Traffic accident analysis and Control Countermeasures of fatigue driving on Expressway

Yan Sun¹,a, Zhihua Tang²,b

¹Transportation Engineering College, Anhui Sanlian college, Hefei, Anhui Province, China
²Transportation Engineering College, Anhui Sanlian college, Hefei, Anhui Province, China
 aemail: 2285076174@qq.com, bemail: 375647906@qq.com

Abstract: In the current high-speed accidents, there is a great cause of fatigue driving. This paper first analyzes the law of fatigue driving accidents on expressways, including time distribution, type distribution and other distribution characteristics of accidents in various states. Secondly, it investigates the sections with heavy traffic accidents and frequent accidents, so as to analyze and find out the unreasonable and deficiencies. Finally, it summarizes the shortcomings of expressway, combined with the fatigue driving accidents caused by human subjective factors, suggestions and improvements are made. Through this study, for the prevention of fatigue driving accidents, drivers need to improve their safety awareness, family supervision and social supervision is very important, and after the accident, we need to correctly handle the results of the accident.

1. Research background
Driving is a physical and mental drain. When the driver is driving at high speed, you need to focus on driving with all your heart and soul. Keep your vision straight ahead and get the road surface. Information, at this time, the driver's whole nerves are in a high degree of tension, so it is easy to produce a sense of fatigue, causing the driver's fatigue driving. In addition, in the case of hot weather, the temperature inside the car is relatively high, which results in the driver's own energy consumption in the process of driving. In addition, the need to resist the high temperature will make the driver more and more tired, and finally lead to fatigue driving.

2. Symptoms and judgment of fatigue driving
Long time high-speed driving will make the driver feel tired. If it is not alleviated, the driver will always be in fatigue driving, self-control ability will be reduced and limbs will be stiff. In case of emergency, improper treatment or not timely treatment will occur, resulting in accidents and casualties.

Spinal fatigue: the driver in a sitting position for a long time, a long time will appear back pain, and the reason is that the sitting posture is not comfortable or the seat is not comfortable.

Eye fatigue: If the driver continues driving for too long or sleeping too little, it will usually lead to eye muscle weakness, reduced eye movement, frequent blinking, severe shaking, and double shadow of the scene in front of you. These are the manifestation of eye fatigue.

Physical signs of driving fatigue: Mental fatigue, often yawn; eye fatigue, eyelid heavy; muscle
fatigue; slow and inaccurate shift. When the fatigue reaches the driver's limit, there will be faster heart beat, cold sweat and shivering all over the body, and there will be an act of self-discipline.

3. Traffic accident investigation of fatigue driving on expressways

3.1. Time distribution of fatigue driving accidents

3.1.1. 24-hour distribution of fatigue driving accidents
According to the highway traffic police, the most concentrated cause of accidents from 0:00 to 7:00 is that the driver drives continuously from night to morning, and the physical and psychological endurance limit is close to the limit. In addition, due to insufficient light at night and narrow vision, traffic accidents are easy to occur. During the period from 14 to 18, the driver will feel tired after meals, and the driver will also feel tired after a day's work. These two reasons cause more accidents in this period.

![Figure 1 24-hour distribution of fatigue driving accidents](image)

3.1.2. Monthly distribution of fatigue driving accidents
Through the analysis of monthly data of high-speed accidents, it can be found that the three months of July, August and September are accident prone periods. By analyzing the monthly distribution characteristics of accidents. The reasons can be summarized as follows: the three months belong to rainy season, the road condition is poor, the road is wet and slippery, which is not conducive to the driving of vehicles.

3.2. Time distribution of traffic accident types
The types of traffic accidents can be divided into four categories: minor accidents, general accidents, major accidents and extraordinarily serious accidents.

3.2.1. Time distribution of major accidents
The heavy and serious accidents of a highway accounted for 12.9% of the accidents in the same period. However, they caused heavy consequences. The number of deaths and injuries accounted for 94.4% and 37.3% respectively in the same period. Compared with ordinary accidents, there are many similarities in the causes of major accidents, there is no fundamental difference, the only difference is that the consequences are more serious.
Figure 2 time distribution of major accidents

It can be seen from Figure 2 that 0:00 to 8:00 in the 24-hour period is the time period of major traffic accidents. During this period of 1:00 a.m., when the vehicle has just entered the expressway, the driver may have been driving the vehicle for several hours or just waking up, which makes him not very sober, and the light is too dark at night, and the sight distance is small, so the driver is easy to relax and have drowsiness. As a result, the reaction speed is slow and accidents are easy to occur.

In the month, July is the period of high incidence of major accidents. In July, it is in the period of high temperature. Drivers are prone to fatigue under high temperature conditions. In addition, road congestion and poor traffic conditions lead to accidents.

