# CHARACTERISTICS OF TRAFFIC ACCIDENTS IN COLD, SNOWY HOKKAIDO, JAPAN

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**ABSTRACT:** Hokkaido, the northernmost prefecture of Japan, lies in the subarctic zone. For approximately the four-month period of late November to mid-March, the weather is cold and snowy, and the daily mean temperature is below freezing. In 1992, the law regulating studded tires was enacted to prevent air dust pollution generated. Since 1992, when the studded-tire-equipping rate fell to almost 0%, the skid resistance of road surfaces has fallen markedly and slippery road surfaces have emerged. Winter-specific accidents increased accordingly. We analyzed the characteristics of traffic accidents in Hokkaido and compared these with other regions of Japan. It was found that Hokkaido has more traffic fatalities per traffic accident and more fatal single- and multi-vehicle collisions in rural areas. The results also revealed that many winter-specific accidents occur in December, early winter.

**Key Words:** traffic accident, skid accident, winter road, studded tire regulation

## 1. REGIONAL AND CLIMATIC CHARACTERISTICS OF HOKKAIDO

Hokkaido's location at the northernmost extreme of Japan has given this prefecture a very different climate from elsewhere in Japan. While most of the other regions lie in the temperate climatic zone, Hokkaido is in the subarctic zone, although Hokkaido has four distinct seasons just as do other regions of Japan.

Hokkaido is at a latitude of roughly 43 ºN. European regions at this latitude include those in Southern France and Central Italy. Winter winds bring cold air from Siberia to Hokkaido, which gives it the severe winter climate.

The lowest temperature recorded in Asahikawa, the city at the geographic center of Hokkaido, is -41 ºC (-41.8 ºF). The normal annual number of days with snowcover is 148.2 days, and days with snowfall is 143.8 days. The maximum recorded depth of snowcover is 138 cm.

The normal monthly temperature of Sapporo, which is the political and economic center of Hokkaido, is about －4 ºC(24.8 ºF) during the coldest months, January and February. The normal annual number of days with snowcover and days with snowfall are 132.4 days and 124.7 days, respectively. The population of Sapporo exceeds 1.8 million.

The modern full-scale development of Hokkaido dates back to the early Meiji era, about 130 years ago. This history is the shortest of anywhere in Japan. Therefore, Hokkaido is typified by low population density, long inter-city distance, and low traffic volume. Also, it lags behind the rest of the nation in the percentage of completion for

expressways projects.

## 2. STUDDED TIRE REGULATION AND ITS EFFECTS

In Japan, studded tires began to gain widespread use from around 1970, soon becoming the standard winter tire. However, in the 1980s, they were found to cause pavement abrasion, rutting, and air pollution by dust. Movements by citizens, the enactment of ordinances, and the voluntary restriction of studded tire production culminated in the promulgation of "The Law on the Prevention of the Generation of Particulates from Studded Tires" in 1990. While this law contributed to dramatic improvements in air quality, very slippery road surfaces have emerged each winter since fiscal 1992. This has raised concerns about the increase in winter-specific traffic accidents and the environmental effects associated with increased application of anti-freezing agents (Figure 1).

