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Research Article

An Analysis of the Influential Factors of Violations in Urban-Rural Passenger Transport Drivers

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Road passenger transport is important for keeping urban and rural areas connected. In order to explore the traffic safety mechanisms behind urban and rural passenger transport, the personal attributes of urban-rural bus drivers from different areas were investigated. Based on the binary logistic regression model, an impact analysis model of 14 indicators of bus driver violations was established. The results showed that personality, gender, bus route, road conditions, and nap habits were important factors that affect driver violations. Female drivers violated slightly more (27.7%) than male drivers (26.2%), but male drivers violated multiple times (2.1), which was significantly higher than female drivers (1.5). Drivers with choleric personality were more likely to violate the traffic rules than others. Rural bus drivers violated significantly more (32.7%) than urban bus drivers (8%). The violation proportion of drivers who usually take naps but were deprived of naps (35.3%) was higher than that of drivers who have no nap habits (21.8%). The research results can act as a reference for improving urban-rural traffic safety.

1. Introduction

Urban-rural passenger transport is defined as a public passenger transport system that travels between urban and rural areas and is an important mode of transport that serves both urban and rural residents. Traffic safety has long been an area of interest in the development of urban-rural passenger transport. Since 2021, serious urban-rural passenger traffic accidents have occurred in Ningxia, Gansu, Hunan, and other provinces in China, causing widespread societal concern. Traffic safety is closely dependent on drivers. According to traffic accident statistics from various countries, the proportion of road traffic accidents that were the result of human factors has been as high as 80% to 90% in recent years [1]. More than 93% of traffic accidents in the Chinese road traffic system are the result of human factors [2]. Of the 22 major road traffic accidents in Anhui Province in 2019, causing more than 3 deaths, the illegal behavior of drivers and passengers resulted in more than 60% of the traffic accidents [3].

Research has been undertaken in order to study the relationship between drivers and traffic accidents. Ge et al. used sample data of 299 Chinese drivers to study the relationship between impulsive behavior and violations. The positive behavior of the driver is positively correlated with some common violations, and three other dimensions of dysfunction are negatively correlated with positive driving behavior and positively correlated with abnormal driving behavior and fines [4]. Gilandeh et al. used a driving simulator to recruit 40 drivers to drive in different scenarios and identified the human factors behind risky driving behaviors [5]. Based on current research into driving behavior, Zhang et al. combined the abnormal driving behavior data from the Internet-of-Vehicles OBD to establish a correlation model between road conditions and abnormal driving behavior so as to establish a research framework for identifying road traffic safety risks [6]. Some studies have shown that adverse emotional and physiological states are the main factors that cause traffic accidents [7].

Many scholars have noticed that there is a correlation between driver gender and driving behavior. Zhang et al. studied urban traffic driving behavior and found that male drivers performed lane-changing operations earlier or more frequently than female drivers [8]. Tao et al. conducted a questionnaire survey on 200 drivers of different genders and

found that women are more prone to traffic violations and negligence, but there is little difference in driving behaviors between men and women overall [9]. Song found that men account for a larger proportion of traffic accidents caused by speeding than women [10]. Through an analysis of a Dutch database, Lourens et al. found that there was no difference in the degree of accident involvement between male and female drivers [11]. Chen and Liu believed that due to the obvious physical and psychological differences between male and female drivers, when women encountered scenarios involving sudden and emotional reactions, their scene processing ability was not as good as that of men [12]. Overall, most scholars believe that gender affects driving behavior, but no relevant evidence showing any necessary link to traffic safety has been found.

The psychological and physiological characteristics of drivers are important factors that affect driving behavior. Hamidreza et al. compiled a questionnaire on driver psychology and traffic behavior and conducted a survey on 336 public transport bus drivers in Tehran, Iran. There was a positive correlation between unsafe behaviors and accidents, indicating that strategies to improve organizational safety culture can reduce unsafe driver behaviors [13]. Chuang and Wu tested the stressors of Taiwanese bus drivers using the effort-reward imbalance model (ERI) and the universal ERI scale and found that physical demands, overtime, and stress-induced sleep problems were the main stressors for professional drivers [14]. Wang et al. used the Eysenck Personality Questionnaire (EPQ) and the Symptom Self-Rating Scale (SCL-90-R) to evaluate the personality and mental health of bus drivers and studied the relationship between drivers' mental health and personal characteristics. It was found that bus drivers are more extroverted and neurotic than the general population. These findings provide a theoretical basis for the selection of bus drivers and intervention measures for high-risk drivers [15]. From the perspective of psychology, Feng et al. categorized drivers' personalities as melancholic, sanguine, phlegmatic, and choleric and found that a driver's personality has a certain influence on their driving speed [16]. Feng et al. divided bus drivers into three groups, a cognitive intervention group, a forgiveness intervention group, and a no-treatment control group, through a grouped and classified survey in order to explore the effect of the cognitive intervention and forgiveness intervention on reducing expressions of anger and aggression while driving, and compared the three groups [17].

