to the large size of the statistical population, the Cochran's formula with an error of 5% was used to select the sample population (train passengers in the last two years leading to the outbreak of Coronavirus), the sample size was 390 persons, and The questionnaire was digitally distributed among the sample population in November 2020.

The effective variables in the process of determining the impact of this virus on rail travel were also determined using the variables determined by the World Health Organization in the travel section [24] as well as reviewing the relevant literature, preliminary knowledge of the study area, and opinions of elite experts in this field. These variables are shown in Figure 3.

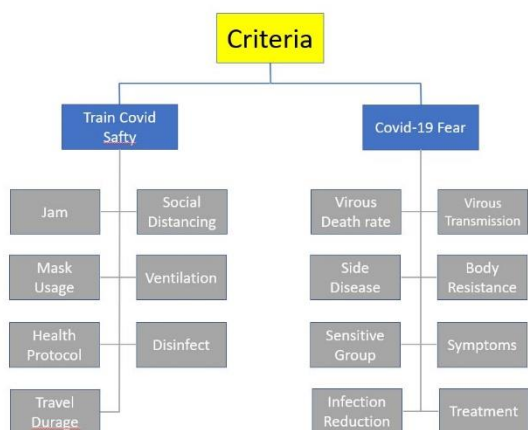


Figure 3- Effective criteria and sub-criteria in measuring the passenger's knowledge of Covid-19 virus and the factors perceived in the rail travel safety in terms of virus transmission

Considering the variables required to measure the criteria and to achieve the objectives set in this study, a questionnaire with 44 questions in three individual-economic-social sections, traveler knowledge, and opinions about the Coronavirus and travel variables has been prepared by rail travel approach. The scale of nominal and sequential variables was a five-level likert item. In this study, the "internal consistency" method was used to assess reliability. The Cronbach's alpha value which is an indicator of the reliability of the

questionnaire, is listed in Table 1. The data were entered into SPSS software for analysis. Details of the random sample variables' frequency analysis results are summarized in Table 2.

Table 1- Cronbach's alpha test for questionnaire reliability

Variables	Corona knowledge components	Components of rail travel safety in terms of virus transmission	The whole scale
Alpha value	0.845	0.932	0.824

Preliminary analysis of the data showed that the main reason or purpose of travel of 77% of rail passengers was faced with closure, obstruction or restriction, during the days of the widespread outbreak of the Coronavirus, and this has led to a situation that 53% of people who traveled by train during April 2017 and March 2019, do not take a trip similar to what they have had by train over the past two years, 14% of people changed their type of transportation system in 2019, and the remaining 33% still use trains for transportation. During the widespread outbreak of the Coronavirus (since April 2020). Among those who did not travel by rail in 2020, only 47% of them have expressed their desire to use the train in case of a necessary trip, and the rest of these people prefer to replace another transportation system. More than half of these people will replace the train with a personal ride for a trip similar to their rail trip (Table 2).

Table 2- Results of frequency analysis of individual-economic-social variables of the sample

Property	Frequency (%)
Gender	
Male	296 (76)
Female	94 (24)
Marital status	
Married	304 (78)
Single	86 (22)
Age	
Under 18	0 (0)
18 – 30 years old	66 (17)
31 – 40 years old	148 (38)
41 – 50 years old	121 (31)
51 – 65 years old	55 (14)
Above 65 years old	0 (0)
Level of Education	
Diploma and sub-diploma	8 (2)
Associate or bachelor's degree	176 (45)
Masters	187 (48)
PhD	20 (5)
Occupational status	
Part time	300 (77)
Full time	35 (9)
Retired	12 (3)
Unemployed	43 (11)
Driving license	
Yes	378 (97)
No	12 (3)