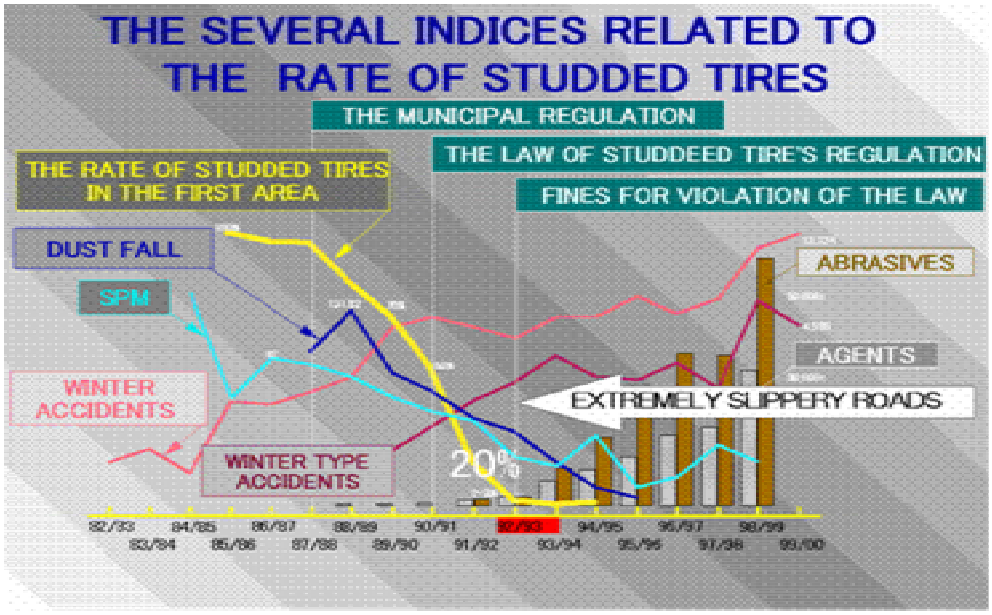


**Figure 1 The Several Indices Related to The Rate of Studded Tires**

## 3. CHANGES IN TRAFFIC FATALITIES

The worst record for traffic fatalities in Japan was 16,765 in 1970. The number dropped to 8,466 by 1979, half the 1970 figure, before increasing again. It reached a second peak of 11,451 in 1992, after which the number started falling. As of 2001, the number was 8,747.

Hokkaido has more traffic fatalities per capita than Japan overall. The peaks for Hokkaido were 889 and 715 in 1971 and 1990, respectively. The number of traffic fatalities fell dramatically to 573 in 1991, since which date it has repeatedly risen and fallen. As of 2001, it was 516.

## 4. CHANGES IN TRAFFIC ACCIDENTS

Traffic accidents in Japan numbered 720,880 in 1969, which was then a record high. The number decreased thereafter, but started increasing again from 1977. In 1993, the 1969 record was broken. The number had increased to 947,169 as of 2001.

Traffic accidents in Hokkaido peaked at 30,042 in 1970. Thereafter the number began to fall, before rising again from 1975, a year in which 15,971 traffic accidents occurred. The number increased to 30,531 as of 2001, almost equal to the number for 1970. The number of traffic accidents in Hokkaido has followed a trend similar to that for Japan overall, although the per-capita number for Hokkaido is smaller than for Japan overall.

## 5. CHANGES IN TRAFFIC FATALITY RATE

Figure 2 shows changes in the number of fatalities per 100 traffic accidents (traffic fatality rate) in Hokkaido and Japan overall. The traffic fatality rate of Japan overall has been decreasing, except for the years 1987 to 1990. The rate of decrease has been particularly high since 1990. The reason is a decrease in fatalities accompanied by a sharp increase in accidents, which is the denominator.

The fatality rate of Hokkaido is higher than that of Japan overall, i.e., there are fewer accidents and more fatalities than the national average. However, it started decreasing from 1997 and fell below 2.0 in 1998. One of the causes for Hokkaido's high fatality rate is thought to be high travel speed in rural areas. Hokkaido is not densely populated, and its cities are widely distributed. The inter-city distance of Hokkaido is roughly twice that of Honshu, the main island of Japan. These factors have caused travel speeds to be high in rural areas.

