A Comparative Study on the Characteristics of Road Traffic Accidents in China and Djibouti

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Abstract

The purpose of this study is to estimate the comparative analysis of road traffic accidents in China and Djibouti for the period of 2012-2016. Traffic violations that lead to mortalities and severe injuries and fatalities are analyzed both for China as well as Djibouti. The comparative analysis is very interesting for having different results against the set variables. This study caters two explained variables: traffic violations and severity of injuries with explanatory variables of considering the riskiness factors of humans, vehicles, roads and environments. In line with the previous study, logistic regression analysis is used for getting the casual relationship between the explained and explanatory variables to assess the status and nature of accidents and fatalities in these two countries. The data are taken from the respective police departments and World Health Organization safety. With current economic boom in China, the volume of vehicle and traffic accidents are considerably higher but subsequently in decreasing trend due to good management of traffic and better infrastructure while the case of Djibouti is reasonably at a very low ebb. Furthermore, in both of these two countries, road accidents are the major reasons for mortality. Some of the prominent risk factors contributing to roads accidents are age, an experience of drivers, male drivers, lacking proper maintenance of vehicles for safety, the design of roads, roads status, low visibility during nights due to low or no lightening system and weather. Goods and passengers vehicles tend to commit more traffic offences in Djibouti which resultantly become a major cause of road accidents and hence more severe fatalities. The first factor contributing the traffic violation and imply more and severe injuries are a human factor which if this can be effectively managed then the mortality rate can be mitigated to a substantial level. The second risk factor related to complying with government traffic rules, laws and regulations targeting various kinds of vehicles, driver groups in terms of reducing human, vehicle and environmental risk factors. Such measures may include road safety programs for drivers, focusing on traffic rules and improvement of transport facility. This study eventually guide the traffic policy maker of these two countries for formulating and deploying effective measures for mitigating the mortalities and severity of injuries due to road accidents.

Keywords: Road accidents; injuries; traffic violations; China; Djibouti.

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1. Introduction

Road traffic's accidents cause many death and permanent disabilities around the globe. According to the report of World Health Organization (WHO), nearly 1.24 million people die each year [1]. These accidents afflicted 20-50 million of people impaired with permanent disabilities. The young aged people 15-29 years die in road accidents the most followed by mature people aged 15-44 that accounts for roughly ascribed for the leading three reasons for mortality. According to the report of Institute for Health Metrics and Evaluation (IHME), around mortality occurred due to road accidents in 1990 was 907,900; in 2010 was 1.3 million and in 2013 was 1.4 million that accounts for one person dies around 25 seconds. The road accidents are counted on a scale of five risk determinants i.e. driving while drunk, over-speeding, helmets, child refrains, and seat-belts. There are 28 countries of the world complying with these parameters that accumulate for about 7% of the world's population (i.e. around 449 million). Majority of the road accidents happened in low and middle income countries. The road accidents cost almost 3% of the gross domestic product to most countries of the globe. Around 33% of the road mortality happened in such countries are the killing of cyclists and pedestrians. Furthermore, 35% of these countries are having rules and regulations for traffic in order to protect innocent citizens. Relatively the rate of people killed in road accidents in developing countries is very high as compared to that of advanced countries. According to the figure, 24.1 per 100,000 people are killed in road accidents in developing countries while there are only 9.2 per 100,000 in developed countries. The international public health sponsored by the United Nations urged for widespread action across the globe to overcome the menace of road accidents mortality rate. World Health Organization (WHO) is the leading body of the health of world that is spearheading health activities worldwide [2]. According to WHO majority of the road accidents occurred in developing countries accounting for roughly 54% of the vehicles due to vulnerable infrastructure and vehicle conditions.
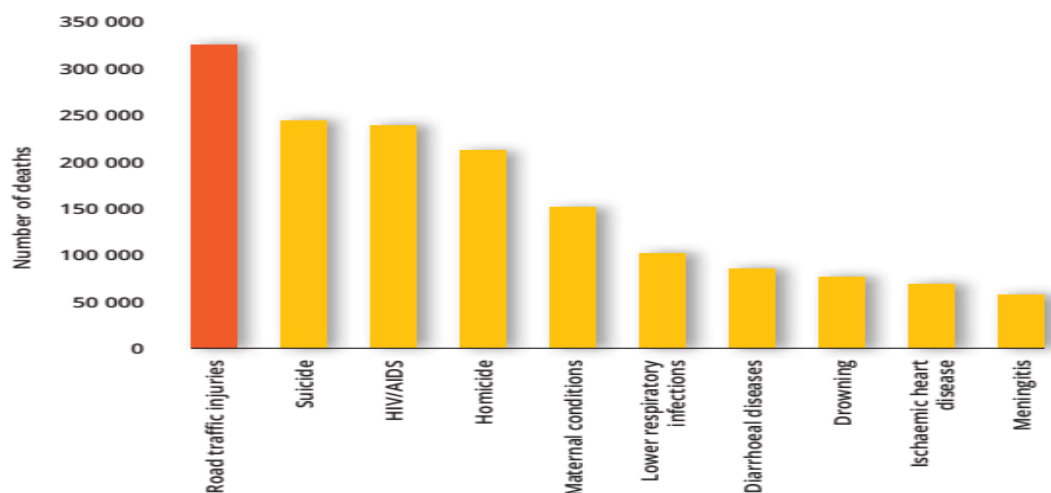
Figure 1: Ten major reasons for death among aged of 15-29 years (Source: World Health Organization (2015)
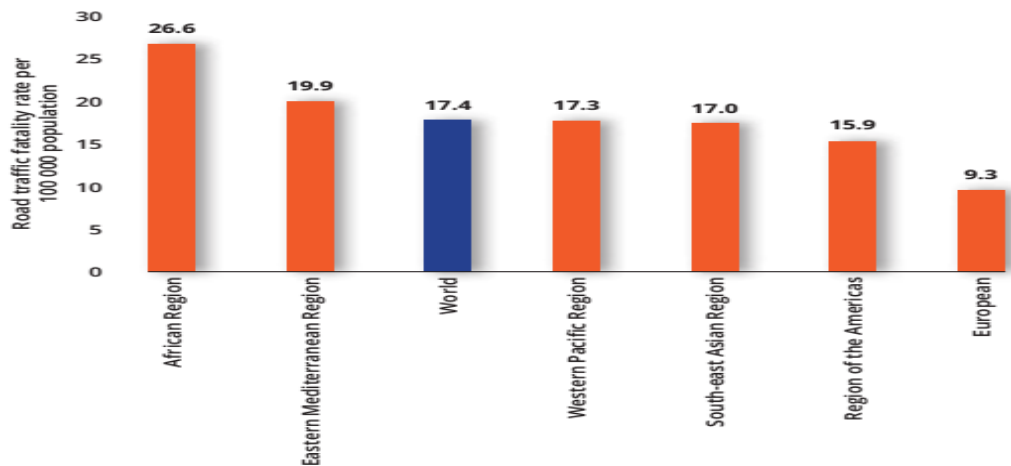
Figure 2: Mortality rate per 100,000 people of traffic by various regions (Source: World Health Organization 2015)

