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Comparison of crashes during public holidays and regular weekends

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ABSTRACT

Traffic collisions and fatalities during the holiday festive periods are apparently on the rise in Alberta, Canada, despite the enhanced enforcement and publicity campaigns conducted during these periods. Using data from 2004 to 2008, this research identifies the factors that delineate between crashes that occur during public holidays and those occurring during normal weekends. We find that fatal and injury crashes are over-represented during holidays. Amongst the three risky behaviors targeted in the holiday blitzes (driver intoxication, unsafe speeding and restraint use), non-use of restraint is more prevalent whereas driver intoxication and unsafe speeding are less prevalent during holidays. The mixed results obtained suggest that it may be time to consider a more balanced approach to the enhanced enforcement and publicity campaigns.

1. Introduction

1.1. Background

Motor vehicle collisions are a major concern in many developing and developed countries. For instance, recent Canadian data showed that a total of 2767 fatalities and 194,177 injuries occurred on the roads as a result of motor vehicle collisions in 2007 (Transport Canada, 2007). In the Canadian Province of Alberta alone, nearly 400 people are killed and more than 27,000 people are injured in over 112,000 motor vehicle collisions each year (Alberta Transportation, 2006). The annual social cost of motor vehicle collisions to Albertans is estimated at $4.68 billion or 2.4% of Alberta's gross domestic product. Therefore, much more work needs to be done to make our roads safer for all users at all times.

With regard to time, traffic collisions and the ensuing fatalities during the statutory holiday festive periods are apparently on the rise in both developing and developed countries (Anowar et al., 2009, 2012). For example, a total of 6937 collisions occurred in 1999 during the holidays and long weekends which killed 39 people in Alberta but the total number of crashes escalated to 11,337 in 2008, with 43 people killed (Alberta Transportation, 1999, 2008). Although collisions during statutory holidays represent only a small percentage (less than 10%) of the total motor vehicle collisions occurring in Alberta, the number of fatal collisions occurring during statutory holidays is found to be higher than those during non-holidays. Overall, the average number of fatal collisions for these holidays (1.11 per day) is approximately 18% higher than the non-holiday rate (0.94 per day). The average number of people killed per day on Albertan roadways during these holidays is also higher than the rest of the year (Anowar et al., 2012).

Consequently, there are more aggressive police enforcement activities and publicity campaigns targeted at drink-driving, speeding and other risky driving behaviors during these festive holidays in Alberta and worldwide (Alberta Transportation, 2006; Transport Canada, 2001; Pilkington, 2000; Watson et al., 2002; Alsop and Langley, 2000). Moreover, traffic fatalities and enforcement activities during these long weekends often attract disproportionately more media and public attention. A sample of news headlines in Alberta shows that this issue is a concern for rural and urban communities, large municipalities and small towns, and printed and electronic media:

"*Christmas Eve crash near Mundare kills three, orphans baby*" (Edmonton Journal, 27/12/2010).
"*Long weekend means police patrol roads*" (Channel 880 News, 21/4/2011).
"*Royal Canadian Mounted Police (RCMP) will hunt speeders on Easter long weekend*" (Calgary Herald, 21/4/2011).
"*The Labour Day long weekend proved once again to be deadly on Alberta's roadways*" (Crowsnest Pass Promoter, 4/9/2008).

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Holidays are meant to be times of enjoyment and festivity. Unfortunately, these times also have the image as a time for partying, drunkenness, speeding and other reckless driving behaviors. Holidays are also associated with a large increase in recreational private travel resulting in longer trip distances, and more travel in rural and unfamiliar environment. Supposedly, owing to these factors, in many countries of the world, holiday periods are commonly viewed as times of heightened danger on the roads resulting in fatal and injurious traffic collisions. Hence, additional resources are frequently employed during public holidays to boost enforcement and publicity campaigns. However, these factors are also over-represented during regular weekends and relatively little research has been done on identifying the road safety issues related to specifically public holidays.

1.2. Objectives and scope of study

In this paper, a logistic regression model will be estimated to identify the factors contributing to crashes during public holidays and long weekends. In particular, we aim to determine whether crashes during public holidays are more severe than any regular weekends and whether the factors contributing to crashes during public holidays are different from those contributing to weekend crashes. More importantly, our results will also provide valuable insight on whether the increased enforcement activities and publicity campaigns during the holidays are used efficiently to address the correct road safety problems.