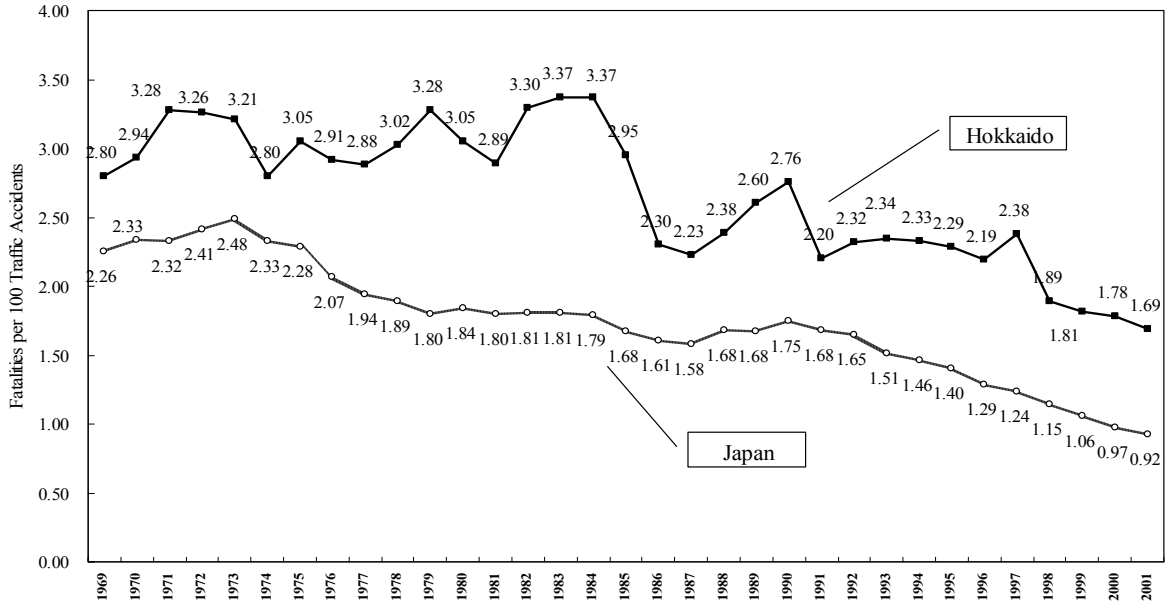


**Figure 2 Fatalities per 100 Traffic Accidents in Hokkaido and Japan**

## 6. TRAFFIC FATALITY RATE AND ACCIDENT RATE PER 100 MILLION

## VEHICLE-KM OF TRAVEL

Vehicle-km of travel is a total of the travel distance of vehicles based on road traffic census. This index (cumulative unit road length × traffic volume of each unit) represents the total road traffic demand. By dividing the number of traffic accidents by the vehicle-km of travel and multiplying the quotient by 100 million, we obtain the traffic accident rate per 100 million vehicle-km of travel. By the same calculation, we obtain the traffic fatality rate per 100 million vehicle-km of travel from the number of traffic fatalities. Figures 3 and 4 show the changes in these rates on national highways and expressways.

The traffic accident rate per 100 million vehicle-km of travel on national highways in Hokkaido has been almost constant at 60% of that for Japan overall. On expressways, the rate for Hokkaido is about the same as that for Japan overall. The traffic accident rates on expressways are very low compared with national highways both in Hokkaido and in nationwide.