The road accidents are increasing in many countries including China and Djibouti. China being constructing good roads may potentially be in a better position of reducing road accidents mortality. It is possible that the incumbent vulnerability would be overcome in near future. Accurate information and data are vital for deploying effective measures for overcoming such fiascos occurring to citizens because of road accidents. The situation of road mortality in Djibouti is highly vulnerable because of low graded infrastructure and the condition of transportations comprising non-maintained and polluting emitting buses.

The discrepancies between data collected from indigenous sources of the countries i.e. police data and that of public health sponsored by WHO are having a contradictory pattern. Normally the indigenous data are underestimated by showing fewer people are being killed due to road accidents. For instance, the indigenous data showing almost 50% fewer mortality due to road accidents than that of WHO's data. Based on the indigenous data for formulating and fabricating policies for overcoming traffic accidents are insufficient and ineffective to control and effectively reduce road traffic mortality rate especially in these countries.

Djiboutian roads are very vulnerable to road accidents because of having proper road safety for pedestrians and livestock that use the same roads. This becomes even more dangerous in the night timing. Some of the roads are well maintained but these are narrow and one-way. Most of the roads don not have road lights. Furthermore the conditions of transportation in terms of effective use are vulnerable to safety and use.

2. Literature Review

2.1 Traffic conditions and accidents trends in China

Due to high urbanization in China, there is high pressure of transportation on the existing roads and infrastructure. The roads in big cities like Beijing are highly crowded all the times due to traffic congestions. Though the size of the roads and intersections are wide enough but still incapable to serve the massive traffic requirements of big cities. This is a fact that intersections in Chinese big metropolitan cities are fewer than

European and American Stats (i.e. less than approximately 20 to 30% than the latter ones) [3]. The limitations of infrastructure are not limited to urban areas rather it's present in motorways even. According to author [4] noted that the capacities of open ways are relatively less than those in some European countries like The Netherlands. Safety of traffic is one of the major concerns in China. Against the reported road facilities, the statistics of roads hazards are alarming. The inefficiencies and unsafety in traffic are becoming a major concern for all developing countries including China to rectify and promulgate effective measures to enhance the safety of the people. The mortality in road accidents approximately accounted for 1 to 3% of the Gross Domestic Product (GDP) of China according to WHO [5]. Due to the growing economy, the volume of the vehicle in China is increasing that leads to more roads mortalities and causalities going to be highest in the globe. According to data of the Ministry of Public Security, China, 2013 alone, the road accidents accounted for more than 67,000 deaths and more than 145 million dollars of losses. This alarming death toll due to road accidents is becoming greater which is going to becoming the number 1 killer in China [3]. Complying with the United Nations Road Safety Action, the State Council of China is establishing a stringent and effective measure to mitigate the mortality by around 36% in incoming five years national strategic plan. According to a well-recognized "Haddon matrix model" introduced [6] there are three measures of related factors that are: Human, Vehicle and Environment considering the accident pre, during and post-collision. Some of the well accepted shortcomings causing mortality due to road accidents are driving behavior such that over-speeding, drunk driving, and not using safety measures such as helmets. According to author [7] noted, indicate that the majority of roads mortality occurred because of traffic crashes in China. Such roads fatalities are mainly associated with various important factors like age, gender, residents locality (i.e. Urban, rural), time distribution, geographic location, crash pattern, crash causes, road type and time distribution. With the accelerated development of new roads and infrastructure, the mortality rate could be enhanced if proper regulations are not taking place. According to statistics provided by the Ministry of Public security traffic management (2004-14), though the mortality has been decreasing for the past few years due to governmental efficacy and its due role to overcome the menace of traffic causalities yet the expansion of traffic and congestion are creating problems in terms of mortalities and serious injurious. The given table shows the rate of mortality of people occurred in road accidents in thousands on the vertical axis with the corresponding year on the horizontal axis.
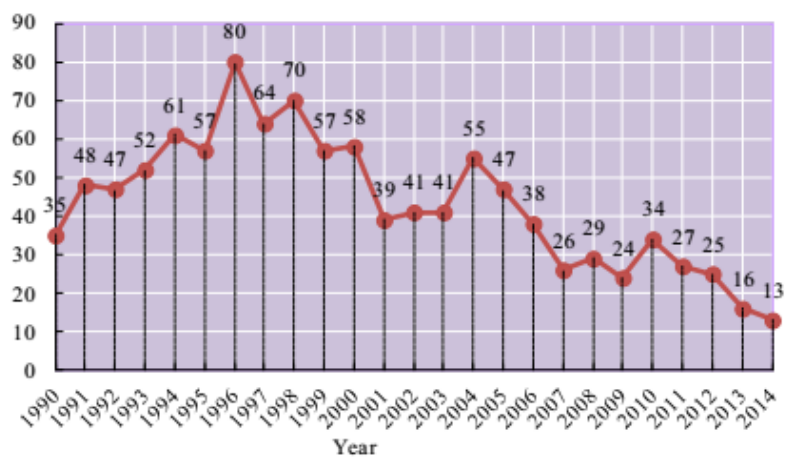
Figure 3: The number of serious Roads Traffic Accidents from 1990-2014 in China (Source: The Ministry of Public Security Traffic Management Bureau China)

