



Analysis of the Influencing Factors for Traffic Crashes-A Case Study of National Highway G205 in Zibo City

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Abstract Aiming at the problem of high frequency of traffic accidents in some sections of national highway, the main characteristics and influencing factors affecting the occurrence probability of traffic accidents were revealed by statistical analysis the data of 55 traffic accidents that occurred in the National Highway (G205-Zibo section) in 2019. The research shows that: (1) the number of traffic accidents at 14-16 p.m. and 20-22 p.m. are higher than that of other periods, but the probability of fatal traffic crashes is the highest at 4:00-6:00 a.m. and 8:00-10:00 p.m., accounting for 18.2% of the total number of fatal accidents, respectively; (2) The number of traffic accidents increases with the increase of visibility. In addition to the visibility of 100-200m, the number of death accidents also increases with the increase of visibility. (3) Among the types of vehicles involved in traffic accidents and responsible for them, the proportion of small buses is 49.1%, higher than other models. It was followed by non-motor vehicles (43.6%) and motorcycles (32.7%). (4) In terms of the causes of accidents, the proportion of traffic accidents caused by driving environment factors and driver factors is higher than other factors. Among them, the proportion of accidents occurred at intersections is the highest (67.3%), followed by over speed (30.9%), and the proportion of traffic signal violation is the lowest (3.6%).

Keywords Traffic safety; Traffic crashes; National highway; Risk factors; Statistic method

1. Introduction

With the rapid economic and social development, China's total highway mileage showed a steady increase from 2009 to 2018, and by the end of 2018, the total highway mileage was 4,846,500 km. Among them, 111,500 kilometers of Class I roads and 293,700 kilometers of Class II roads were built, an increase of 73,100, 0.63, and 13,200 kilometers, respectively, or 1.53%, 1.05%, and 1.03%, compared with 2017 [1]. The continuous improvement of the road network not only alleviates the criticism of traffic congestion, but also shortens the travel time of vehicles and reduces pollutant emissions. At the same time, the number of traffic accidents increased as road miles and vehicle ownership increased.

Among them, national highways carry more passenger and freight traffic, making them a high-risk section of the highway transportation network. The total number of traffic accidents on national highways exceeded 30,000, accounting for 25.56% of the annual accident volume, resulting in more than 13,000 deaths, 35,000 injuries, and 390 million yuan in property damage, accounting for 31.60%, 26.59%, and 47.10% of the total, respectively [2]. It has brought a severe test to the road traffic safety in China. Therefore, in order to reduce the probability of traffic accidents and improve the level of traffic safety, it is necessary to study the data of traffic accidents occurring on national highways, which is of significant significance for improving the safety level of road traffic.



In recent years, research on the probability of traffic accidents and their influencing factors has received extensive attention from scholars [3], and a comprehensive traffic safety theory system has been formed [4]. However, differences in the types of data used in different studies have led to different focuses, some of which have tended to focus on the effects of objective factors such as weather, visibility, and time of day on traffic accidents [5]. Some scholars have also focused on subjective factors such as driver gender, age, and speed to reveal the significant influences of traffic accidents [6]. Other scholars have studied the effects of differences in region, vehicle type, and other factors on traffic accidents [7]. The factors that have a significant impact on the occurrence and severity of traffic accidents have been studied in terms of people, vehicles, roads, and the driving environment. However, due to the differences in research focus and data types, the results are not always comparable.

In summary, the occurrence of traffic accidents has a significant impact on road safety, and it is important to reveal the influence of different factors on traffic accidents to improve traffic safety. Secondly, there are differences in the traffic operation characteristics between China and Europe and the United States, and their research results are not very transferable. Therefore, through the statistical analysis of the road traffic accidents involving injuries or deaths on National Highway 205 in Zibo City in 2019, this paper analyzes the characteristics and influencing factors of traffic accidents and proposes countermeasures for the prevention of traffic accidents from the aspects of driver management, motor vehicle operation, and road safety facilities, aiming to provide a theoretical basis for traffic management departments to formulate traffic accident prevention measures.

2. Traffic accident impact factor analysis

Through the statistics of the traffic accident database, there were 55 road traffic accidents involving injuries or deaths in G205-Zibo section in 2019, of which 22 were fatal accidents, resulting in 23 deaths and 41 injuries.