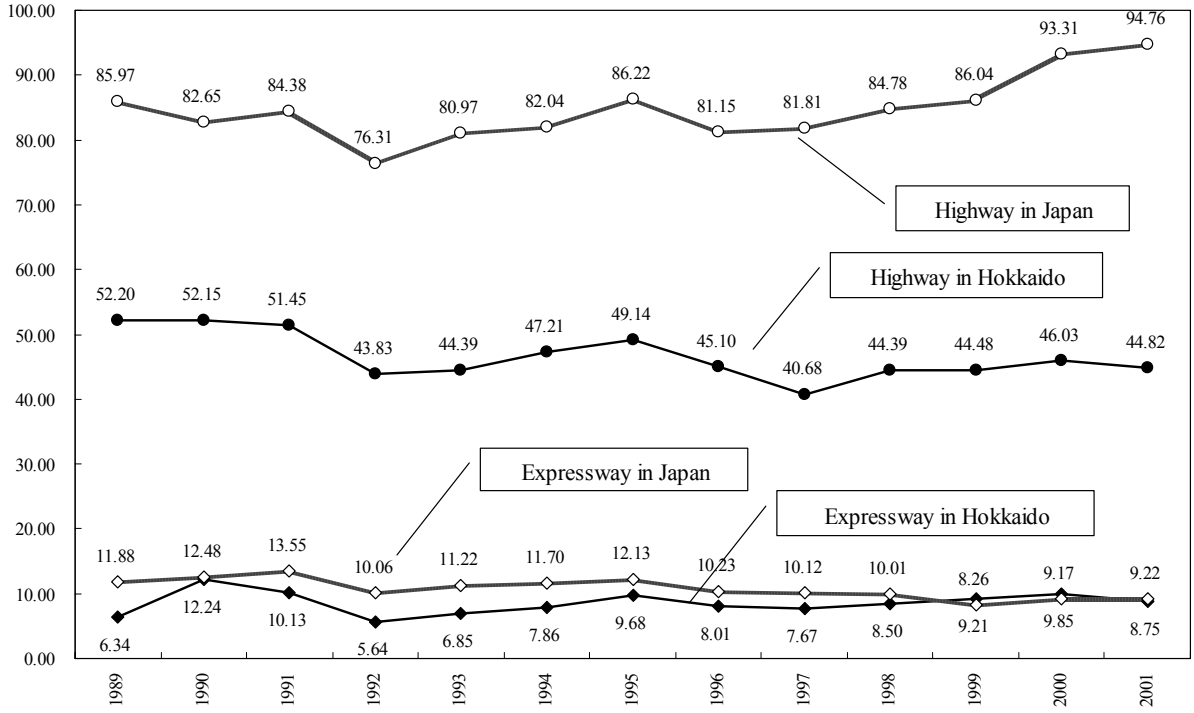


**Figure 3 Traffic Accidents per 1 billion vehicle kilometres in Hokkaido and Japan**

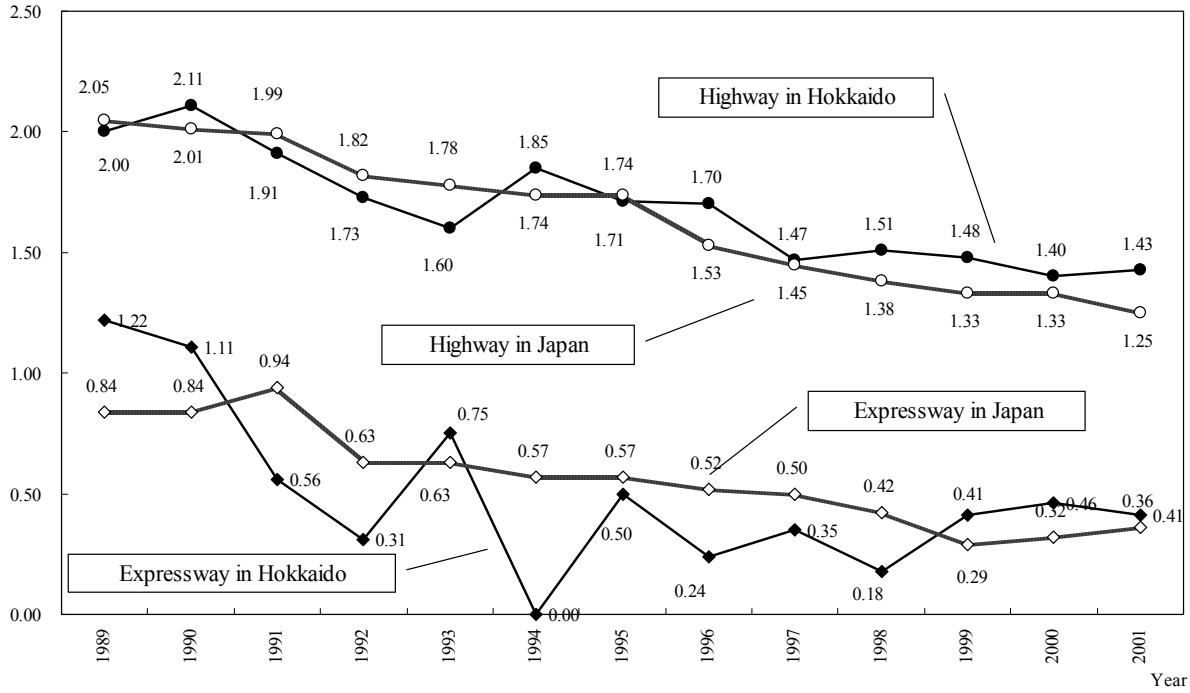


**Figure 4 Fatalities per 1 billion vehicle kilometres in Hokkaido and Japan**

## 7. CHARACTERISTICS OF TRAFFIC ACCIDENTS BY ACCIDENTS TYPE

Figure 5 presents the number and percentage of traffic accidents and fatal traffic accidents by accident type. Compared with Japan overall, the proportion of rear-end collisions among total traffic accidents is high in Hokkaido. Among fatal traffic accidents, the proportions of head-on collisions and deviation accidents are high. Possible reasons include 1) the road structure (most roads in Hokkaido are two lanes without a median strip), 2) the road surface condition (slippery for most of the winter), and 3) the shortage of expressways.