1.3. Literature review

Road crashes during the major holiday periods attract intense media interest. Nonetheless, research studies focusing on analysing the contributory factors of the road crashes are relatively few, and mostly examine specific holidays, crash types or behaviors. For example, the Australian Transport Safety Bureau (ATSB, 2003, 2006) conducted two studies focusing on holiday accidents. The goal of both studies was to examine the characteristics of fatal crashes occurring during the national holiday periods. The annual trends in road fatality numbers for two of the major statutory holiday periods, Christmas and Easter, were examined and compared with the remainder of the year. Interestingly, both studies found that the observed differences of fatality rates between holiday and non-holiday periods were generally small in size and not statistically significant.

A similar research initiative was undertaken by the American state of Missouri to identify the magnitude, severity and characteristics of holiday traffic crashes (MSHPSAC, 2003). The study analyzed crashes occurring during the following statutory holidays: Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas and New Year Day. However, no comparison was made between holiday and non-holiday crashes or between holiday and regular weekend crashes.

Bloch et al. (2004) used crash data of 14 major holidays and special occasions in California to compare the rise in alcohol related fatal and injury crashes during holidays with that of the non-holiday periods. They employed the Poisson regression modeling technique (log-linear and logistic), controlling for the seasonal differences in terms of days of week and months of the year. The results of the study suggested that drinking and driving was more of a concern during the winter holiday seasons than the summer ones.

Farmer and Williams (2005) used data for the years 1986–2002 to determine which days of the year tend to experience a relatively higher number of deaths. They observed that six of the ten days with the greatest number of deaths occurred near these major American holidays: Independence Day, Christmas, New Year, and Labor Day. The authors attributed such high numbers of crash deaths to the probable combination of increased recreational travel, alcohol consumption, and excessive speeding during holidays. Amongst other possible reasons for the increased fatalities during holidays suggested were: travel on rural unfamiliar roads, driver distractions and fatigue, which all resulted in the increased likelihood of drivers committing errors.

In another study, Alsop and Langley (2000) specifically focused on the Christmas road tolls. They used the negative binomial and binomial regression techniques to examine the temporal trends in the number of fatalities during the Christmas holiday festivities in New Zealand. Their results indicated that the road toll neither decreased nor improved significantly over the years. The authors argued that the lack of statistically significant increase in Christmas fatalities could be viewed as a positive outcome, given the large increases in population and number of cars driven. Presumably, the average individual risk might have reduced over time. On the other hand, a lack of statistically significant decrease in Christmas fatalities could not be viewed as a positive outcome, given the increased emphasis placed on this period by traffic safety agencies.

Besides statutory holidays, the effect of weekdays and weekends were also explored in several studies since traffic patterns during weekdays and weekends were quite different and crashes during weekends tended to be more severe (Yau, 2004; Gray et al., 2008; Barua and Tay, 2010; Quddus et al., 2010; Christoforou et al., 2010; Rifaat et al., 2011). According to these authors, much of the traffic during weekends consisted of discretionary travel, involved more drivers who had been drinking, speeding and driving while fatigued. However, very little research was found that examined the relative crash risks between holidays and weekends or the differences in the factors contributing to crashes during these two types of non-work days.

2. Methodology

2.1. Logistic regression model

Recall that the aim of the research is to determine the factors that are different between crashes that occur during statutory holidays (including long weekends) and those crashes occurring during normal weekends. Since the dependent variable is discrete and dichotomous in nature, the binary logistic regression is an appropriate technique to identify the different factors contributing to these two types of crashes. In this study, the binary response variable, y_{in}, is defined as:

$$y_{in} = \begin{cases} 1, & \text{if crash } n \text{ occured during statutory holidays} \\ 0, & \text{if crash } n \text{ occured during regular weekends} \end{cases} \quad (1)$$

Let, $P_n\ (i)$ and $1 - P_n\ (i)$ denote the probability of crash n occurring during statutory holiday periods and regular weekends, respectively. McFadden (1981) shows that under the standard logistic distribution, the closed form solution of the probabilities will be:

$$P_n(i) = \frac{\exp(\boldsymbol{\beta_i x_{in}})}{1 + \exp(\beta_0 + \boldsymbol{\beta_i x_i})} \quad (2)$$

where $\boldsymbol{x_{in}}$ is a vector of measurable characteristics that determine outcome i; $\boldsymbol{\beta_i}$ is a vector of estimable parameters.