Property	Frequency (%)
Having an underlying disease	
Yes	55 (14)
No	335 (86)
Employed in essential jobs	
Yes	261 (67)
No	129 (33)
Number of personal vehicles of the family	
0	31 (8)
1	293 (75)
2	55 (14)
3	8 (2)
More than 3	4 (1)
The effect of Coronavirus on income	
The Income has increased	0 (0)
The Income has decreased	152 (39)
It has not had much effect	238 (61)
Having a person belonging to a sensitive group in the family	
Yes	195 (50)
No	195 (50)
Monthly income	
Lower than 150 \$	20 (5)
Between 150 and 300 \$	256 (68)
Between 300 and 500 \$	59 (5)
More than 500 \$	20 (5)

Changes in the tendency of passengers to choose the type of vehicle with which to get to the train station, before and after the outbreak of the Covid-19 virus, are shown in Figure 4, and as it is obvious, the general trend is to increase the use of private rides to get to the train station. As shown in Figure 5, "recreation or pilgrimage"

had the greatest reduction as the main purpose of traveling by train at the time of the outbreak of the virus, and "work" is the first major goal of traveling by train, whether before or after the outbreak of the disease. It is worth mentioning that goals such as education, treatment, sales are considered in this chart as "others."

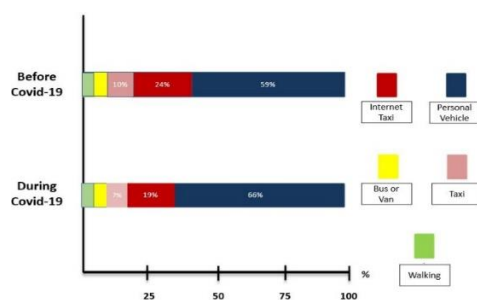


Figure 4: Comparison of changes in how rail passengers get to the train station before and after the Covid-19 virus outbreak

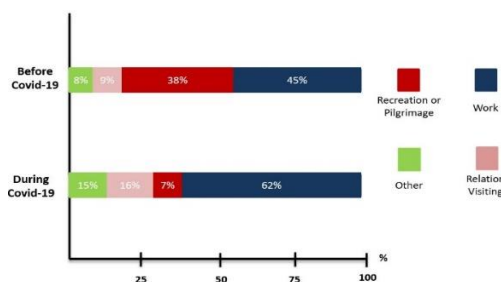


Figure 5- Comparison of changes in the main reason or purpose of traveling by train, before and after the outbreak of Covid-19 virus

4. Results

In order to investigate the relationship and significant differences between corona disease variables and rail travel safety in terms of virus transmission and individual-economic-social variables in the choice of the train as a means of transportation for travel during the Coronavirus epidemic and the choice of the vehicle other than train, multivariate analysis of variance (MANOVA) was used. This analysis is a statistical method for comparing the mean of several variables from several groups (population). This method is a generalized form of univariate analysis of variance (ANOVA) and is used when the number of dependent variables is two or more. This method helps to answer questions such as:

Do changes in independent variables have significant effects on dependent variables, and what are the interactions between dependent and independent variables [25]. According to Table 3, the MANOVA analysis was performed among individuals who selected the train at the time of the spread of the Coronavirus (N = 129), and people who have replaced the train with another type of transportation system at this time (N = 55) and people who have not gone on any travel similar to what they have done by train in the last two years (N = 206).

Table 3- Results of descriptive analysis of individual-economic-social variables, corona knowledge, and rail travel safety in terms of virus transmission of respondents by train users (N = 129), the users who have replaced train (N = 55), and no travel (N = 206) by MANOVA analysis