But according to author [8] noted, many people object on such data provided by the local ministry rather they are of the view that the Health department is accurate. According to the finding of this research, China currently is facing high mortality rate as compared to the advanced world due to a design of roads, traffic management, unsafe behavior of pedestrians, and driving attitudes of drivers.

2.2 Traffic conditions and accidents trends in Djibouti

The conditions of traffic and roads are widely different from those in advanced countries. The sole means of transportation in Djibouti is public sector transportation through buses among various cities. These buses are vulnerable in terms of maintenance and safety for the general public due to mainly of the shabby conditions of roads and drivers irresponsible behaviors that lead to many roads fatalities.

The roads in Djibouti do not have safety for the pedestrians and live stocks that normally roaming around roads through walkways during days as well as night timings. The chances of roads fatalities even become more vulnerable in the night timings due to such infrastructure. While there are few roads which are well maintained for traffic but those are also lacking proper facilities of having lights and sewerage system. Few of the roads are repaired. Due to having improper policies for maintaining the vehicles, many of the times the accidents occurred due to breakdowns and eventually resulted in human causalities. There are few of the leading reasons beside breakdown of a vehicle, which resulting into accidents in Djibouti: high speeding, indigenous local driving attitudes, lack of pedestrians safety on walkways due to improper demarcation on roads, the presence of livestock in the roadways, and unavailability of fundamental safety instruments in vehicles. Due to these shortcomings, the mortality and serious injurious happens on daily basis.

Furthermore, the speed limits are imposed strictly for reducing the mortality and other serious injuries. The Djiboutian Gendarmerie and Police force hold accountability for the safety of roads in the country. In 2012, the Road Police was developed but the role was not explicitly determined. The authorities are affixing some issues like correcting the traffic lights to mitigate the accidents and promulgate the effective flow of traffic. The local authorities are helping the drivers how to follow the traffic rules for more safety. There are two major highways in the country connecting to the capital city through Dire Dawa, Ethiopia, and Obock, Djibuti. The former highway is in poor condition due to vulnerable infrastructure. Both of these roads are occupied by Ethiopian trucks that are transporting consignments across the country. The condition of roads becomes more vulnerable in rural areas where the roads are broken into various patches. Due to the lack of emergency handling services in Djibouti, the accidents' victims are not being treated effectively for recovery. The rural areas have no cell phone coverage facility which eventually becomes one of the main reasons for interacting with the relevant authority on time in case of any causality. In Djibouti the traffic roads mortality has been increasing for the past almost thirty years. According to a report of Global status on road safety in 2015, the WHO has depicted the highest rates of mortality in African region including Djibouti. The rate of such traffic mortality and injuries were around 27 per 100,000 people for 2013 in Djibouti. In this year alone, more than 85% of all such mortalities and 90% of people impairment and disabilities from traffic accidents happened in low-and-middle income countries that account for around [9]. The increased fatalities from traffic accidents in the shape of deaths and injuries in Djibouti happened due to lack of economic development which raises such

fatalities. The mostly available transportation for the people of Djibouti is public transportation as rail and air transportations are very expensive to be affordable [10, 11]. The roads infrastructures are pathetic and the commuters are facing dangers as their lives are prone to unsafety due to road environment. In 2009 according to the Global status report on road safety for the first time reported the unreported road traffic accidents in Djibouti which has been statistically unreported due to unreliable data about mortality and serious injuries due to traffic and roads [10]. In this report Djibouti has been shown with the highest mortality rate of around 32 per 100,000 people as compared to almost 7 per 100,000 mortality rate reported during this period. Such unreported data about fatalities and serious injuries due to road accidents depicts non-availability of proper and accurate data system which could be utilized for the formulation of strategic planning about road safety and improvement and upgrading the hospital system. The government's responsiveness is not at par rather irresponsible in this regard.

2.3 Key factors/reasons of accidents (Chinese context)

There are several factors describing road accidents' mortality in China. According to author [12] noted that there are various important reasons for roads' mortality each year in China which are as below:

1. The vulnerable visibility due to inappropriate traffic lights and street lights during night time coupled with poor intersections has enhanced the chances of road accidents in China.
2. Overloading of cargo trucks is another leading reason for road mortality. In lieu of earning more money, the contractor and driver used to overload the cargo coupled with less attention by police deployment for effective monitoring and control leads to major road accidents that claim many people's lives.
3. Unfocused driving due to less driving attention and at times wrong overtaking leads to dangerous vehicle collisions.
4. Inappropriate use of driving manners like seat belts is one of the major reasons for afflicting more causalities than normal
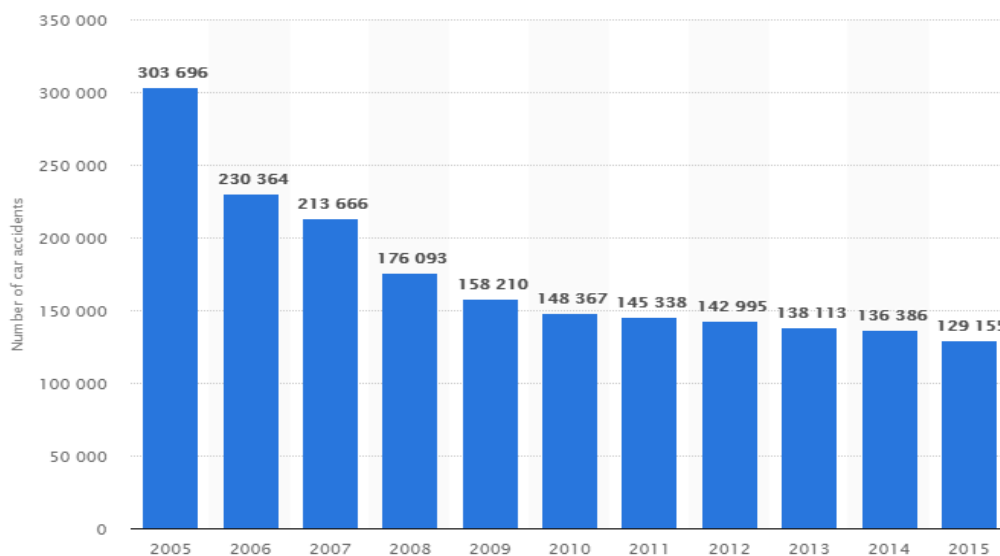
Figure 4: Statistics of car accidents during 2005-15 in China