3.2.2. Traffic mode distribution of major accidents

In the extremely serious accidents, the most frequently occurred vehicles are trucks, accounting for 77% of the total. The truck itself is characterized by slow starting speed, poor mobility, poor operation and other problems, and the truck drivers often have some violations, which makes the accident rate of trucks keep high. Car speed is relatively fast, poor road conditions, hot weather is easy to cause fatigue driving, causing accidents. Passenger cars account for a small proportion, but once an accident occurs, it will cause serious accidents. In addition, passenger cars and freight cars account for 84% of the total accidents. The drivers of these two types of vehicles are the group most prone to fatigue driving. Therefore, although the proportion of major accidents is small, the proportion of deaths and injuries is the largest.

Figure 3 distribution of traffic modes in major accidents

3.3. Factors of people, vehicles, roads and environment

There are many reasons for fatigue driving, the most important reason is four points: people, vehicles, road and environment.

①Human factors mainly include: the main causes of driver fatigue driving: continuous driving, lack of insomnia or poor quality of insomnia. In addition, the driver's poor health, poor driving skills, personality differences, weak safety awareness and other reasons can also lead to fatigue driving.

②Vehicle factors mainly include: poor performance of the vehicle, high temperature in the car, uncomfortable seat, etc.
③ The main factors of road are as follows:

1. Traffic accidents are caused by defects in safety measures of construction section. During the maintenance of the construction section, the safety warning signs are not well done, and the safety organization is not in place. The construction workers do not pay attention to their own safety during the construction, and the illegal operation or driving of construction vehicles lead to accidents.

2. Traffic accidents caused by poor road conditions. As an important transportation channel, there will be a large number of vehicles passing through the expressway every day, which makes the road condition worse and worse. However, the maintenance of the expressway can not be frequent, which will affect the traffic order. In addition, the rain and snow weather and the erosion of the road surface by rain will gradually produce potholes on the road surface. On the highway, this situation will make the high-speed vehicles out of control, causing accidents.

④ The main environmental factors are as follows: different seasons have different influences. Due to the high temperature in spring and summer, the air conditioning in the car is very comfortable, and the driver is prone to fatigue. The weather in autumn and winter is very suitable, and the driver will also feel tired. And the climate will also be different, such as bad weather, icy road, wet road, etc.; the time of day and night is different, and the impact of biological clock will make drivers feel comfortable in the morning, tired from afternoon to night, resulting in fatigue.

3.4. Analysis on objective factors of accidents on Expressways

The characteristics of the road surface and the surrounding environment of the expressway determine that it is easy to produce fatigue driving behavior when driving on the expressway for a long time.

① In the process of driving at high speed, the nerves of the whole body are always in a state of high tension. During driving, the driver's eyes should always look forward, and all attention must be paid to observe the conditions on the road. With the increase of vehicle speed, the driver needs time to obtain more road information, which increases the working intensity of the driver's brain and makes the nerve more nervous. It is very necessary for the driver to be in a tense state when driving at high speed. However, if such a time is too long, the driver will be under more and more physiological and psychological pressure and begin to produce fatigue, which will slow down the driver's reaction speed and weaken his judgment ability.

② The freeway is very wide, with lanes separated in both directions. On expressways, there is no influence of non motor cars, pedestrians and vehicles in the opposite direction, and greening is too monotonous. In the process of driving, the driver has been in a monotonous environment in the field of vision, and repeatedly do the same operation action. After a long time, the brain cell inhibition will appear, and the reaction will be slow when the situation occurs, and the situation will also be drowsy.

③ High speed driving itself is hypnotic. The voice that the driver hears in the process of driving is very monotonous, without any stimulation. Under the influence of this sound, the driver's feeling will be excessively relaxed, and people will feel drowsy. The fatigue will fill the whole body, and the reaction will become dull.

4. Countermeasures against high speed fatigue driving accidents

4.1. Self control of drivers

There are many reasons for driver fatigue driving, and the driver's own problem is the most important reason. To solve the problem of fatigue driving, we need to start from the driver himself. Fatigue can be divided into two types, one is physical fatigue, the other is psychological fatigue, especially psychological fatigue is the most critical, which requires the driver's own psychological adjustment and control to overcome. Usually, when the driver encounters slight fatigue, it is necessary to rely on the driver's own psychological adjustment and control to eliminate the fatigue problem. However, in the face of more serious or even more serious fatigue problems, when it has exceeded the driver's tolerance limit, it is necessary to take the correct method to solve, in order to ensure the driver's safe driving. 1. Drivers should have enough sleep. From the biological clock point of view, people are more
suitable for working in the daytime and resting at night. The efficiency of night rest is greater than that of daytime rest. If the driver needs to drive at night, the rest time in the day will be longer at night to achieve the same effect, so as to ensure that the driver can drive safely. 2. Driving time should not be too long. With the driver's driving time becoming longer, the greater the driver's risk factor, the stronger the fatigue. When the driver's fatigue reaches a certain limit, there will be a temporary brain blank. In this case, it is easy to cause accidents, especially at night, which is very dangerous. 3. Pay attention to self-regulation during driving. One is to pay attention to make a plan in advance when driving at high speed, so as to have a rest in time in case of driving fatigue, so as to reduce the occurrence of accidents. Second, you can adjust your sitting posture and seat properly in the process of driving. Don't always be in a sitting position, which will cause your fatigue. Drink more water and eat some light food. Third, in the process of driving, we should ventilate the cab, control the indoor temperature, listen to music, relax ourselves, and keep a safe distance from the front and back of the car. When you feel tired, you can take a proper look at the environment around the vehicle or look far away to reduce your fatigue. Fourth, we should pay special attention to driving at night and at noon, which are prone to accidents. Therefore, we need to reduce our fatigue and wash our hands and faces in time.