Index	Train users (SD)	Train replaced by another (SD)	no travel (SD)	F-Value	P-Value
Gender	0.88 (0.326)	0.98 (0.149)	0.93 (0.264)	1.797	0.169
marital status	0.47 (0.504)	0.6 (0.495)	0.54 (0.505)	0.928	0.337
Age	0.14 (0.345)	0.29 (0.458)	0.2 (0.401)	0.979	0.378
education	1.92 (0.816)	1.93 (0.915)	1.71 (0.814)	0.267	0.606
Number of personal family vehicles	0.63 (0.488)	1.04 (0.208)	0.66 (0.53)	10.23 ***	0.00
Occupational status	0.86 (0.345)	0.98 (0.149)	0.83 (0.381)	2.697	0.071
Having driver's license	0.19 (0.393)	0.18 (0.387)	0.15 (0.358)	0.081	0.922
Employed in essential jobs	0.19 (0.393)	0.33 (0.477)	0.12 (0.331)	2.772	0.066
Having a person belonging to a sensitive group in the family	0.17 (0.378)	0.24 (0.435)	0.15 (0.308)	0.644	0.526
Income	2.58 (0.649)	2.93 (0.33)	2.73 (0.633)	3.744 *	0.026

Knowledge about the virus	0.17 (0.378)	0.27 (0.447)	0.41 (0.499)	3.72 *	0.036
Having an underlying disease	0.73 (0.448)	0.51 (0.506)	0.2 (0.401)	18.04 ***	0.000
Rail travel safety in terms of virus transmission	0.34 (0.477)	0.44 (0.503)	0.63 (0.488)	7.819 **	0/006

Wilks' $\lambda=0.802$, $F=2.424$, *** $\rho<0.001$, ** $\rho<0.01$, * $\rho<0.05$

The overall results of this study were significant regarding the relationship between train use, replacement of another transportation system instead of train and non-rail travel with corona knowledge, rail travel safety in terms of virus transmission, and individual-economic-social variables. In this analysis, there was a significant difference between the average values of variables of individual income, the number of personal family vehicles, having an underlying disease, correct and accurate knowledge of the corona and the rail travel safety in terms of virus transmission, choosing an alternative transportation system and not traveling during the epidemic of covid virus-19.

The results showed that people with a more correct and accurate knowledge of the Coronavirus or people with an underlying disease were less likely to travel during the outbreak of the virus, people who believe in rail travel safety in terms of virus transmission are more likely to continue using the train, people with fewer personal cars and a lower average income are less likely to choose an alternative transportation system at this time.

A summary of the results of fitting the structural research model is shown in Table 4.

Figure 6 shows the structural research model in which the estimated regression coefficients between the research structural model variables are shown.

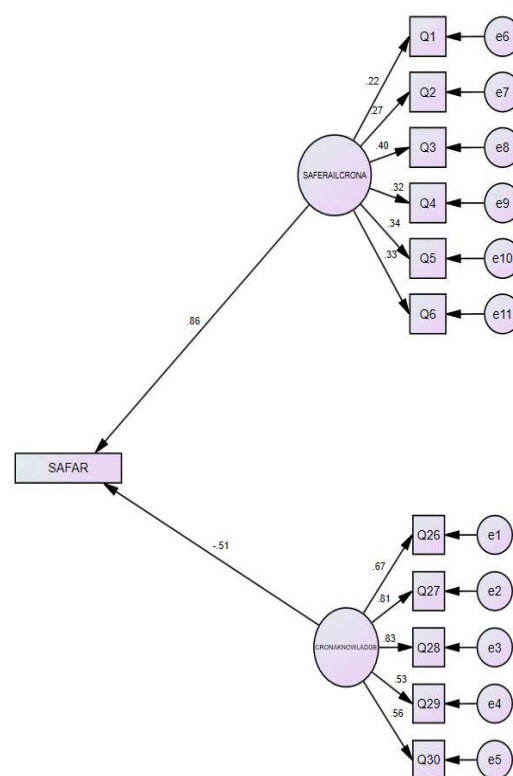


Figure 6- The values of the standard coefficients of the relationships between the variables of the research model in the structural mode

Table 4- Results of fitting the structural research model

Relationships between concepts and indicators in the model	Standard coefficient	Test statistics	Significance level
The effect of knowledge about Coronavirus on rail travel	0.86	4.273	< 0.001
Impact of perceived rail travel safety in terms of virus transmission	0.51	-10.501	< 0.001