2.1. Regional Factor

G205 in Zibo City spans five administrative districts, including Boshan, Gaoxin, Linzi, Zichuan, and Huantai, and the regional distribution of the total number of accidents and the number of fatal accidents are shown in Figure 1. As can be seen in Figure 1, Huantai had the highest total number of traffic accidents and fatalities, with 19 traffic accidents and 8 fatalities, accounting for 34.55% and 36.36% of the total number of traffic accidents and fatalities, respectively. This phenomenon may be Huantai is located in the county, traffic control and traffic safety awareness of residents than urban areas, the phenomenon of local residents crossing the road from time to time, motor vehicles and electric vehicles illegal driving (such as speeding, overloading) is also more common, these behaviors will lead to an increased probability of traffic accidents. Zichuan had the second highest number of traffic accidents and the second highest number of fatal accidents, with 17 traffic accidents, including 6 fatal accidents, accounting for 30.91% and 27.27% of the total number of accidents and fatal accidents, respectively. The total number of accidents in the Gaoxin and the Zhoucun was lower, with four traffic accidents, and the Gaoxin had the lowest number of fatal accidents, with one fatal accident.

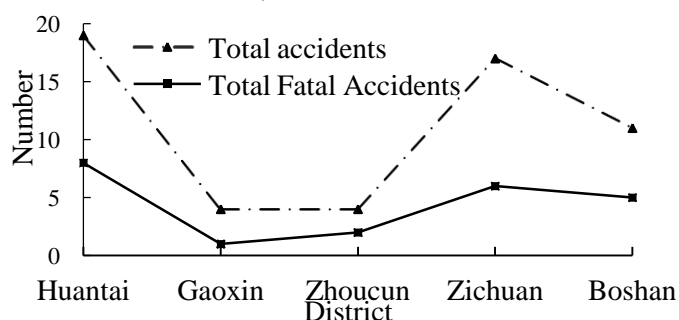


Figure 1: Regional characteristics of accident distribution

2.2. Time Factor

The time distribution of traffic accidents is shown in Figure 2 and Figure 3, which shows the time zone distribution characteristics and month distribution characteristics. As can be seen from Figure 2, there were 8



traffic accidents in the afternoon (14-16 pm) and evening (20-22 pm), which were more probable than other time periods, accounting for 14.5% of the total number of accidents. The probability of fatal traffic accidents is higher in the 20-22 hours than in the other hours, accounting for 14.5% of the total number of accidents. Among the 8 traffic accidents in the two hours, 3 fatal accidents occurred in the 14-16 hours, while 4 accidents involving fatalities occurred in the 20-22 hours, accounting for 50% of the total number of accidents in that hour. The probability of fatal traffic accidents is 66.67%, which means that the probability of fatal traffic accidents is highest in this period.

Moreover, the number of accidents in the 0-2 and 2-4 periods, although lower than in the 4-6 period, is still noteworthy because the number of accidents and fatalities increase from the 0-2 period to the 4-6 period. Because traffic volumes are much lower in the early morning hours than in other hours, the number of accidents, especially fatalities, did not decrease significantly, suggesting that accidents in the early morning hours are more likely to have serious consequences.

The reason may be that traffic control is weak during this period, and speeding and other violations are common, and traffic accidents tend to be more serious. Secondly, there was only one traffic accident in the morning peak period (8-10), indicating that although the traffic flow is large, the probability of traffic accidents is low in this period. In the evening hours (16-18), there were 7 traffic accidents, 2 of which resulted in fatalities, which shows that the probability of traffic accidents is at the second peak, but the probability of serious traffic accidents is low. At the macro level, there were 26 traffic accidents in the daytime (6-18), of which 9 were fatal, accounting for 34.6% of the total number of accidents; 29 traffic accidents in the evening (18-6), of which 13 were fatal, accounting for 44.8% of the total number of accidents in the evening, indicating that the number of traffic accidents in the evening was higher than that in the daytime, and that the nighttime traffic accidents in the evening accounted for 44.8% of the total number of accidents. Traffic accidents are also more likely to result in fatalities than during the day.

As for the characteristics of the monthly distribution of traffic accidents, we can see from Figure 3 that there were 9 traffic accidents in April, 5 of which were fatal accidents, the probability of traffic accidents and the probability of fatal accidents were 16.4% and 22.7% respectively, which were higher than other months; while the probability of traffic accidents in November was the lowest, with only 1 traffic accident and no fatal accident. From the trend of the monthly distribution curve of accident volume, the monthly curve of traffic accidents and the fatal accident volume curve were basically consistent, showing a gradual increase from January to April and reaching an annual peak in April. However, there is a decrease from April to June, and then a slight increase again after July, and then the number of accidents falls to the lowest level in the whole year in November.