Many scholars have introduced the logistic regression model to analyze the relationship between drivers' personal attributes and traffic safety behavior. Lin et al. analyzed the relationship between motor vehicle driver attributes and accident severity by constructing a logistic regression model. Seven variables, including motor vehicle driver fault, were significantly correlated [18]. Tian and Liu designed and used a questionnaire to investigate 1,800 primary and secondary school students in Guangzhou and used the Pearson correlation analysis and a multiple regression model analysis. The results show that education, awareness, attitude, and personal factors affect the scores of adolescents' traffic safety behavior [19]. Through the LOGIT regression model, Song et al. found that factors such as women and the elderly were significantly correlated with the severity of driver injuries [20].

Currently, there exists a relatively large amount of research on the relationship between drivers as individuals and traffic safety but the research objects are mainly general drivers, and there are few studies on the illegal behavior of professional drivers engaged in urban-rural passenger transport. The road environment that urban-rural passenger transport drivers face is relatively complex, and both the mileage of bus lines and driving time are long, which more easily results in greater physical stress and psychological pressure on drivers. In addition, there are great differences in the traffic safety environment for urban and rural buses. Urban buses have set up standing areas, and the traffic volume is significantly larger, while rural buses have narrower roads, more bends, and imperfect traffic safety facilities. These factors will have different effects on driving safety behavior. Therefore, it is necessary to carry out research according to the characteristics of urban-rural passenger transport drivers. This paper studies the influence of the personal attributes of urban-rural passenger transport drivers on violations, explores the factors that influence driver violations, and provides a certain theoretical basis and reference for the selection of urban-rural passenger transport professional drivers.

2. Research Methods

2.1. Logistic Regression Model. The logistic regression model is a classification model that studies the relationship between classification results and influencing factors, which can be expressed as the probability of the occurrence of a certain result by the influencing factors. In the field of road traffic, the logistic regression model is an important model for analyzing individual traffic behavior. It can analyze the impact of one or more influencing factors on a nonnumerical classification result and can describe the decision-making behavior of individuals or groups more accurately and comprehensively, thus obtaining relatively rich research results. In this study, the binary logistic regression theory is introduced into the field of urban-rural passenger transport safety analysis, and an analysis model of urban-rural drivers' violations is established through a questionnaire survey.

The model's driving dependent variable y is a binary variable with values of 1 and 0, and x is a risk factor that affects y. Let the probability of $y = 1$ under the condition of x be

$$P = P(\mathrm{y} = 1 \mid \mathrm{x}) = \frac{e^{\alpha+\beta \mathrm{x}}}{1+e^{\alpha+\beta \mathrm{x}}} = \frac{\exp(\alpha+\beta \mathrm{x})}{1+\exp(\alpha+\beta \mathrm{x})}. \quad (1)$$

2.2. Questionnaire Design and Survey

2.2.1. Design of the Questionnaire. The content of the questionnaire is mainly based on the previous research and

Table 1: Questionnaire.

Project	Options	Detailed description	Project	Options	Detailed description
Gender	1	Male	Bus routes	1	City bus lines
	2	Female		2	Rural bus lines
Age	1	≤30	Bus line length	1	≤10 km
	2	30–39		2	11–20 km
	3	40–49		3	21–40 km
	4	≥50		4	≥40 km
Education level	1	Junior high school and below	Hours of bus driving per day	1	≤6 hours
	2	High school or secondary school		2	7–8 hours
	3	College for professional training		3	≥9 hours
	4	Undergraduate and above	Nightly sleep duration	1	≤5 hours
Driving age	1	1–3 years		2	6–8 hours
	2	4–6 years		3	≥9 hours
	3	7–10 years	Glasses worn	1	Yes
	4	≥10 years		2	No
Character	1	Melancholic	Number of penalties for violating traffic rules within three years	1	0 times
	2	Sanguine		2	1 time
	3	Phlegmatic		3	2 times
	4	Choleric		4	3 times or more
Three-year driver's license deductions	1	0	Traffic accidents in the past three years	1	0
	2	Within 3 points		2	1
	3	Within 6 points		3	2
	4	Within 12 points		4	≥3
Napping habit	1	Never naps	Traffic conditions	1	Poor
	2	Has a nap habit		2	General
	3	Take a nap		3	Better

earlier investigations. First, previous studies [11, 14, 21, 22] found that factors such as gender, age, sleep, driving experience, road conditions, and personality were related to driving violations. Secondly, through interviews with bus companies in Linquan County and Shitai County of Anhui Province, the factors that affect the drivers are analyzed. According to the interview results, indicators such as education level, bus routes, bus route lengths, and deductions were included in the survey content. In addition, in order to improve the accuracy of the driver violation data, the driver violation data are uniformly provided by bus companies. All factors related to bus driving safety were tried to be considered to predict unsafe driving behavior among bus drivers.