(Source: https://www.statista.com/statistics/733949/number-of-car-accidents-china/)

According to the data of the ministry of public security annual reports the maximum deaths occurred to pedestrians due to roads accidents followed by 3 wheelers motorists and others. The given pie chart reflects the requisite statistic:
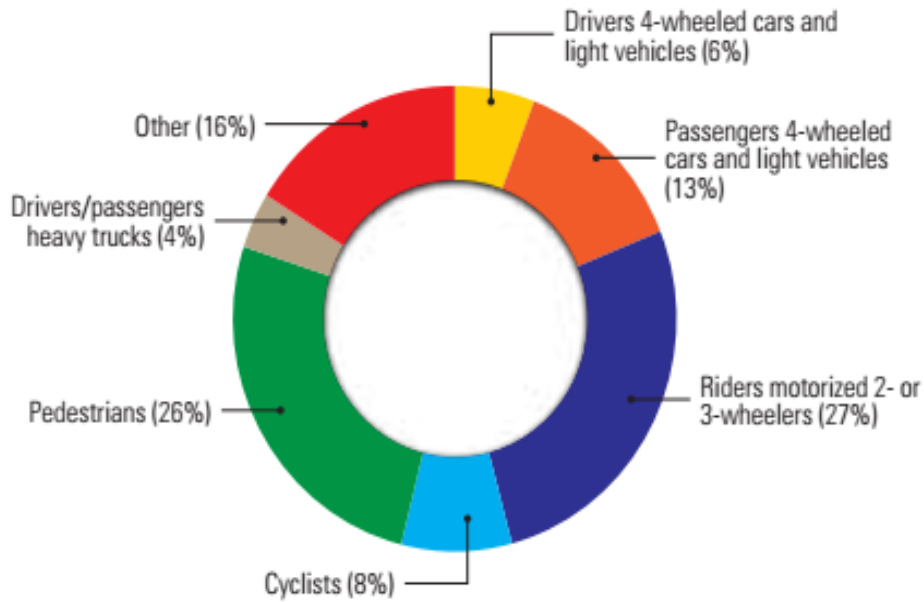
Figure 5: Mortality due to the following categories

(Source: 2015, Ministry of Public Security annual report on traffic accidents on roads China)

2.4 Key factors/reasons of accidents (Djibouti context)

Few of the leading reasons and factors for high mortality rate in Djibouti according to WHO (2015) [13] report are as Follow: over-speeding against the set limit i.e. roughly 50 km/hour that causes causalities, vulnerable conditions of roads that can't afford vehicle for going on more than the provided speed limit, two-way roads that normally become a cause of serious accidents due to overtaking, less vigilance and control of police and even no presence in rural areas, lack of awareness program for pedestrians as well as drivers, lack of governmental promulgation for effective maintenance of vehicles, lacking to comply with road safety rules by pedestrians, sideway animals flocks using the same roads, and use of mobile phones.

2.5 Comparative analysis

Comparative analysis of factors and parameters, including countries, is an important theme in studies involving empirical investigations surrounding them [14,15]. The means of transportation, their conditions, and infrastructure are widely different in China from Djibouti. The former is highly developed and advanced while the latter is lacking in many spheres. The rates of accidents in China are relatively very fewer than that of Djibouti due to proper designing of roads, multiple avenues of transportation like trains. The statistic of fatal

accidents leading to mortality is relatively very fewer in China than in Djibouti. The data are mostly available in China's context that is normally utilized for formulating guidelines, policies and regulations for enhancing the incumbent infrastructure for more reliability and more safety. While the debate about the figures on police and health sector is still under debate. Accordingly, in Djibouti there is a shortcoming of having accurate and sufficient database to be utilized effectively for carving any policy that may entail safety of commuters. The traffic accidents imply various fatalities in both of these countries because of speed not compatible to the existing design of roads or because of improper pathways for pedestrians that are highly inflicted because of these accidents especially in Djibouti where animals and human beings use the same pathways beside public transportation. The role of government in China looks vigilant to comply with accidents and other fatal scenarios but this is not possible in Djibouti due to poverty and having very low GDP. In nutshell it can be safely said as that the two countries are having a very widely different perspective in terms of commuting infrastructure, roads, the design of roads for the speed limit, other means of transportation like railways, subways, airways and tramps. Like the aforementioned means of transportations are available in China but the people of Djibouti are mostly relying on public transportations. The railways and airlines are very costly considering their purchasing powers. The maintenance in Djibouti for vehicles is the lowest ebb and the government does not have any measure to monitor and control them. The police are incapable to deploy stringent measures to overcome the mortality happening due to roads accidents. In China, there is huge intervention by the government to rectify and align the shortcomings with measures effective for controlling the traffic in a proper way. Though due to the huge and congested population there results could not be made comparable to an advanced world where these sorts of limitations to most of the extent have been overcome.