The best estimate of $\boldsymbol{\beta}$ could be obtained by maximizing the log likelihood function:

$$LL(\boldsymbol{\beta}) = \sum_{i=1}^{n} \{y_{in} \ln(P_n(\mathrm{i})) + (1 - y_{in}) \ln(1 - P_n(\mathrm{i}))\} \quad (3)$$

In this study, *Stata* version 11 is used for model development and estimation.

Note that there are two common binary or dichotomous models: the binary logistic model used in this study and the binary probit model which assumes that the error terms are normally distributed. Many studies have found that the results obtained from both these models are very similar (Maddala, 1988; Kennedy, 2001; Greene, 2003). The binary logistic model is chosen in this study for convenience. It is also more commonly used than the probit model (Kennedy, 2001).

Moreover, some researchers have chosen to use random effects or the random coefficient logit model or mixed logit model instead of the fixed effects model (Milton et al., 2008; Anastasopoulos and Mannering, 2009; Kim et al., 2010). Random effects model are often used when the data contain repeated measures and/or to account for driver heterogeneity. These issues, however, are not a concern in this study because neither panel data nor repeated measures are used and the unit of analysis is a crash event. Moreover, preliminary analyses using random coefficient models found that the estimates of the variances of the random coefficients were statistically insignificant.

2.2. Data

The data used in this study is obtained from Alberta Transportation and Infrastructure. It should be noted that in Alberta, traffic crash data is compiled by the Office of Traffic Safety, Alberta Transportation from police reports collected and maintained by the Royal Canadian Mounted Police in the rural areas and by local municipal police forces in larger cities of the province. In Alberta, any crash resulting in injury or property damage costing more than $1000 would be required by law to be reported to the police. The crash records contain the common types of information on the collision, including the time, location and severity of collisions as well as data on the driver, crash type, vehicle, environment and any special road features at the crash locations.

Data on crashes during the weekends and statutory holidays for the years 2004–2008 were extracted from this provincial database. For this study, the holidays considered were: New Year, Family Day long weekend, Easter long weekend, Victoria Day long weekend, Canada Day, August long weekend, Labor Day long weekend, Thanksgiving long weekend, Remembrance Day and Christmas. These ten holidays were chosen because the crashes occurring during these holidays were routinely reported and highlighted in Alberta Transportation's Annual Collision Reports. The weekend crashes comprised those crashes that occurred during regular weekends excluding statutory holidays. The final data sample consisted of 125,416 crashes for the five-year period and of these, 27.8% occurred during statutory holidays and the rest (72.2%) occurred during regular weekends.

Based on the information available in the dataset, 15 factors were selected for analysis. These factors included crash characteristics, environmental conditions, operational characteristics and driver characteristics. Following some preliminary analyses, three statistically insignificant factors were excluded and 12 factors were retained in the final analysis. The descriptive statistics of the variables included in the final model are reported in Table 1.

Note that several factors that were widely used in the literature on crash frequency analyses were not included in this study since our focus was on delineating between crashes occurring on regular weekends and public holidays. For example, although exposure would be significant in determining crash frequency, no theoretical reason existed to hypothesize that exposure should be a significant factor in our model. The effects of traffic flow on crash risks during weekends and public holidays would likely be very similar. Moreover, exposure data were not available for most of the crash locations. On the other hand, although data for other variables, such as weather, were available, they were not included in the model because their effects on crash risks during weekends and public holidays were expected to be very similar. Preliminary analyses also found that the estimated coefficients were statistically insignificant.

Since all the contributing factors were categorical in nature, several dummy variables were used to represent each of these factors. Note that one of the dummy variables had to be used as the reference. The estimates obtained for the other variables were then interpreted with reference to the default or reference case. For example, for the number of vehicles factor, the reference case used was single vehicle and the estimates for the two and more than two vehicle crashes were analyzed and interpreted relative to single vehicle crashes.

Table 1
Difference in crash profiles (%).