The questionnaires obtained are shown in Table 1.

2.2.2. Data Acquisition and Processing. The study included all drivers from public transport enterprises in Linquan County and Shitai County of Anhui Province. Linquan County is a typical plain area, and the road conditions for urban-rural passenger transportation are relatively flat with a wide field of vision. Shitai County is a typical mountainous area where the traffic routes are circuitous, the roads are narrow and sharp, and the field of vision is limited.

In order to improve the accuracy of the data, this survey adopts the real-name system through online questionnaires, requiring bus drivers to fill in the questionnaires objectively and impartially. The methods for filling out the questionnaires were explicitly explained by the researchers before the participants began a survey. On questions where drivers had doubts, the researchers were responsible for answering them. In total, 242 questionnaires were distributed, and all of the questionnaires were valid.

3. Establishment and Improvement of the Driving Violation Behavior Model

3.1. Descriptive Statistical Analysis. Table 2 presents basic information on the urban-rural transport drivers who participated in the survey, including 68 drivers with violation records and 178 drivers without violation records , some of whom have committed multiple violations.

3.1.1. Gender Analysis. Most of the urban-rural passenger transport drivers are male, with 206 males and 36 females (see Table 3). This is mainly due to the characteristics of the work of urban-rural passenger transport drivers. Their work intensity is high and their physical requirements are relatively high. Men have innate advantages and are more capable of doing this kind of labor-intensive work.

3.1.2. Age Analysis. The age range of the drivers is 22 to 59 (see Table 4). There are only 8 drivers under the age of 30, and most of the drivers are 40 years old or above. Further research found that it takes a long time for drivers to obtain

Table 2: Driver statistics.

Project	Frequency	Percentage	Project	Frequency	Percentage
Gender			Age		
Male	206	85.12%	≤30	8	3.31%
Female	36	14.88%	30–39	50	20.66%
Education level			40–49	93	38.84%
Junior high school and below	170	70.25%	≥50	90	37.19%
High school or secondary school	60	24.79%	Driving age (years)		
College for professional training	11	4.55%	1–3 years	2 5	10.33%
Undergraduate and above	1	0.41%	4–6 years	21	8.68%
Hours of bus driving per day			6–10 years	21	8.68%
≤6 hours	36	14.88%	≥10 years	175	72.31%
7–8 hours	113	46.69%	Three-year driver's license deductions		
≥9 hours	93	38.43%	0	175	72.31%
Character			Within 3 points	21	8.68%
Melancholic	0	0.00%	Within 6 points	35	14.46%
Sanguine	139	57.40%	Within 12 points	11	4.55%
Phlegmatic	58	23.90%	Bus routes		
Choleric	45	18.50%	City bus	62	25.62%
Wear glasses or not			Rural bus	180	74.38%
Yes	14	5.79%	Bus line length		
No	228	94.21%	≤10 km	5	2.07%
Traffic conditions			11–20 km	50	20.66%
Poor	77	31.82%	21–40 km	78	32.23%
Generally	112	46.28%	≥40 km	109	45.04%
Better	53	21.90%	Siesta habit		
Sleep time per night			Never nap	32	13.22%
≤5 hours	4	1.65%	Have nap habit	97	40.08%
6–8 hours	202	83.47%	Must take a nap	113	46.69%
≥9 hours	36	14.88%	Traffic accidents in the past three years		
Deduction in three years			0 times	216	89.60%
0 times	224	92.90%	1 time	19	7.80%
1 time	14	5.80%	2 times	5	2.0%
2 times	3	1.20%	≥3 times	1	0.40%

Table 3: Gender distribution.

Gender	Total	Bus driver		
		Percentage (%)	Number of accidents	Percentage (%)
Male	206	85.12	54	26.21
Female	36	14.88	10	27.78

Table 4: Age distribution.

Age	Total	Bus driver		
		Percentage (%)	Number of accidents	Percentage (%)
≤30	8	3.31	1	12.50
30–39	50	20.66	12	24.00
40–49	93	38.84	29	30.80
≥50	90	37.19	22	24.40

qualifications for urban-rural passenger driving, and urban-rural passenger transport driving is not well paid and is relatively boring, which is not attractive to young people.