3. Research Methodology and Framework

$$\text{Traffic\_violation} = C + \beta_1 \text{ Human} + \beta_2 \text{ Vehicle} + \beta_3 \text{ Road} + \beta_4 \text{ Envrm} + e$$

$$\text{Injuries} = = C + \beta_1 \text{ Human} + \beta_2 \text{ Vehicle} + \beta_3 \text{ Road} + \beta_4 \text{ Envrm} + e$$

According to the World Health Organization [1] a regression model is used for a country having more than 150,000 populations to estimate the deaths of people due to road accidents. The above model is used for taking both China and Djibouti as the population is greater than the given bracket. In this model, N is the total deaths occurred due to road accidents, C is the constant term, and explanatory variables are given as follow: human risk factors, vehicle risk factors, road accidents factors, and environment risk factors which are represented by human, vehicle, road and environment variables respectively in the given model . The explained variables are traffic violations and serious injuries and fatalities which are represented by Traffic violation and injuries in the model above respectively.

4. DATA and Methodology

4.1 Data

This research relies on the accidents of traffic for the duration of four years (i.e. 2012-16) by taking data from the requisite police departments and WHO for China as well as Djibouti. The data are taken from the traffic

management department of the given countries. The police data entail the on-the-spot reported data that was conducted and collected through assessments and given feedback to the incumbent headquarters. The sample of the data contains annual data for the given period for the given two countries. Each dataset entails the demographic information, the characteristic of vehicles, the severity of injuries, the condition of roads, the environmental condition and time of the crash. Here it worth mentioning there are primarily two approaches in research for data analysis and each approach depending on the type of data.

The authors highlighted this phenomenon in detail in their works [16,17]. If data is insufficient or incomplete researchers usually use grey system theory and if data is sufficient then researchers use statistics [14,18].

The current researches were mainly based on the survey data or observation in order to evaluate the safety of pedestrians, seatbelt use, and helmet [19] and the attitude of drivers while taking care of safety during driving the vehicle [20]. There are other studies which are reliant on taking the regional traffic accident data on a smaller scale to determine the effect of irresponsible driving behavior leads to major fatalities during road accidents [21,22].

The following dependent variables are taken for this study: (A) whether there occurred any traffic violation in the form of yes (1) and No (0), whether the accidents catered with severe injuries/fatalities which is given by 1 for yes and 0 for No. as we see the outcomes are measured in either 1 or 0, therefore, a logistic regression model is used to empirically estimate the implication of risk factors/determinants on the probability of (A) violation of traffic, and (B) severe injuries during roads accidents.

Though the binary logit regression model is the mostly utilized method/model for analyzing severe injuries occurring due to roads accidents, ordinal discrete results is an appropriate choice when the data of injuries and fatalities are based on an ordinal scale [23].

This study caters the severity of injuries is divided into two categories i.e. injuries that are severe and fatal or not. The risk determinants considering are as follows: human factors, vehicles conditions, roads factors and environmental factors.

4.2 Risk Factors

4.2.1 Human Determinant/ Factor

The age of the driver and gender are deemed to be prospective risk determinants. According to the data of the traffic management bureau and ministry of the countries, the habits vary with age brackets. This can be divided into five categories: $\leqq 25$, 26-35, 36-45, 46-55, $\geqq 56$ and the experience of driving are classified into six categories which are as follow: $\leqq 2$, 3-5, 6-10, 11-15, 16-20, $\geqq 21$ years.

The violation of drivers in traffic and accidents are highly related to their education, social status and income. These are the prospective determinants for traffic violations.

4.2.2 Vehicle Determinant/ Factor

The vehicles are categorized into three kinds: passenger vehicles, vehicles for goods transportation and motorcycles. The requisite data is based on the insurance of the vehicles, safety condition of vehicles, overloading conditions and importantly on whether the vehicle is used for commercial purpose or not.

4.2.3 Road Determinant/ Factor

According to the functional categorization of roads, the types of traffic lanes can be divided into: shared lanes, vehicle lanes and other types of lanes considering the function. The roads can be highways, ordinary highways and metropolitan or urban expressways and highways.

The ordinary highways consist of first through fifth class highways while urban expressways include ordinary and other highways.

4.2.4 Environmental Determinant/ Factor

The environmental determinants are categorized into 8 which are given as below: weather situations, street-light situations, visibility level, weekend effect, public holiday, time of the daytime, year of accident and season. The street-light situation is categorized into the following types: daylight, a condition of light at night time, and not light at night time.

The weather condition is measured as 0 for good and 1 for bad followed by visibility level (good is measured with 0 and bad for 1). The weekend's effect is determined as 17:00 Friday to 23:59 Sunday, as it is assumed and considered that traffic accidents are anticipated more during these hours [24]. Similarly anticipation is considered for public holidays in both of these countries (i.e. China and Djibouti).

Season does effect on traffic accidents but during hot seasons it's assumed to be lesser because there are fewer commuters as compared to ordinary seasonal environment.

4.3 Statistical analysis of the data

The association of risk factors/determinants and (A) violation of traffic and (B) severity of injuries are given in the contingency tables. Chi-square tests are conducted for independence at a significant level of 5% is done.

The logistic regression model is used for empirically estimating the risk factors on traffic violation and severity of injuries.

5. Finding and empirical result

Tables 1 and 2 depict the chi square estimation for evaluating the relationship between the explanatory variables and the explained variables i.e. (A) violation of traffic and (B) serious injuries and fatalities.