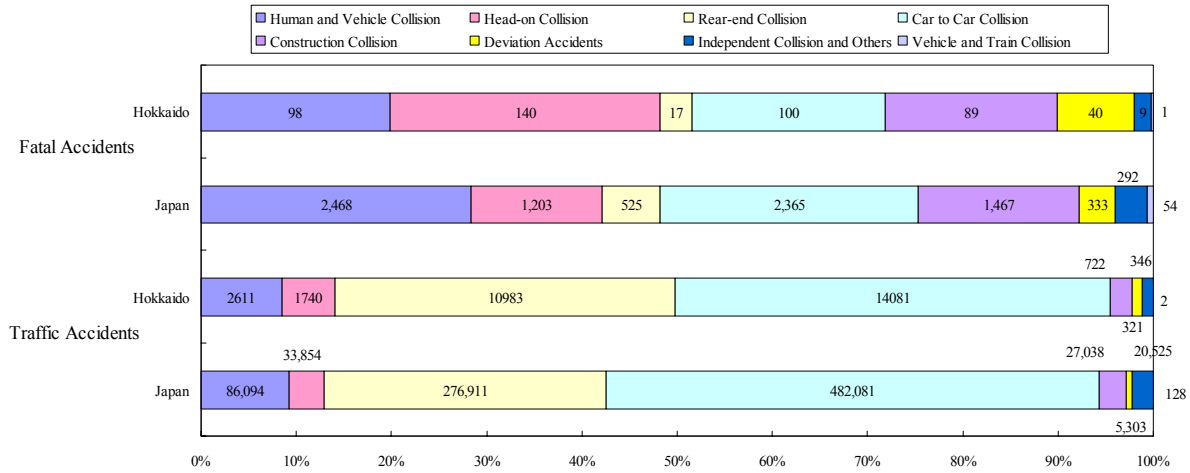


**Figure 5 The Number and Percentage of Traffic Accidents by Accident Type**

## 8. CHARACTERISTICS OF TRAFFIC ACCIDENTS IN WINTER

Figure 6 shows the monthly changes in the number of traffic accidents in Hokkaido. The number for December started to increase from fiscal 1992. It exceeds those of the other months by more than 500. Introduction of studless tires has led to an increase in traffic accidents in early winter (i.e., December). One possible reason for this is that drivers have not yet adjusted to winter road surfaces at the early stage of winter.