3.1.3. Educational Level Analysis. The education level of drivers is mainly classified in the "junior high school and below" category (70.25%), as seen in Table 5, with no drivers attaining postgraduate education and most of the urban-rural passenger transport drivers not attaining higher education. This is mainly because there is no significant correlation between driving skills and education [23]. The driving profession is not attractive to the highly educated population in China.

3.1.4. Driving Experience Analysis. It can be seen from Table 6 that most of the drivers have more than ten years of driving experience (72.31%), which shows that most drivers are experienced at driving.

3.1.5. Personality Analysis. From Table 7, it can be seen that most of the drivers' personalities are classified as sanguine, and positive characteristics include calmness, tolerance, conscientiousness, patience, and hard work; however, they

Table 5: Distribution of educational attainment.

Education level	Bus driver			
	Total	Percentage (%)	Number of accidents	Percentage (%)
Junior high school and below	170	70.25	46	27.00
High school or secondary school	60	24.79	17	28.30
College for professional training	11	4.55	1	9.00
Undergraduate and above	1	0.41	0	0.00

Table 6: Driving experience distribution.

Driving experience	Bus driver			
	Total	Percentage (%)	Number of accidents	Percentage (%)
1–3 years	25	10.33	4	16.00
4–6 years	21	8.68	5	23.80
6–10 years	21	8.68	2	9.50
≥10 years	175	72.31	53	30.20

Table 7: Personality distribution.

Character	Bus driver			
	Total	Percentage (%)	Number of accidents	Percentage (%)
Melancholic	0	0.00	0	0.00
Sanguine	139	57.40	30	21.50
Phlegmatic	58	23.90	15	25.80
Choleric	45	18.50	19	42.20

Table 8: Distribution of driving license points deductions in a three-year period.

Deduction in three years	Bus driver			
	Total	Percentage (%)	Number of accidents	Percentage (%)
0	175	72.31	41	23.40
Within 3 points	21	8.68	8	38.00
Within 6 points	35	14.46	12	34.20
Within 12 points	11	4.55	3	27.20

are inflexible, lack enthusiasm, and conservative. No drivers described themselves as melancholic.

3.1.6. Three-Year Driving License Points' Deduction Analysis. The vast majority of drivers did not receive a points' deduction within a period of three years, as can be seen in Table 8, and the number of drivers who did not receive a points deduction was 175, accounting for more than 72% of the total, which shows that most drivers obey the traffic rules.

3.1.7. Nap Habit Analysis. Most drivers habitually take naps, among which 46.69% of the drivers must take a nap, while only 13.22% do not habitually take naps. This is mainly because driving a vehicle for a long time constantly results in drivers maintaining one posture, which consumes a lot of physical energy. Some people will choose a noon break to relax so that they have enough energy to work in the afternoon, as can be seen in Table 9.

3.1.8. Bus Routes' Analysis. From Table 10, it can be seen that there are 180 rural bus drivers and 62 urban bus drivers. With the rapid development of rural passenger transport, the demand for rural passenger transport has steadily increased, and more passenger routes need to be operated. At the same time, the proportion of driving violations (32.7%) in rural public transport is significantly higher than that in urban public transport (8.0%).

3.1.9. Analysis of the Lengths of Bus Lines. Urban-rural passenger routes are relatively long, and 109 people travel more than 40 kilometers in a single trip, accounting for 45.04% (see Table 11).

3.1.10. Analysis of Hours of Bus Driving per Day. The vast majority of drivers drive for more than seven hours a day, and 38.43% drive for more than 9hours. A driver's daily driving time is relatively long, and the work intensity is relatively high (see Table 12).

Table 9: Distribution of nap habits.

Nap habit	Bus driver			
	Total	Percentage (%)	Number of accidents	Percentage (%)
Never naps	32	13.22	7	21.80
Has a nap habit	97	40.08	17	17.50
Must take a nap	113	46.69	40	35.30

Table 10: Distribution of bus routes.

Bus routes	Bus driver			
	Total	Percentage (%)	Number of accidents	Percentage (%)
City bus	62	25.62	5	8.00
Rural bus	180	74.38	59	32.70

Table 11: Distribution of bus line lengths.

Bus route length	Bus driver			
	Total	Percentage (%)	Number of accidents	Percentage (%)
≤10 km	5	2.07	1	20.00
11–20 km	50	20.66	7	14.00
21–40 km	78	32.23	21	28.20
≥40 km	109	45.04	34	31.10

Table 12: Distribution of daily bus time.