Table 1: Association of traffic and severity of road accident in Chiba

Factors/Determinants	Traffic violations *Chi-Sqd,* p-value, dof	serious injuries (traffic violation) *Chi-Sqd,* p-value, dof
Human determinants		
Gender of driver	80.297*(<0.001),1	152.362*(<0.001),1
Age of driver	24.183* (<0.001), 5	8.971 (0.099),5
Driving experience	19.00* (0.002), 4	39.023*(<0.001),4
Vehicle determinants		
Type	499.765*(<0.001),2	645.234*(<0.001),2
Safety status	226.234*(<0.001),1	304.645*(<0.001),1
Overload condition	4.141 (0.077),1	261.001*(<0.001),1
Whether the vehicle is Commercial or not	42.003* (<0.001),1	692.123*(<0.001),1
Road determinants		
Traffic lanes	137.343*(<0.001),1	9.003*(0.005),1
Type/kind	376.787*(<0.001),7	1299*(<0.001),7
Environmental determinants		
Street-light Situation	6.435* (0.049),2	578.564*(<0.001),2
Weather Situation	31.232* (<0.001),1	0.315(0.765),1
Visibility	20.01* (<0.001),1	64.120*(<0.001),1
Weekend effect	6.56* (0.015),1	16.876*(<0.001),1
Time Horizon	5.002(0.312),5	117.564*(<0.001),5
Seasonal effect	8.912*(0.0478),3	38.234*(<0.001),3
Yearly	218.432*(<0.001),4	19.012*(0.001),4
Traffics' violation	1321.000*(<0.001),5	344.343*(<0.001),5

*Significant at 5% level.

Table 2: Association of traffic and severity of road accident in Djibouti

Factors/Determinants	Traffic violations *Chi-Sqd,* p-value, dof	serious injuries (traffic violation) *Chi-Sqd,* p-value, dof
Human determinants		
Gender of driver	89.0997*(<0.001),1	167.362*(<0.001),1
Age of driver	27.183* (<0.001), 5	12.971 (0.099),5
Driving experience	39.00* (0.002), 4	40.023*(<0.001),4
Vehicle determinants		
Type	539.765*(<0.001),2	765.234*(<0.001),2
Safety status	346.234*(<0.001),1	404.645*(<0.001),1
Overload condition	13.141 (0.077),1	343.001*(<0.001),1
Whether the vehicle is Commercial or not	55.003* (<0.001),1	898.123*(<0.001),1
Road determinants		
Traffic lanes	207.343*(<0.001),1	10.003*(0.005),1
Type/kind	126.787*(<0.001),7	2209*(<0.001),7
Environmental determinants		
Street-light Situation	12.435* (0.049),2	458.564*(<0.001),2
Weather Situation	51.232* (<0.001),1	0.315(0.765),1
Visibility	30.01* (<0.001),1	54.120*(<0.001),1
Weekend effect	12.56* (0.015),1	21.876*(<0.001),1
Time Horizon	15.002(0.312),5	121.564*(<0.001),5
Seasonal effect	18.912*(0.0478),3	48.234*(<0.001),3
Yearly	318.432*(<0.001),4	29.012*(0.001),4
Traffics' violation	1256.000*(<0.001),5	664.343*(<0.001),5

*Significant at 5% level.

For further assessment of the incumbent casual association between explanatory as well as explained variables,

logistic regression model beside adjusted odds ratios with 95% confidence intervals for the significance of the given factors are established that are provided in Tables 3 and 4.

Table 3: Odds ratios (adjusted) at a 95% confidence interval level assuming stepwise logistic regression of given risk factors linking with traffic violations and severity in accidents in China

Factors/Determinants	Traffic violations *Chi-Sqd,* p-value, dof	serious injuries (traffic violation) *Chi-Sqd,* p-value, dof
Gender of driver -Male -Experience of driver (≦2)	1.542(1.326,1.230) 1.347(1.230,1.329)	1.342(1.763,1.894) 0.651(0.092,0.993)
Vehicle determinants Type -Passenger -Goods Safety status Overload condition Whether the vehicle is Commercial or not	 1.542(1.987,2.224) 2.463(1.675,2.333) 2.456(2.384,2.9090) 1.788(1.388,1.321) 1.997(1.450,1.423)	 1.671(1.454,1.465) 1.784(1.769,1.960) 1.789(1.178,1.456) 1.870(1.564,1.651)
Environmental determinants		
Street-light Situation (No street light)	1.207(1.200,1.341)	1.456(1.454,1.567)
Weather Situation		
Visibility	1.1127(1.206,1.296)	1.430(1.056,1.333)
Weekend effect	1.455(1.011,1.332)	1.457(1.055,1.177)

Table 4: Odds ratios (adjusted) at a 95% confidence interval level assuming stepwise logistic regression of given risk factors linking with traffic violations and severity in accidents in Djibouti

Factors/Determinants	Traffic violations *Chi-Sqd*, p-value, dof	serious injuries (traffic violation) *Chi-Sqd*, p-value, dof
Gender of driver -Male -Experience of driver (≦2)	1.432(1.245,1.674) 1.447(1.165,1.289)	1.382(1.213,1.574) 0.911(0.852,0.973)
Vehicle determinants Type -Passenger -Goods Safety status Overload condition Whether the vehicle is Commercial or not	1.992(1.877,2.114) 2.023(1.895,2.160) 2.586(2.274,2.940) 1.248(1.128,1.380) 1.347(1.260,1.440)	1.371(1.284,1.464) 1.774(1.609,1.956) 1.289(1.164,1.427) 1.480(1.334,1.641)
Environmental determinants		
Street-light Situation (No street light)	1.197(1.110,1.291)	1.536(1.414,1.667)
Weather Situation		
Visibility	1.097(1.006,1.196)	1.450(1.656,1.256)
Weekend effect	1.065(1.011,1.562)	1.657(1.578,1.187)

From the overall results of the given test, it is empirically established that around 74% of the traffic accidents are done due to a traffic violation in China as compared to Djibouti where this ratio is around 86%. Serious and fatal road accidents involving traffic violations account for roughly almost 41% in China while it is around 73% in Djibouti which is showing significance at 5% level of significance. While the rest of the road accidents have occurred in the absence of traffic violations at the given statistically significant level of 5%. The severities of road accidents are positively associated with traffic violations. This implies that the absence of traffic rules and violation by the drivers apt for more road accidents and hence results in more mortality and serious injuries. The trend in Djibouti is very alarming probably because of less compliance with traffic rules and conditions of roads and lack of vehicles maintenance while the case in China is widely different because of having higher income cadre catering more promulgation of rules by the drivers due to more police vigilance, better and updated roads infrastructure and maintenance of vehicles as per law.