4.2. Transport unit control
High-speed traffic management departments need to work harder to supervise to prevent the occurrence of fatigue driving. 1. Strictly control the vehicles in and out of the high-speed intersection, strengthen the management and inspection of the road surface, make full use of the current management and law enforcement personnel as far as possible, and allocate personnel through scientific and feasible methods. All departments should cooperate with each other, unite and share information, and give full play to the role of cooperation. All traffic control departments should take 24-hour safe driving action to remind drivers of safe driving, timely solve problems encountered by drivers or passengers, and remind drivers or passengers of safe driving at all times. On both sides of the highway, electronic signal devices should be installed to transmit safe driving tips to drivers anytime and anywhere. In some freeway sections where the traffic flow is relatively concentrated, a number of law enforcement personnel should be arranged on duty, so that the driver can find the traffic management personnel to deal with the situation as soon as possible, and can also provide the traffic management departments with timely traffic information for further control. 2. Night is a natural barrier for drivers, and most illegal behaviors will occur at night. Therefore, traffic management departments should increase the inspection of drivers' driving status at night. For large vehicles, overloading, random parking and other situations, traffic management personnel need to carry out strict education on drivers independently, and put the concept of safe driving into the hearts of drivers. And we should punish them in different degrees and manage them in a combination of these two ways. At the same time, the traffic control department should also take more humanized methods to better communicate with drivers. For illegal vehicles, traffic control personnel should not deal with them in the main way of fine punishment. They should fundamentally eradicate the driver's fluke mentality and drive safely.

4.3. Road landscape facilities to alleviate driving fatigue
The highway has the characteristics of wide and flat, and there is no change in the view. In the process of driving, the driver must have the vision forward. In this state, once the human brain is inhibited, it can not get any stimulation and is in a depressed state. Gradually, the brain will enter into a state of fatigue gradually. When the human brain enters into the state of fatigue, the driver's response will become slow and his attention will drop sharply. In case of emergency, he does not take the right measures in time, which will cause the accident. Under this reason, it is necessary to strengthen the greening around the expressway, set up large warning signs in the road sections prone to accidents, set up more deceleration sections of vehicles, install more electronic police for speed supervision, and appropriately reduce the speed of vehicles. In addition, the unreasonable arrangement of service areas
should be improved, the number of service areas should be increased, the distance between service areas should be reduced, and guide signs should be set up to guide the drivers to rest in the service areas, so as to be adjusted in time when the drivers have not experienced fatigue driving. As an important place for drivers to adjust their own state, service area should improve their service attitude, reduce consumption level, meet the needs of all kinds of drivers to get the most appropriate service here, and make it a real rest place for drivers.

5. Conclusion
In today's rapid economic development, the importance of traffic is more and more obvious. Because of this, the pressure of traffic is increasing, leading to more and more traffic accidents. Fatigue driving is one of the important reasons, which requires us to analyze and prevent. This paper summarizes and analyzes the characteristics of traffic accidents in our province at the present stage, and then through consulting the information on the Internet and investigating the accident scene, the following conclusions are drawn:

① This paper analyzes the fatigue driving accidents of expressways in our province. Through the comparison in recent years, it is concluded that the situation of highway accidents in our province is serious, so it is of great significance to study the prevention of accidents;

② Based on the data of highway traffic accidents in our province, the characteristics of high-speed fatigue driving accidents in our province are summarized and analyzed;

③ Our province highway fatigue driving accidents need to be supervised by themselves, at the same time, the relevant departments need to strengthen publicity to prevent the occurrence of these problems, at the same time, family supervision is also very important.

Acknowledgments
Fund Project: Study on short term fatigue recovery characteristics of Expressway drivers (Grant NO. zsys20002) Study on urban road traffic risk based on coupling characteristics of mixed traffic and adverse climate and environment factors (Grant NO. PTZD2020017)

References
[1] Xin, Zhe. (2008) Study on the analysis method of road traffic accident causes. Tongji University, 25: 13-15.
[2] Hepeng, Zhang. (2008) Analysis on the influence of Expressway driving environment on traffic safety. Nanjing Forestry University, 163: 35-38.
[3] Zhe, Mao. (2009) Research on recognition method of fatigue driving behavior of motor vehicles. Wuhan University of technology, 36: 59-62.
[4] Fang, Liu. (2009) Design and research of driver fatigue driving real-time monitoring system based on Video. Zhejiang University of technology, 12: 90-92.
[5] Hongji, Du. (2014) Study on the influence of fatigue driving on driving behavior and its discrimination method. Beijing University of technology, 28: 102-104.
[6] Shenglong, Qian. (2014) Study on distribution characteristics of fatigue driving behavior in regional expressway network. Chang'an University, 39: 57-59.