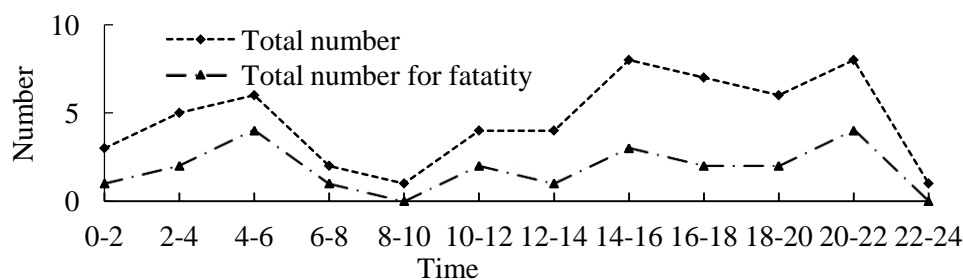


Figure 2: Time zone distribution characteristics

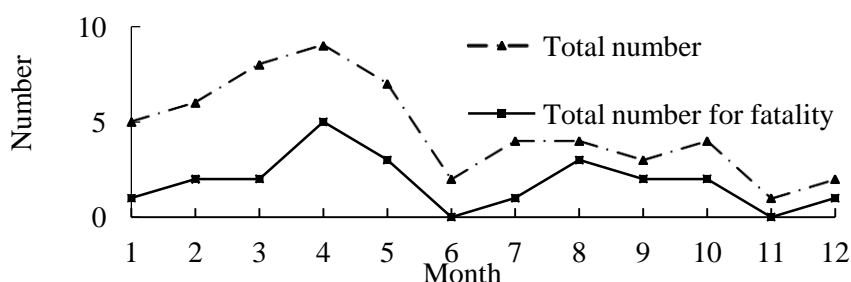


Figure 3: Distribution characteristics in month



2.3. Visibility Factor

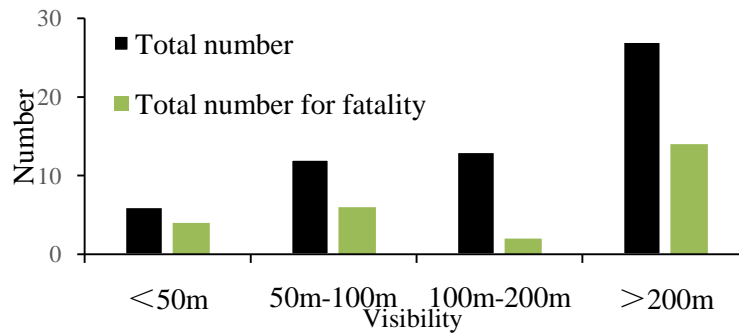


Figure 4: Visibility distribution characteristics

The distribution of the number of traffic accidents and the number of fatal accidents under different visibility conditions are shown in Figure 4. It can be seen that the number of traffic accidents is highest when visibility is above 200m and lowest when visibility is below 50m. This is obvious, according to the atmospheric visibility detectors set up in Zibo City's districts and counties, 92% of the weather maintains visibility above 200m, and only a small amount of weather occurs with reduced visibility such as haze. In addition, in the three segments with visibility below 200m, the number of accidents was about the same for 50m-100m and 100m-200m, but the number of accidents resulting in fatalities was higher in the former. Second, the probability of fatalities in traffic accidents was 50%, 54.5%, 8.3%, and 46.2% in the four sectors from low to high visibility, respectively. The highest probability of fatalities was found in the 50-100 m visibility range, where the number of fatal accidents accounted for 27.3% of the total number of fatal accidents. The lowest probability of fatalities was found for visibility conditions of 100-200 m. The number of fatalities was highest for visibility conditions of 50-100 m, which accounted for 27.3% of all fatalities.

3. Conclusion

- (1) Based on the 55 traffic accidents that happened in 2019 in Zibo section of National Highway 205, this paper analyzes the time, month, visibility, vehicle type and cause of traffic accidents to find the factors that influence the probability and severity of traffic accidents, and the research results can provide reference for the traffic safety management department.
- (2) Among the five administrative regions spanned by G205 Zibo, the traffic accidents in Huantai County accounted for 34.55% and 36.36% of the total number of traffic accidents and total number of fatal accidents respectively, with the highest total number of traffic accidents and total number of fatal accidents, and the lowest probability of traffic accidents and fatal accidents in the Hi-Tech Zone.
- (3) For different time periods, the probability of traffic accidents is highest during 14-16 pm and 20-22 pm, with the number of accidents accounting for 14.5% of the total number of accidents respectively, while the probability of fatal traffic accidents is highest during 4-6 am and 20-22 pm, with the number of fatal accidents accounting for 18.2% of the total number of fatal accidents respectively; during 0-2 am and 4-6 am, the number of fatal accidents accounts for 14.5% of the total number of accidents respectively. Both the number of traffic accidents and the number of fatal accidents showed an increasing trend; in addition, only one traffic accident occurred between 8 and 10 a.m., indicating that the probability of traffic accidents is low in this period despite the high traffic flow; from the perspective of the month, the probability of traffic accidents is higher in April than in other months, and the probability of traffic accidents is lowest in November. Secondly, for different visibility scenarios, the number of traffic accidents tended to increase in tandem with the increase in visibility; except for visibility in the 100-200m range, the probability of fatal accidents also increased with the increase in visibility.

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