5.1 Risk factor impacting traffic violation

As shown in the tables-1 & 2 of the second column there are many factors associated significantly to traffic violations in China as well as Djibouti. The gender of the drivers is one of the crucial factors in this regard. The violation committed by the female drivers in China is almost 66% to the overall proportion of traffic violations while in Djibouti the ratio is not very big because of the reasons that female do not normally use to drive over there. The age is also one of the important factors effecting traffic violations and eventually leads to more mortality and serious injuries in both China and Djibouti. The results evident that young, new and experienced drivers are doing more traffic violations. The probability is high. For Djibouti the less developed and vulnerability on the part of government further aggravate the situations to effectively tackle the traffic conditions as per law.

The other factors such as the type of vehicle, safety status and commercial aspects are few of the significant determinants related to violations of traffic. Motorcycles in China are showing less proportion of traffic violations as compared to goods vehicle (77%) and passenger vehicles (78%) while in Djibouti the motorcycles are relatively showing more traffic violations as compared to goods vehicles and passengers' vehicles which are 91%, 79% and 82% respectively. Furthermore, the safety status of vehicles, overload and commercial vehicles in Djibouti show a higher than mean traffic violations as compared to China. Besides, other environmental conditions such as street light condition, visibility level during night specially, weather condition, weekend effect and other public holidays implications are related to traffic violations more in Djibouti than China due to lack of proper resources to cater good infrastructure to facilitate their masses. The given table shows the effect of all these determinants in a clear manner that necessitates the urge for deploying effective measurements by Djibouti especially and by the Chinese government too for moving ahead for providing a better environment to curb mortality due to roads accidents.

Male drivers having less than 6 years of experience imply to commit more traffic violations than others. Passengers and goods transportation vehicles tend to exhibit more traffic violations than others because of the careless attitude of drivers. This is especially more concerned in Djibouti than in China as the conditions of such vehicles are very odd. Overloading and overlooking safety measures are also found to be significantly affecting the traffic rules that result in severe consequences in the shape of serious injurious and fatalities. Some other factors may also include the age of the drivers, and third party insurance of vehicles also matter for determining the traffic compliance as per rules.

5.2 Risk factor impacting the severity of injuries

Conditional on the violation of traffic, the severity of injuries are estimated due to road accidents in China as well as Djibouti. Table-1&2 depicts the chi-square statistic for evaluating the explained variables and explanatory variables for the severity of injuries inflicted due to traffic roads accidents. It is measured and assessed that nearly 42% of accidents catered severe injuries in China which are used as a base in this case for Djibouti where this ratio is alarmingly very high i.e. 71%. This is probably due to lack of proper infrastructure and compliance with traffic rules. In Djibouti the traffic condition for passengers as well as goods is highly questionable. Among other factors associated are age, and gender. For instance from the given statistics, it is

visible that female drivers are prone to such fatal injuries by around 26% which is lower than a male that around to 42%. There are other related reasons for China as well as Djibouti which are meaningful in the context of comparing the two on the basis of vehicles of goods, passengers, safety, overloading, insurance to a third party and commercial effect. Besides the weekend and many weekdays do impact on Mannering the given figure such as visibility, light during night timings, weather condition and using of drugs are some of the leading factors catering more injuries in the road accidents.   Table-3&4 gives the odd ratios at a 95% confidence interval for male traffic offenders involving major serious fatalities. Some of the given variables related to show are the experience of drivers in terms of age and driving duration in China and Djibouti. For instance the statistics show that drivers in China and Djibouti having less than and equal to two years ($\leqq 2$) years of experience tend to commit lower risk of being doing severe accidents in both countries. The third party insurance for overcoming these fatalities is almost none in Djibouti where the loss is exaggerated than expected. Some of the prominent environmental factors such as proper lighting during night times also lead to severe roads accidents. The timing of such accidents really does matter which is widely found in weekends and other public holidays. Majority of the road accidents happen during the rush hours almost in the evening. In China the urban metropolitan cities are thickly populated where there used to be the congestion of traffic and hence prone to more traffic violations than Djibouti. The case of rural areas would be a changed scenario but due to lack of availability of data on rural areas of China as well as Djibouti, it would be out of the scope of discussion.

The severity of injuries interestingly is not highly related to traffic violation but depends on the accidents that determine the fatalities of nature. For instance, the cases where traffic violations are not present the relationship of severity of injuries and roads accidents are highly related especially for the driving experience of 6-10 years and 11-15 years while comparing it with less one is tend to commit less association with injury severity.

6. Discussion

The outcomes of this research show that some of the factors are deemed to be significantly related to traffic violations and injury severity due to logistic regression. In the given output as a summary, the male gender, vehicles of goods, the vulnerable condition of safety, and overloading, low visibility due to low or no light, weekend effect are some of the crucial aspects determining a good likelihood and association with traffic violations which resultantly tend to high severity of injuries. New drivers having less experience of less than or equal to 2 years tend to commit more traffic accidents than other which eventually result in more severity of roads accidents. China is showing a more stable and controlled record of mitigating all such occurrence in the shape of promulgating better infrastructure, more deployment of technology of enhancing the efficiency of police to manage and control the traffic in urban areas exclusively. Besides, Djibouti is highly underdeveloped in this regard and the situation is highly deplorable and miserable given the following context of variables. The drivers normally do not follow any rule and this situation become even worse in rural areas where there is no direct and effective role of police. The situation in urban areas become more vulnerable in rush hours in the evening which become a source of more roads accidents due to more traffic offense and resultant into more sever fatalities at times. Djibouti is considerably facing less trouble of such rush hours due to less population catering low transportation while China is facing a tremendous burden of traffics in urban areas especially in office hours during the evening and moreover during weekends. The statistics indicate that the government of

China and their traffic police is overcoming the roads accidents and mitigating the fatalities of such accidents subsequently each year since 2012 onwards but the situation of Djibouti is not considerably different than before.