Hours of bus driving per day	Bus driver			
	Total	Percentage (%)	Number of accidents	Percentage (%)
≤6 hours	36	14.88	13	31.60
7–8 hours	113	46.69	29	26.50
≥9 hours	93	38.43	22	23.60

Table 13: Distribution of sleep time per night.

Sleep time per night	Bus driver			
	Total	Percentage (%)	Number of accidents	Percentage (%)
≤5 hours	4	1.65	0	0.00
6–8 hours	202	83.47	56	27.70
≥9 hours	36	14.88	8	22.20

3.1.11. Sleeping Time per Night Analysis. From Table 13, it can be seen that the sleep time of urban-rural passenger drivers usually lasts between 6 and 8 hours, a proportion as high as 83%, which is not significantly different from other groups [24].

3.2. Reliability Analysis. In this study, Cronbach's alpha coefficient is used to analyze the reliability of the questionnaire through SPSS 25.0 software. The calculated result is $\alpha = 0.604$ greater than 0.6, indicating that the questionnaire has good reliability. The details are shown in Table 14.

SPSS 25.0 software was used to analyze the validity of the questionnaire, and the results are shown in Table 15. The KMO (Kaiser–Meyer–Olkin) coefficient is 0.532, which is greater than 0.50, and the Sig value is 0.00, which is less than 0.05. Therefore, a factor analysis can be performed.

3.3. Logistic Model Analysis

3.3.1. Selection of Dependent and Independent Variables. Based on whether the urban-rural bus drivers violated regulations, this study plans to classify the total number of drivers into two categories: violators and nonviolators. The value of the dependent variable Y is shown in Table 16. According to the questionnaire data, as shown in Table 16, all items are set as the independent variable X.

Table 14: Reliability statistics.

Cronbach's alpha	Cronbach's alpha based on standardized items
0.606	0.603

Table 15: KMO and Bartlett's tests.

KMO sampling suitability quantity		0.532
Bartlett's sphericity test	Approximate chi-square	207.339
	Degrees of freedom	28
	Significance	0.000

Table 16: Dependent variables.

Y	0	Not violated
1	Violated	

Table 17: Score test results.

Influencing factors	Score	Degrees of freedom	Salience
Gender	0.039	1	0.844
Age	0.083	1	0.774
Education level	0.748	1	0.387
Driving age	3.194	1	0.074
Character	6.695	1	0.010
Wears/does not wear glasses	1.13	1	0.288
Deductions in three years	1.762	1	0.184
Traffic accidents in the past three years	0.344	1	0.557
Hours of bus driving per day	1.641	1	0.200
Bus route	14.479	1	0.000
Route length	4.408	1	0.036
Sleep time per night	0.031	1	0.861
Nap habit	5.846	1	0.016
Number of penalties within three years	0.56	1	0.454

A Binary logistic regression analysis is performed on the questionnaire, and the forward stepwise regression method (LR method) based on the maximum likelihood estimation is used on the basis of the significance level $\alpha = 0.05$. According to whether the p value corresponding to the score value meets the given significance level, the variables that meet the requirements are preliminarily selected, as shown in Table 17.

The significance of all influencing factors is determined according to the preliminary test, and then, all influencing factors are gradually substituted into the equation. When the change of the estimated parameter value is less than 0.001, the estimation is terminated at the fifth iteration, and the following results are initially obtained, as shown in Table 18.

3.3.2. Model Verification. In this comprehensive test of the coefficients of the binary logistic regression model, the model line outputs the likelihood ratio test results of whether all parameters in the logistic regression model are 0, as shown in Table 19. The significance level is less than 0.05, which means that, in the model fitted this time, the OR (odds ratio) value of at least one variable is statistically significant, and the model is overall meaningful.

In this study, the Hosmer–Lemeshow tests are used to test the goodness of fit of the model, and the calculated significance level is $0.964 > 0.005$, indicating that the model has a good fit, as shown in Table 20.

Four influencing factors, including gender, character, driving route, and nap habit, were selected from the model results, and SPSS 25.0 software was used to carry out a binary logistic regression analysis on these four factors. The significance level $\alpha = 0.05$ using the input method, and the final results can be seen in Table 21, for details. In the comprehensive test of the model coefficients, the significance level is less than 0.05, indicating that the model is generally meaningful. In the Hosmer–Lemeshow tests, the significance level is 0.496, greater than 0.05, indicating that the model has a good fit.

4. Discussion

This study presented a comprehensive examination of driving violations in China through a case study of urban-rural bus drivers. Relevant research showed that approximately 6% to 8% of such drivers in China are accident prone, but the number of road traffic accidents caused by them accounts for approximately 30% to 40% of the total number of accidents [25]. Accident predisposition refers to an inherent property whereby some drivers are more prone to accidents than others for physical or psychological reasons. In order to explore the influencing factors behind driver violations, a binary logistic regression of urban-rural bus drivers was established based on data from a questionnaire survey, revealing that gender, character type, driving route, and napping habits were significant factors behind driving violations.