The results of the above table show that the regression coefficient of the perceived viral safety standard for traveling by train is 0.86 with a significance coefficient of 4.273, which is significant and direct at the significance level of 5% (Because the significance level is less than the test level of 0.05 and the regression coefficient is positive). In other words, the more obeying the health protocols, disinfecting the fleet, observing the social distance on the train, using the mask by passengers, proper ventilation in the wagon, and reducing the number of passengers on the train, the more traveling by train during the outbreak of Coronavirus.

On the other hand, the standard regression coefficient of the correct and accurate knowledge of the Coronavirus is 0.51 with a significance coefficient of -10.501, which is significant and indirect at the test level of 5%. (Because the significance level is less than the test level of 0.05 and the sign of the regression coefficient is negative). In other words, the more a person knows about the Coronavirus, its lethality, effective treatment method, susceptible groups with underlying disease, how the virus is transmitted, and infection with the virus, the less travel by train during the Coronavirus outbreak.

6. Conclusions

The worldwide spread of the Covid-19 virus has had a profound effect on various aspects of human life. One of the effects of the outbreak of the virus, which was announced in the world in late 2019, is on the transportation industry, which has had a tremendous impact on the quantity and quality of travel. In this paper, an attempt was made to investigate the effects of the outbreak of the Coronavirus on the rail travels of passengers of the Railway Company of the Islamic Republic of Iran by reviewing its effects on transportation. After investigating the direct effects of the Covid-19 virus outbreak on reducing the number of rail passengers from April 2020 to January 2021 compared to the same period in the last year, we examined the effects of various variables on this type of travel during the corona epidemic in Iran. For this purpose, a questionnaire was designed and distributed digitally among the statistical population (390 persons) of rail passengers, which was determined using Cochran's formula with an error coefficient of 5%, who traveled by train during 2018 or 2019 (Before the outbreak of the virus in Iran).

Preliminary analysis of the data showed that the main reason or purpose of travel of 77% of rail passengers, in the days of the widespread outbreak of the Coronavirus, was faced with closure, obstruction, or restriction, and this has led to a situation in which 53% of people who traveled by train during 2018 or 2019, not take a trip similar to what they have had by train over the past

two years, during the widespread outbreak of the Coronavirus (since the beginning of April 2020), 14% of people have changed their type of transportation system in April 2020, and the remaining 33% still use trains for transportation. Among those who did not travel by rail system from April 2020 to January 2021, only 47% of them have expressed their desire to use the train in case of a necessary trip, and others prefer to replace the transportation system; More than half of these people will replace the train with a personal ride for a trip similar to their rail trip.

Using multivariate analysis of variance on the gathered data, the factors related to the use of the train during the outbreak of the virus, the choice of a train replacing the system, and the lack of rail travel were identified. The results obtained from the analysis of variables related to the mentioned cases were significant. Significant and relevant variables were the number of personal family vehicles, the amount of income, the extent of accurate knowledge of the virus, having an underlying disease, and rail travel safety in terms of virus transmission.

The results showed that people with more correct and accurate knowledge of the Coronavirus or people with an underlying disease were less likely to travel by train during the virus outbreak, people who believe in rail travel safety in terms of virus transmission are more likely to continue using the train, People with fewer personal cars and a lower average income are less likely to replace rail transportation with another system.

The results of fitting the research variables structural model showed that the higher the level of observing health protocols, disinfection of the fleet, social distance on the train, the use of masks by passengers, proper ventilation in the wagon, and the reduction in the number of passengers on the train, the more travel by train during the outbreak of Coronavirus and the more a person's knowledge about the coronavirus

lethality, the effective treatment method, the susceptible and underlying disease groups, the transmission ways of the virus and being infected, the less travel by train during the coronavirus outbreak.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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