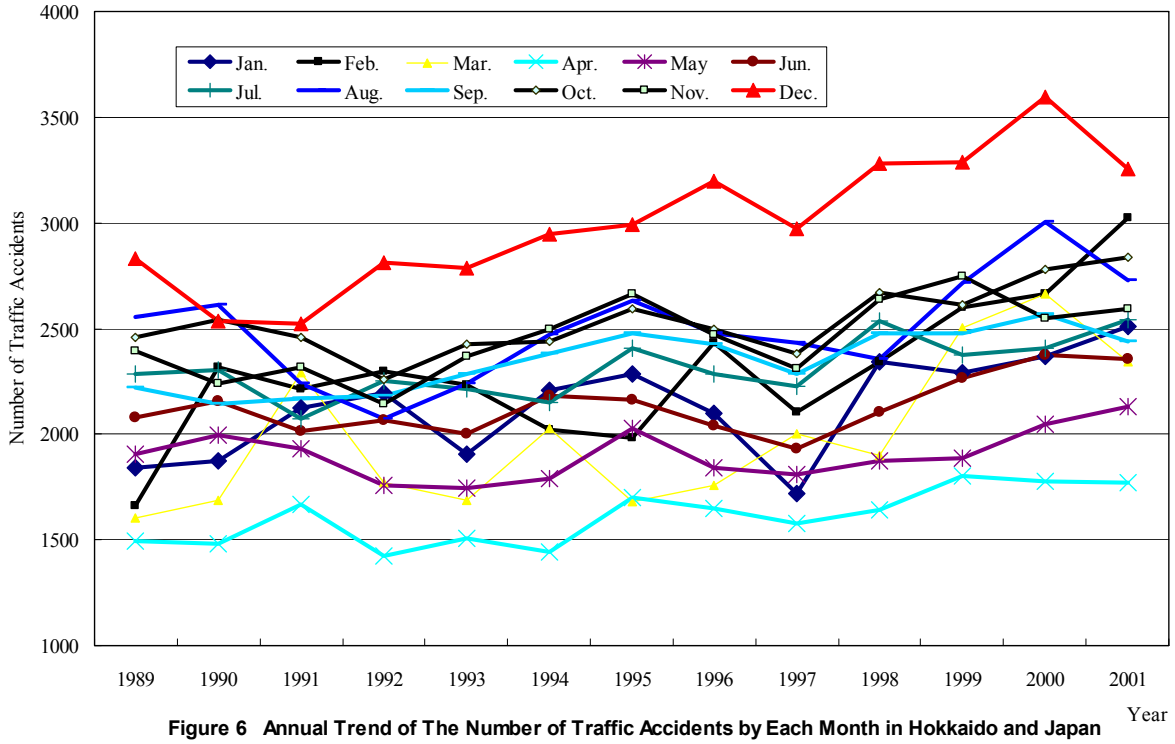


**Figure 6 Annual Trend of The Number of Traffic Accidents by Each Month in Hokkaido and Japan**

Accidents during winter (November through March) that are caused directly or indirectly by winter phenomena, such as snow accumulation, ice, and snowstorm, are defined as winter-specific accidents. Figure 7 shows changes in the number of traffic fatalities and accidents by winter-specific accidents. Winter-specific accidents include skid accidents caused by compacted snow and icy road surfaces, accidents caused by snowstorm-induced poor visibility, and accidents caused by ruts. The figure shows winter-specific accidents have been increasing. Winter-specific accidents greatly increased from fiscal 1989 to fiscal 1993, during which period the studded-tire-equipping rate was decreasing every year. Pervasion of studded tires is likely to have been responsible for this sudden increase. The number of winter-specific accidents stabilized thereafter, but it started increasing again from 1998. Conversely, the number of fatalities for accidents in winter and winter-specific accidents have been largely stable.

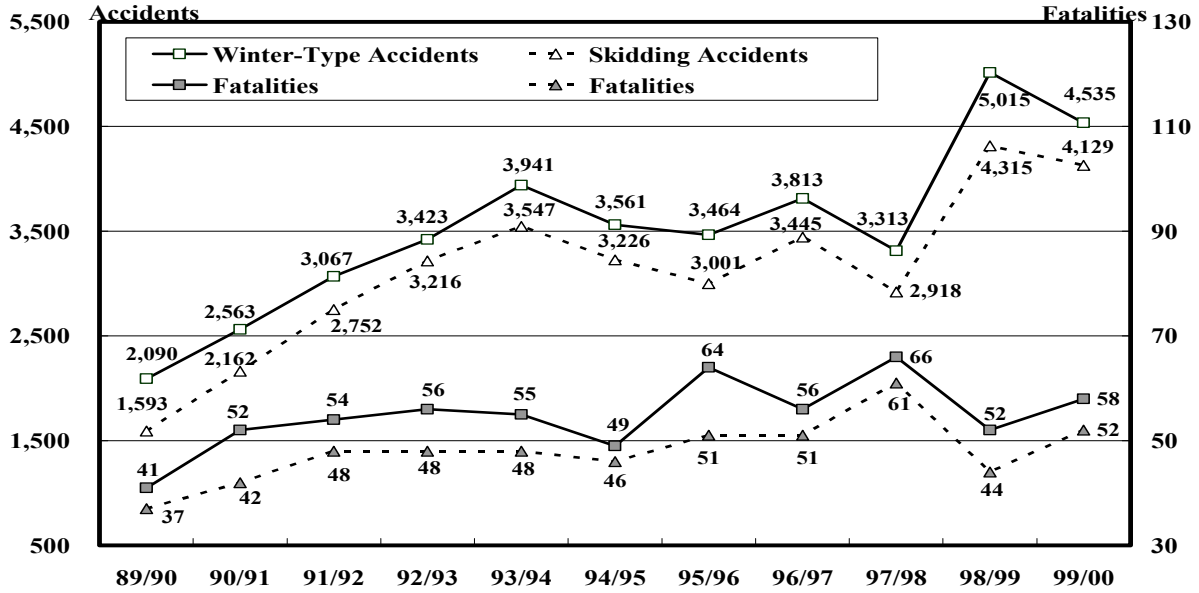


**Figure 7 Trend of winter-specific(=winter-type) accidents and fatalities**

Figure 8 shows percentage of skid accidents by accident type. Rear-end collisions account for approximately 50% of all accidents.