It has been debated whether there is a correlation between gender and traffic violations. McGuire et al. summarized the results of several studies and concluded that gender variables (under the premise of controlling for driving experience and age) were not significantly related to accident rates. However, accident severity is related to gender and has been recognized [26]. According to the International Road Traffic and Accident Database (IRTED), female drivers drive less frequently than male drivers, but female drivers commit more infractions than male drivers if both drive the same number of miles. Zhang et al. showed that female drivers have a lower accident rate than male drivers [10, 27], but it is widely believed that female drivers are more dangerous while driving. This study was slightly different from previous studies. The survey found that female drivers violated more (27.7%) than male drivers (26.2%), but in groups with violation records, the number of male drivers who had violated multiple times was significantly higher, with an average of 2.1 violations for men as opposed to 1.5 for female drivers. Further research found that male drivers are more confident in their own driving skills, and following violations, they are more likely to ignore or even contradict the traffic safety reminders from bus

Table 18: Model (if item is removed).

Step	Variable	Degrees of freedom	Salience
1	Bus route	1	0.000 _
2	Gender	1	0.001
	Bus route	1	0.000 _
3	Gender	1	0.001
	Bus route	1	0.000 _
	Nap habit	1	0.0 18
4	Gender	1	0.001
	Character	1	0.0 09
	Bus route	1	0.000 _
	Nap habit	1	0.00 7

Table 19: Comprehensive test of model coefficients.

		Chi-square test	Degrees of freedom	Salience
Step 4	Step	6.789 _	1	0.009
	Piece	4 0.425	4	0.000
	Model	4 0.425	4	0.000

Table 20: Hosmer–Lemeshow tests.

Step	Chi-square test	Degrees of freedom	Salience
4	1.431	6	0.964

Table 21: Variables in the equation.

	Degrees of freedom	Salience	OR (95%CI)
Gender	1	0.006	10.138 (1.929–53.289)
Character	1	0.005	1.778 (1.1187–2.665)
Bus route	1	0.001	28.682 (3.969–207.248)
Nap habit	1	0.012	1.911 (1.152–3.169)

enterprises, resulting in multiple traffic violations. Female drivers have a calm personality and are more likely to correct their mistakes after a violation occurs.

According to previous relevant research, a personality can be classified as melancholic, sanguine, phlegmatic, and choleric according to psychology. There was a close relationship between a driver's violation and their personality [16, 28]. Yi conducted surveys and interviews with 150 bus drivers in Chengdu city in China and found that choleric and depressive bus drivers are more likely to possess bad driving behaviors than phlegmatic and sanguine bus drivers [29]. Xiao et al. believed that the maneuvering behavior of choleric drivers was less safe, potentially resulting in accident-causing behaviors [30], which is basically similar to the research in this study. This study found that although choleric drivers account for a small proportion of the group (18.5%), their violation rate is 42.1%, which is much higher than that of sanguine drivers (21.5%) and phlegmatic drivers (23.9%). Therefore, bus companies should strengthen their guidance for choleric drivers.

Driving while fatigued is a significant cause of traffic accidents [2], and a driver's perceptual reaction time and ability to maintain attention decrease with a driver's drowsiness [31]. Related studies have shown that napping is an important factor that affects a driver's fatigue whilst driving. Following nap deprivation, a driver's subjective fatigue is significantly increased [32]. This study studied nap indicators in drivers and analyzed whether naps have a significant impact on driving violations (significance = 0.013). The violation proportion of drivers who habitually nap but are deprived of naps (35.3%) is higher than that of drivers who usually take no naps (21.8%). As a result, bus companies should provide drivers with places to nap so as to meet their needs of drivers.

Few scholars have comparatively studied violations among urban and rural bus drivers. This study found that there is a large difference in traffic violations between urban and rural bus drivers (the significance level is 0.000), and the proportion of rural bus drivers who violate the rules (32.7%) is significantly higher than the proportion of urban bus driver violations (8%), indicating that different driving environments have a greater impact on drivers. Compared with rural roads, urban roads have better environmental management and better transportation facilities, which can greatly affect the driving safety of bus drivers [33]. However, the construction of the rural road safety infrastructure lags behind relatively, and the traffic behaviors of participants differ greatly, which poses more of a challenge to drivers.