Variables	Statutory holidays	Weekends
Crash severity		
Fatal crash	0.5	0.4
Injury crash	17.0	16.5
PDO	82.5	83.1
Occurrence time		
Morning (6:00 am–12:00 pm)	20.5	19.5
Mid-day (12:00 pm–6:00 pm)	40.3	40.0
Evening (6:00 pm–12:00 am)	28.8	28.0
Night (12:00 am–6:00 am)	10.3	12.5
Municipality		
Urban	67.4	69.6
Rural	32.6	30.4
Location		
Intersection	56.0	56.8
Non-intersection	44.0	43.2
Road class		
Highway	28.5	26.2
Non-highway	71.5	73.8
Number of vehicles		
Single-vehicle	38.4	39.1
Two-vehicle	57.6	57.0
More than two vehicles	4.0	3.9
Crash type		
Struck-object	31.2	31.3
Off-road	11.0	12.0
Angular	18.9	18.2
Sideswipe	8.2	8.4
Rear-end	22.6	22.4
Head-on	0.9	0.9
Other collisions	7.3	6.9
Driver familiarity		
Albertan	92.1	92.6
Non-Albertan	7.9	7.4
Light condition		
Daylight	60.0	57.8
Dark without artificial light	54.4	53.0
Dark with artificial light	14.0	15.7
Unknown light condition	5.3	5.8
Driver condition		
Normal	93.5	92.5
Drunk	4.8	5.5
Fatigued	0.7	0.7
Other driver condition	1.2	1.3
Speed of vehicle		
Safe	92.4	91.9
Unsafe	7.6	8.1
Seat-belt use		
Restrained	90.5	90.5
Non-restrained	3.4	3.2
Seat-belt use unknown	6.2	6.3

3. Results and discussion

The estimation results of the binary logit model are reported in Table 2. Overall, the model fitted the data relatively well, with a very large chi-square statistic and very small p-value. Note that

Table 2
Estimation results of the binary logistic regression.

Variables	Coefficient	Std. err.	*t*-Stat	Odds ratio
Main variables				
Crash severity (reference: PDO)				
Fatal crash	0.1848	0.0928	1.99	1.2030
Injury crash	0.0440	0.0180	2.44	1.0449
Driver condition (reference: normal)				
Drunk	−0.0558	0.0316	−1.76	0.9457
Speed of vehicle (reference: safe)				
Unsafe	−0.0420	0.0243	−1.73	0.9588
Seat-belt use (reference: restrained)				
Non-restrained	0.0909	0.0371	2.45	1.0951
Unknown	0.0519	0.0268	1.93	1.0532
Control variables				
Occurrence time (reference: morning (6.00 am–12.00 pm))				
Night (12:00 am–6:00 am)	−0.1744	0.0224	−7.80	0.8399
Mid-day (12:00 pm–6:00 pm)	−0.0328	0.0144	−2.28	0.9677
Municipality (reference: urban)				
Rural	0.1103	0.0240	4.60	1.1167
Location (reference: intersection)				
Non-intersection	0.0346	0.0181	1.91	1.0352
Road class (reference: non-highway)				
Highway	0.0847	0.0212	4.01	1.0884
Number of vehicles (reference: single vehicle)				
Two-vehicle	0.0659	0.0216	3.05	1.0681
More than two vehicles	0.0736	0.0381	1.93	1.0764
Crash type (reference: struck-object)				
Off-road	−0.1297	0.0228	−5.68	0.8783
Angular	0.0823	0.0231	3.56	1.0857
Rear-end	0.0455	0.0215	2.12	1.0465
Other collisions	0.0911	0.0271	3.36	1.0954
Driver familiarity (reference: Albertan)				
Non-Albertan	0.0555	0.0237	2.34	1.0570
Light condition (reference: daylight)				
Artificial light	−0.0700	0.0200	−3.51	0.9323
Unknown	−0.0860	0.0283	−3.04	0.9175
Constant	−1.0498	0.0215	−48.74	–
Number of observations	125,416			
Log likelihood at zero	−86,931.75			
Log likelihood at convergence	−73,943.01			
Chi square (20)	356.50			
P-value	<0.001			

a positive estimated coefficient will indicate that the corresponding variable increases the likelihood of a crash occurring during public holidays rather than regular weekends, whereas a negative estimated coefficient will indicate the reverse.