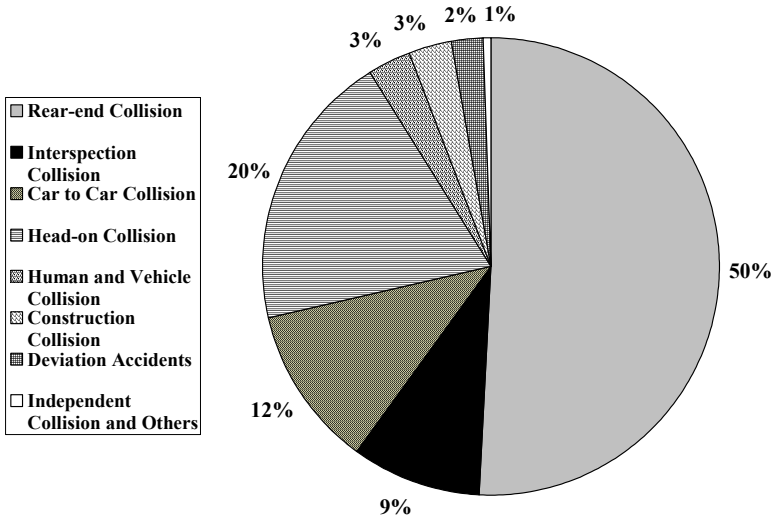


**Figure 8 Percentage of skid accidents by accident type**

## 9. OCCURRENCES OF SKID ACCIDENTS, TEMPERATURE, AND SNOWFALL

Figure 9 shows daily mean temperatures and snowfall, as well as the average number of skid accidents in Sapporo for the 1989-99 winter (November through March). The figure excludes days without skid accidents. Since penalties began to be imposed under the studded tire regulation law that took effect in fiscal 1992, the studded-tire-equipping rate has fallen to almost 0%. Therefore, one graph shows the fiscal years up to 1991, and another the years after. The number of skid accidents per day in fiscal 1992 and thereafter exceeded that in fiscal years up to 1991. The average number of skid accidents per day showed a peak when the daily average temperature was around －4 ºC(24.8 ºF) (Figure 9). At this temperature, very slippery surfaces are likely to form.

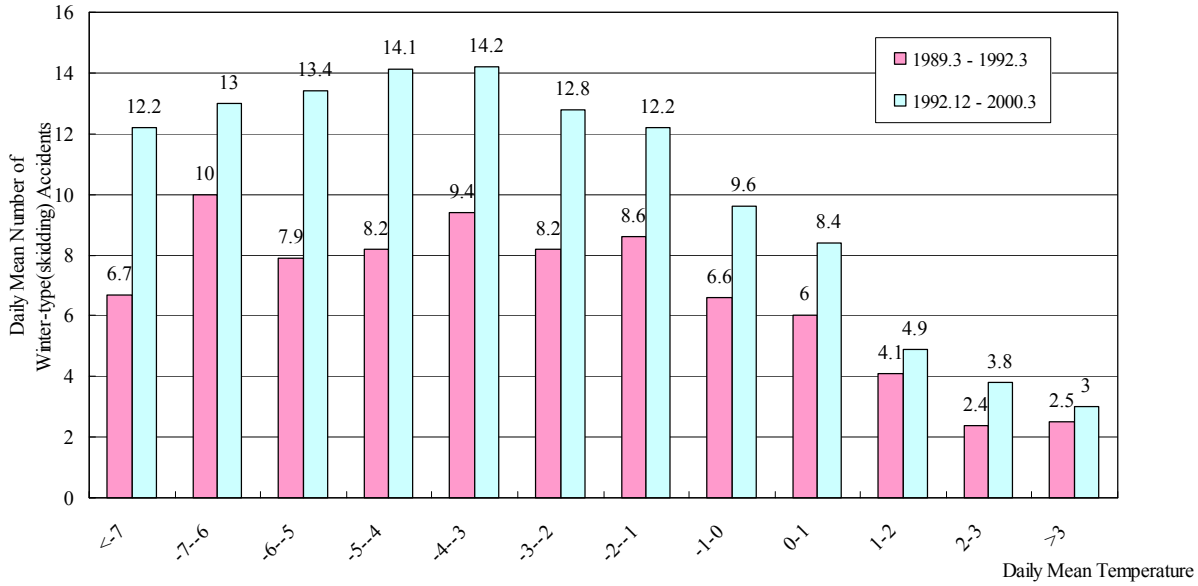


**Figure 9 The Daily Mean Number of Skid Accidents VS. Daily Mean Temperature**

## 10. POSTSCRIPT

Every year, traffic accident fatalities exceed 500 people in Hokkaido, and they number approximately 9,000 people in the entire nation. These figures are larger than that of non-traffic accidents or disasters. Societal losses are also large. Further efforts are required for improvement in the future.

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