It is generally thought that age and driving experience correlate closely to driving violations. Lei et al. found that, with changes in driver age, driving behavior changes can also be seen, which affects safe driving [21]. Fang believes that drivers aged 40 to 52 drive relatively slowly, their driving behavior is relatively stable, and their driving overall is safer [22]. This study found that age and driving experience have no significant impact on whether bus drivers have traffic violations. The violations of drivers of different ages and different driving experiences are relatively close, but it is worth noting that bus drivers are generally older, with drivers aged 40 or above accounting for 76% of the total driver number. With an increase in age, the physiological functions and motor skills of drivers gradually decline, which has a greater impact on traffic safety.

5. Conclusions

The impact of the personal attributes of urban-rural passenger transport drivers on violations is an important topic of study in the field of transportation, and the behavior of drivers has a significant impact on traffic safety. This study investigated the personal attributes and violations of urban-rural passenger transport drivers and used the binary logistic regression model to analyze factors affecting the illegal behaviors of bus drivers. The following conclusions were drawn:

(1) The chances of urban-rural bus drivers having violations are significantly related to the driver's individual gender, personality, napping habits, bus driving routes, and road conditions.

(2) Male drivers with a choleric personality and drivers whose napping habits are deprived are most likely to behave illegally whilst driving, which should be paid more attention to. The research results can provide a reference in recruitment and in the management of public transport enterprises.

6. Limitations of This Study

(1) There is no guarantee that the data provided by the respondents are absolutely true, and future research should strengthen the review of multisource data.

(2) Although the data obtained from the questionnaire survey in this paper are representative to a certain extent, if the sample size can be further increased, the research conclusions will more truly reflect the actual situation. In addition, the number of female drivers in this survey is relatively small, and future research should further expand the sample size of the survey.

(3) The dependent variables used in the model in this study are divided into two categories: violations and nonviolations. In future research, violations can be further divided into high-risk violations and low-risk violations.

Data Availability

All the relevant data used to support the findings of the study are available within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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References

[1] NBSPRC, "China Statistical Yearbook-2019," China Statistics Press, Beijing, China, 2019, http://www.stats.gov.cn/tjsj/ndsj/2019/indexch.htm.

[2] X. Zhang, X. Wang, Y. Ma, and Q. Ma, "Advances in international research on driving behavior and driving risk," *Journal of China Highway and Transportation*, vol. 33, no. 6, pp. 1–17, 2020.

[3] D. Wu, Z. Wang, and X. Chen, "Analysis of the major road traffic accidents in Anhui Province in 2019," *Road Traffic Management*, no. 12, pp. 40-41, 2020.

[4] Y. Ge, W. Qu, M. Zhou, T. Zkan, and K. Zhang, "Psychometric adaption of the impulsive driver behavior scale in a Chinese sample," *Transportation Research Part F: Traffic Psychology and Behaviour*, vol. 68, 2019.

[5] S. S. Gilandeh, M. H. Hosseinlou, and A. J. Anarkooli, "Examining bus driver behavior as a function of roadway features under daytime and nighttime lighting conditions: driving simulator study," *Safety Science*, vol. 110, pp. 142–151, 2018.

[6] M. Zhang, X. Cai, and R. Du, "Exploration of urban road safety risk identification method driven by driving behavior data," *Traffic and Transportation*, vol. 36, no. 2, pp. 30–34, 2020.

[7] H. Guo, X. Han, and L. Liu, "Research on reliability risk measurement of driver's traffic safety behavior," *Chinese Journal of Safety Science*, vol. 23, no. 6, p. 7, 2013.

[8] X. Zhang, C. Pan, and X. Jin, "Microscopic driving behavior characteristics of urban road multi-lane weaving areas," *Traffic Information and Safety*, vol. 38, no. 3, p. 10, 2020.

[9] D. Tao, R. Zhang, and X. Qu, "The influence of gender, age and personality traits on risky driving behavior," *Journal of Shenzhen University: Science and Technology Edition*, vol. 33, no. 6, p. 7, 2016.

[10] X. Song, Y. Yin, H. Cao, S. Zhao, M. Li, and B. Yi, "The mediating effect of driver characteristics on risky driving behaviors moderated by gender, and the classification model of driver's driving risk," *Accident Analysis & Prevention*, vol. 153, p. 106038, 2021.

[11] P. F. Lourens, J. A. M. M. Vissers, and M. Jessurun, "Annual mileage, driving violations, and accident involvement in relation to drivers' sex, age, and level of education," *Accident Analysis & Prevention*, vol. 31, no. 5, pp. 593–597, 1999.

[12] Y. Chen and H. Liu, "Research on female driver's stress response ability," *Transportation Systems Engineering and Information*, vol. 12, no. 3, p. 4, 2012.

