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Characterization of crash-prone drivers in Saudi Arabia – A multivariate analysis

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ABSTRACT

This study conducted a survey of traffic crashes with the data collected from police stations in the three cities of Saudi Arabia involving different features related to crashes, drivers, vehicles, and understanding of traffic signs. Among the chauffeurs, drivers at fault and not at fault were separated and investigated through factor analysis for 19 parameters related to their background and knowledge of traffic signs. The data show that a particular age group and time of the day may provide more insights to characterize the overall crashes in these cities. The factor analysis shows that the drivers at fault and not at fault may have distinguishable profile. Logit models were developed to quantify the effects of these variables. The models show that driver's experience and knowledge of traffic signs for chauffeurs has positive impact on reducing faulty behavior of drivers. Approximately, 68%–74% of the original variables are required to characterize chauffeurs, indicating the possibility of data reduction in traffic safety monitoring program. This study may assist in profiling the chauffeurs involved in crashes and reducing the parameters to be monitored for traffic safety program. The recommendations of this study may be considered beneficial in making policy for licensing and hiring of chauffeurs.

1. Introduction

Road traffic crashes (RTCs) can be defined as the events in which one or more motorized vehicle(s) collide with another vehicle, person or object resulting in fatality, injury or property damage (AASHTO, 2010). They have significant impacts as evident from the annual cost of crashes in Saudi Arabia, which reaches 6 billion US Dollars (Al-Atawi et al., 2014). In 2013, RTCs result in 1.25 million road traffic deaths globally. Without action, it is projected that RTCs will become the 7th leading cause of death by 2030 (World Health Organization (WHO), 2015).

In Saudi Arabia, RTC is a national problem adversely affecting the economy and societal fabric. There were approximately 544,179 traffic crashes in 2010, resulting in 7153 fatalities (Ministry of Interior, 2010), indicating that there were 20 traffic crashes for every 1000 persons and one fatality in every 76 traffic crashes (Central Department of Statistics and Information, 2010). These rates are alarming compared to other industrialized countries in Europe and North America (Ratrout et al., 2016). This study aims to assess the possibility of profiling drivers with higher probability of being at fault in crashes. Furthermore, the study assesses the possibility of collecting fewer data items for RTC without losing the characteristics needed for understanding RTC. Currently, Saudi Arabia does not have up to date online RTC data. One major challenge in this study was to collect, code, and analyze a representative RTC from all over the country.

The causes of road crashes can be attributed to human, vehicular and environmental factors. Human factor, apart from vehicular and environmental factors, may account for more than 90 percent of the crashes (Ergün and Al-Khaldi, 1984). Behnood and PakGohar (2008) reported that human factor influenced road safety and crashes by about 90%. Human factors involved in driving can be related to driving skills and driving style (Elander et al., 1993). Regular practice and training improve the driving skills, while individual driving habits govern the driving style. Although driving style is established within a certain period, it does not necessarily make driving safer (Klauer et al., 2006).

Past studies investigated the influence of various errors on road crashes. These include driver distractions due to secondary

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Nomenclature

Following abbreviations and symbols have been used in this paper:

a	Component loading (double definition)
A	Age
A1	Age < 25
A2	26 < age < 33
A3	34 < age < 41
A4	41 < age < 49
A5	Age > 50
AF	At fault
C	City
DAF	Drivers at fault
DNAF	Drivers not at fault
e	Residual term accounting
FA	Factor analysis
fi	Factored score
i	Component number
J	Sample number
m	Number of variables
N	Nationality
N1	Saudi
N2	Non-Saudi Arab people
N3	Southeast Asia people
N4	East Asia people
N5	People from other countries
NAF	Not at fault
P	Profession
P1	Drivers
P2	Student
P3	White collar jobs
P4	Blue collar jobs
P5	Other professions
PC	Principal component
PCs	Principal components
PCA	Principal component analysis
Q1	Type of crash
Q2	Driver's responsibility
Q3	Reason for crash
Q3-H	Crash due to human error
Q3-V	Crash due to vehicle problem
Q3-R	Crash due to road problem
Q3-O	Crash due to other reasons
Q4	Vehicle type
Q4-SC	Small cars
Q4-LT	Light trucks
Q4-HT	Heavy trucks
Q4-LTR	Light trailers
Q4-HTR	Heavy trailers
Q5	Driving experience outside Saudi Arabia
Q6	Driving experience inside Saudi Arabia
Q7	First license issuing country
Q8	Benefits from driving schools in Saudi Arabia
Q9	Distance of residence from workplace
Q10	Driving distance (km) per day
Q11	Working hours per day
Q12	Understanding of traffic signs written in Arabic
Q13	Understanding of traffic signs written in English
Q14	Understanding of traffic signs written in native language
Q15	Job type of driver
Q16	Level of satisfaction
Q17	Level of income
Q18	Health condition
Q19	Understanding of traffic sign for speed limit
Q20	Understanding of traffic sign for no entry
Q21	Understanding of traffic sign for no overtaking
Q22	Understanding of traffic sign for stop
Q23	Understanding of traffic sign for roundabout
T	Time of crash
T1	5 am–11 am
T2	11 am–5 pm
T3	5 pm–11 pm
T4	11 pm–5 am
VFs	Varifactors
x	Measured values of variable
X	Data matrix
Z	Component score (double definition)

activities (Klauer et al., 2006; McEvoy et al., 2007), negative emotions (Groeger, 2000), looked but failed to see (Herslund and Jorgensen, 2003), failure of observation and situation awareness (Brown, 2005), and difficulty in hazard perception (Underwood et al., 2003). Driver distraction is reported to be responsible for approximately one-half of road crashes caused by human factors (Stutts et al., 2001). The distraction is often in the form of engagement in secondary activities (e.g. phone calls, interaction with passengers) causing a shift of attention from driving (Dibben and Williamson, 2007). Driving behavior can be negatively affected by emotions (Mesken, 2001). Iversen and Rundmo (2004) reported correlations between risky styles of driving, traffic rule violations, and road crashes. Intake of alcohols, fatigue, medications, and drowsiness can hamper driving performance greatly (James, 1998; Williamson et al., 2001; Philip et al., 2005; Ingre et al., 2006; Alvarez and Fierro, 2008).

In Saudi Arabia, human factors are found to be responsible for approximately 80% of road crashes (Lee, 1986). Recent data indicate that 76% of traffic crashes in 2010 were related to human factors. Ansari et al. (2000) reported that more than 65% of the crashes between 1971 and 1997 were due to high speed and/or traffic signal violations. The major causes of traffic crashes in the Asir region (Saudi Arabia) were over-speeding, violation of traffic laws, fatigue, and carelessness of the drivers (Khan et al., 2010).

A more comprehensive review study was conducted by Mansuri et al. (2015) who reviewed the literature related to RTCs in KSA for the last 25 years. They highlighted the fact that majority of the crashes involve teenagers and are because of over-speeding. They attributed the severity of the injury to the violation of wearing seatbelt law.

The other factors for road crashes in this region were kids in laps while driving, lack of driving skills, underage driving, and use of cell phones. The factor analysis of driver behavior questionnaire focusing on characteristics of drivers may assist in identifying the major causes of crashes and can help in characterizing the crash-prone drivers in Saudi Arabia. However, such an initiative in context to characterizing drivers is limited. As such, there is a need to better understand the characteristics of the drivers involved in crashes. There have been some efforts made to investigate the causality of crashes, which are briefly presented as follows.

The first study found for modeling the causality of crashes in KSA was by Ageli and Zaidan (2013). They applied Granger-causality technique to determine the relationship between RTCs and other macro-scale parameters including, GDP, number of vehicles and licensed drivers, etc. However, they did not cover the factors related to specific crashes and limited themselves to evaluating the factors affecting number of crashes.

A detailed study was done by de Oña et al. (2013), which evaluated the factors affecting crashes in Granada (Spain). They