3.1. Main independent variables

In our analysis, the main independent variables considered are crash severity, driver intoxication, unsafe speeding and restraint use because these are the most highlighted issues related to holiday crashes in the media and much of the enforcement activities and publicity campaigns are focused on deterring drivers from these driving infringements. It should be noted that the results obtained on the outcomes are only correlational and do not imply any causality. Hence, care should be exercised in interpreting the results and their implications.

It is evident from the results shown in Table 2 that both fatal and injury outcomes are more prevalent during statutory holidays than weekends, and this finding is consistent with the general belief that the roadways are more dangerous during statutory holidays (Farmer and Williams, 2005). Moreover, our results also show that non-use of restraints (seat-belts) by vehicle occupants (driver and/or passenger) is higher in crashes during holiday periods which can be partly attributed to the lower proper restraint use during leisure trips as observed by Okamura et al. (2010). On the other hand, both driving while impaired and driving at an unsafe speed are found to be less prevalent in holiday crashes, albeit, only marginally significant (90% confidence level).

With respect to policy implications, our results showed that relative to regular weekends, non-use of seatbelt was more prevalent whereas drink-driving and speeding were less prevalent during public holidays. Hence, policy makers might want to consider focussing more on seatbelt use during their holiday blitzes and targeting drink-driving and speeding more during regular weekends. Note that our model was only able to identify the factors that were more prevalent in crashes occurring during holidays than crashes occurring during regular weekends but not the effectiveness of the enforcement or publicity per se. The results, however, would enable us to identify potential target areas and set the right priorities for future enforcement and publicity campaigns.

3.2. Control variables

In our study, several factors were included as control variables. We found that holiday crashes were less likely to occur during night-time or mid-day and also less likely to occur under artificial lighting conditions. These results might indicate a difference in consumer travel patterns and high risk times during holidays as compared to normal weekends.

Rural areas were over-represented in crashes that occurred during public holidays. Moreover, crashes during long weekends were more likely to involve out-of-province drivers. Long-distance social and recreational travels might occur during national holiday periods and most of these trips would be more likely to take place on high speed and unfamiliar rural roads. Consistent with these findings, we also found that holiday crashes were more likely to occur on highways and at non-intersection locations.

Multiple-vehicle (both two and more than two vehicles) crashes were also found to be more prevalent during the holidays. Interestingly, both angular and rear-end crashes were over-represented during the holidays whereas off-road crashes were under-represented. Holiday travelers might not be maintaining enough distance between vehicles and as a result, getting involved in higher number of rear end collisions. Driver distractions by passengers (*e.g.* chit-chatting, tending to children etc.) were more likely to be associated with rear-end or an angular crash than single-vehicle crash (Ghazizadeh and Boyle, 2009) and this kind of distraction might happen more frequently during holiday trips than regular weekend trips.

4. Conclusion

Holidays are often viewed as times of increased risky driving behaviors on the roads and many jurisdictions around the world, including Alberta, have invested additional resources to enhance their enforcement and publicity campigns during these periods. However, most of the factors contributing to the alleged increase in crash risks are also present during regular weekends and little research has been conducted to examine the differences between collisions occuring between holidays and regular weekends.

This study examined the factors associated with the statutory holiday crashes that significantly differed from the factors associated with weekend crashes. A binary logit model was applied to a sample of collision data from Alberta from 2004 to 2008. We found mixed but interesting results from our analysis. First, our model showed that both fatal and injury crashes were over-represented during holidays which was consistent with the perception that the roadways were more hazardous during the national holiday periods. Second, amongst the three behavior and policy variables (driver intoxication, unsafe speeding and restraint use), non-use of restraint was found to be more prevalent whereas driver intoxication and unsafe speeding were less prevalent during holidays. These mixed results obtained would suggest that we might need to reconsider how the enhanced enforcement and publicity campaigns should be conducted and to adopt a more balanced approach between holidays and regular weekends as well as among the different risky behaviors targeted.

In addition to the main influences on holiday crashes discussed, other factors identified included rural locations, highways, and non-intersection locations, as well as multi-vehicle, angular, rear-end collisions. Moreover, we found that relative to regular weekend crashes, holiday crashes were more likely to involve a driver in an unfamiliar environment. On the other-hand, holiday crashes were less likely to occur during the night and the afternoon, under artificial light conditions, or involved running off the road incidences.

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