Analysing the Severity and Frequency of Traffic Crashes in Riyadh City Using Statistical Models

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ABSTRACT

Traffic crashes in Riyadh city cause losses in the form of deaths, injuries and property damages, in addition to the pain and social tragedy affecting families of the victims. In 2005, there were a total of 47,341 injury traffic crashes occurred in Riyadh city (19% of the total KSA crashes) and 9% of those crashes were severe. Road safety in Riyadh city may have been adversely affected by: high car ownership, migration of people to Riyadh city, high daily trips reached about 6 million, high rate of income, low-cost of petrol, drivers from different nationalities, young drivers and tremendous growth in population which creates a high level of mobility and transport activities in the city. The primary objective of this paper is therefore to explore factors affecting the severity and frequency of road crashes in Riyadh city using appropriate statistical models aiming to establish effective safety policies ready to be implemented to reduce the severity and frequency of road crashes in Riyadh city. Crash data for Riyadh city were collected from the Higher Commission for the Development of Riyadh (HCDR) for a period of five years from 1425H to 1429H (roughly corresponding to 2004-2008). Crash data were classified into three categories: fatal, serious-injury and slight-injury. Two nominal response models have been developed: a standard multinomial logit model (MNL) and a mixed logit model to injury-related crash data. Due to a severe underreporting problem on the slight injury crashes binary and mixed binary logistic regression models were also estimated for two categories of severity: fatal and serious crashes. For frequency, two count models such as Negative Binomial (NB) models were employed and the unit of analysis was 168 HAIs (wards) in Riyadh city. Ward-level crash data are disaggregated by severity of the crash (such as fatal and serious injury crashes). The results from both multinomial and binary response models are found to be fairly consistent but the results from the random parameters model seem more reasonable. Age and nationality of the driver, excessive speed, wet road surface and dark lighting conditions and single vehicle crashes

are associated with increased probability of fatal crashes. More specifically, the probability of having a fatal crash increases with the age of the driver and Saudi drivers (relative to non-Saudi drivers) are associated with the probability of fatal crashes (relative to serious injury crashes). A crash involving a single vehicle is found to be more severe than a crash involving a multiple vehicles. The results from the frequency models suggest that percentage of non-Saudi found positively associated with serious injury crashes; percentage of illiterate people and the income per capita found to be positively significant with the frequency of fatal and serious injury crashes; and the increased residential, transport, and educational areas of land use is associated with the decreased level of fatal and serious injury crashes occurrences. Based on the findings, a range of countermeasures are proposed to reduce the severity and frequency of traffic crashes in Riyadh city.

1. INTRODUCTION

Riyadh, the capital of Kingdom of Saudi Arabia (KSA), is one of the fastest growing cities in the Middle East. Riyadh has experienced a very high rate of population growth as its population was 150,000 in the 1960s, over 4.5 million (about 18.5% of the total KSA population) in 2005 and expected to reach 10.5 million by 2020 [1]. The population of Riyadh city includes 66% Saudis and 34% non-Saudis. This tremendous growth in population creates a high level of mobility and transport activities in the city. In 2005, there were about six million trips generated per day in Riyadh city. This is predicted to rise to about 15 million trips per day by 2020. In 2007, about 85% of these trips were by private vehicles, 8% were made by private buses, 5% by taxis, and only 2% by public transport. Average car ownership is approximately 1.72 vehicles per household for the Riyadh city [2].

In KSA, road death rate was 21 fatalities per 100,000 people in 2005 and this is the second highest fatality rate within the Middle East and North Africa [1]. In 2005, there were a total of 47,341 injury traffic crashes in Riyadh (19% of the total KSA crashes) and 9% of those crashes were severe. The total length of road network in Riyadh is about 11,372 miles (about 11% of the total KSA road length). Previous studies have highlighted traffic safety as a serious issue for Riyadh and there is an urgent need to develop safety policies aimed at reducing both traffic crashes and their severity ([3], [4], [5], [6] & [7]).

Road safety may have been adversely affected by: high car ownership, migration of people to Riyadh city, daily trips made by cars inside the city reached about 6 million compared with about 1 million twenty years ago, high rate of income, low-cost of petrol, drivers from different nationalities, and a high proportion of young drivers.

The increase in trips is primarily due to increases in population, vehicle ownership, and income. Therefore, good transport planning and implementation are essential to increase safety standards and reduce the severity of crashes in the city of Riyadh. Because of the negative impact of traffic crashes which cause losses in the form of deaths, injuries and property damages, in addition to the pain and social tragedy affecting families of the victims, it is important to carry out a careful investigation to understand the relationship between traffic crash severity and their contributing factors