[13] H. Mokarami, S. S. Alizadeh, T. Rahimi Pordanjani, and S. Varmazyar, "The relationship between organizational safety culture and unsafe behaviors, and accidents among public transport bus drivers using structural equation modeling," *Transportation Research Part F: Traffic Psychology and Behaviour*, vol. 65, pp. 46–55, 2019.

[14] Y.-S. Chung and H.-L. Wu, "Stress, strain, and health outcomes of occupational drivers: an application of the effort reward imbalance model on Taiwanese public transport drivers," *Transportation Research Part F: Traffic Psychology and Behaviour*, vol. 19, no. 4, pp. 97–107, 2013.

[15] X. Wang, K. Wang, K. Huang, X. Wu, W. Huang, and L. Yang, "The association between demographic characteristics, personality, and mental health of bus drivers in China: a structural equation model," *Physiology & Behavior*, vol. 229, no. 6, Article ID 113247, 2021.

[16] Z. Feng, H. Yuan, and J. Liu, "Influence of driver's personal characteristics on driving speed," *Chinese Journal of Transportation Engineering*, vol. 12, no. 6, pp. 89–96, 2012.

[17] Z. Feng, J. Zhan, C. Ma et al., "Is cognitive intervention or forgiveness intervention more effective for the reduction of driving anger in Chinese bus drivers?" *Transportation Research Part F: Traffic Psychology and Behaviour*, vol. 55, pp. 101–113, 2018.

[18] Q. Liu, Y. Deng, and J. Hu, "Logistic regression analysis of factors affecting driver fault and accident severity in non-mechanical traffic accidents," *Safety and Environmental Engineering*, vol. 26, no. 5, pp. 187–193, 2019.

[19] S. Tian and E. Liu, "Analysis of adolescent traffic safety behavior based on multiple regression model," *Traffic Information and Safety*, vol. 000, no. 2, pp. 98–102, 2015.

[20] D. Song, X. Yang, X. Zu, and B. Si, "Research on the injury severity of drivers in urban road accidents based on mean heterogeneity random parameter Logit model," *Transportation Systems Engineering and Information*, vol. 21, no. 3, pp. 214–220, 2021.

[21] X. Lei, "Analysis of the influence of driver's age on driving safety," *Transportation Energy Conservation and Environmental Protection*, vol. 12, no. 6, pp. 15–17, 2016.

[22] Y. Fang, "Experimental research on the differences in driving behavior characteristics of different types of drivers," *Safety and environmental engineering*, vol. 27, no. 5, pp. 208–212, 2020.

[23] M. Bu, Y. Qin, and Y. Sui, "Analysis of Driving Risk Differences Based on Personality and Demographic Variables," *Journal of East China Jiaotong University*, vol. 033, no. 2, pp. 86–92, 2016.

[24] J. Li, Y. Pan, and Y. Yang, "Analysis of sleep time of adults in Tianjin," *Chinese Journal of Disease Control*, vol. 13, no. 5, p. 2, 2009.

[25] L. Zhao, H. Liu, and S. O. Automobile, "Study on relationship between driving behavior characteristics and personality traits," *Journal of Safety Science and Technology*, 2016.

[26] F. L. Mcguire, "Personality factors in highway accidents," *Human Factors*, vol. 18, no. 5, pp. 433–441, 1976.

[27] Y. Zhang, Y. Deng, Q. Lin, and C. Shi, "Analysis of influencing factors of car accidents with different gender drivers," *safety and environmental engineering*, vol. 26, no. 3, pp. 170–174, 2019.

[28] D. Yang, C. Ma, P. Liu, and X. Yang, "Influence of BRT driver's personal attributes on driving speed," *Traffic Information and Safety*, vol. 36, no. 6, pp. 54–64, 2018.

[29] T. Yi, "Investigation and characteristic analysis of bad driving behavior of bus drivers–taking Chengdu as an example," *Heilongjiang Transportation Science and Technology*, vol. 38, no. 10, pp. 166–168, 2015.

[30] J. Xiao, Y. Q. Qin, and Y. Y. Wang, "Research on the relationship between the driver's temperament and driving behavior," *Chinese Journal of Ergonomics*, vol. 20, no. 5, pp. 23–27, 2014.

[31] A. E. Kofi, "Better rested than sorry: data-driven approach to reducing drowsy driving crashes on interstates," *Journal of Transportation Engineering, Part A: Systems*, no. 10, p. 147, 2021.

[32] J. Fan, L. Wang, and M. Xie, "Effect of metal fatigue induced by nap deprivation on cognitive function and heart rate variability," *Medical Journal of Air Force*, vol. 40, 2018.

[33] Q. Li, *Research on the Influencing Factors of Traffic Accidents of Public Transport Vehicles*, Xidian University, Xi'an, China, 2015.