6.1 Human Factor

According to the findings from the requisite literature, male drivers tend to commit more traffic violations and hence resulting in inot more severe injuries and fatalities [25-32]. The level of income, education and social status are some of the related factors related to road safety [33]. The information related to this data is absent in this research because of the unavailability of requisite data for China as well as Djibouti. The previous research indicated that age is one of the pivotal varibales related to traffic accidents and roads fatalities [34-38]. This study does not find the significance relationship between age of drivers and traffic violations and eventually the severity of accidents. The focus here is on the experience of drivers that is closely related to the traffic violations and severity of roads accidents for China as well as Djibouti through logistic regression analysis. The Chinese drivers tend to focus more on skill driving learn through driving schools as against Djibouti where there is no formal education and training for inculcating such awareness for potential drivers [39].

6.2 Environmental factors and vehicle

Vehicles for transporting goods tend to exhibit more risk of committing both traffic violations and roads accidents catering to severe fatalities. The finding of this research in line with previous literature where the goods vehicles tend to have a significant relationship with traffic violation and severity if injuries [40,41]. The overloading of vehicles in Djibouti is the most important concern for such dilemma of roads accidents and the severity of fatalities due to roads accidents. Our research complies with the findings of literature that the traffic violation is normally observed on weekends in urban cities of China and Djibouti to some extent. The effect of the various time does occur on the statistic of roads accidents. The visibility is one of the most important factors for highly concerned for rural areas and Djibouti where the nature of accidents are highly related to low or no light on roads and streets [42]. Accordingly weather is also an important factor for estimating the road accidents fatalities and severity as shown by this study. The findings are in line with already one of the studies conducted in the USA for urban areas of China [43]. This research shows that bad weather mitigating the risk of traffic offenses and resultantly having no significant implication on the severity of roads accidents. Besides the visibility tend to cater significance for traffic violation and severity of accidents due to roads accidents.

6.3 Road safety improvement

Roads accidents are normally occurring at random unexpectedly. Contrary to that the deployment of scientific measures could avert or reduce the intensity and the level of such catastrophe. According to WHO (2015), in China the roads accidents have categorically declined by adopting stringent measures for overcoming the menace of traffic violation and severity of injuries. Djibouti is not in significantly comparable with high income countries like that of China due to low resources for effective managing and control and lack of developing infrastructural capacities. Once the traffic violations are controlled followed by less severity of fatalities due to roads accidents.

It is alarming in case of Djibouti where the traffic violation has not shown reasonable progress in terms of managing them which resultantly cater to huge severe injuries. The passengers and goods transportations are not been getting proper and due attention for rectifying and maintaining for the safety of the passengers. The ratio of male drivers tendency of committing traffic offense is largely high than female drivers in China. Traffic effective management could be possible if the requisites governments deploy formal policy and enactment for proper training and awareness campaign among drivers for more safety and reliability. Besides, the roads infrastructure needs to be revised especially in Djibouti where a single road is used for pedestrians, animals, passengers and goods transportations. In light of this research it needs to be done with immediate effect that roads design, structure, check out of vehicles for effective maintenance, deployment of traffic rules and regulations are there in urban areas of China on a priority basis.

However, the conditions of roads, management of traffic and status of vehicles are significantly different between these two countries of China and Djibouti. In the latter country i.e. Djibouti majority of the people in urban areas are using bicycle, motorcycles and taking buses and some other walking on the roads and streets. Contrary to this China is using sophisticated technology of using the better commuting system for transportation with more precautionary measures of complying with roads safety and regulations of the government.

7. Conclusion

With current economic boom in China, the volume of vehicle and traffic accidents are considerably higher but subsequently in decreasing trend due to good management of traffic and better infrastructure while the case of Djibouti is reasonably at a very low ebb. Furthermore, in both of these two countries, road accidents are the major reasons for mortality. Some of the prominent risk factors contributing to roads accidents are age, the experience of drivers, male drivers, lacking proper maintenance of vehicles for safety, the design of roads, roads status, low visibility during nights due to low or no lightening system and weather. Goods and passengers vehicles tend to commit more traffic offences in Djibouti which resultantly become a major cause of road accidents and hence more severe fatalities.

The first factor contributing the traffic violation and imply more and severe injuries are a human factor which if this can be effectively managed then the mortality rate can be mitigated to a substantial level. The second risk factor related to complying with government traffic rules, laws and regulations targeting various kinds of vehicles, driver groups in terms of reducing human, vehicle and environmental risk factors. Such measures may include road safety programs for drivers, focusing on traffic rules and improvement of transport facility. This study eventually guides the traffic policy maker of these two countries for formulating and deploying effective measures for mitigating the mortalities and severity of injuries due to road accidents.

This study caters two explained variables: traffic violations and severity of injuries with explanatory variables of considering the riskiness factors of humans, vehicles, roads and environments. In line with the previous study, logistic regression analysis is used for getting the casual relationship between the explained and explanatory variables to assess the status and nature of accidents and fatalities in these two countries. The data are taken from the respective police departments and World Health Organization safety.

The scope of this study reflects the relative differences between the status of roads accidents in China and Djibouti for their control and managing it through promulgation of rules and regulations. In this regard China has shown tremendous control for effectively managing the traffic accidents mortality rate which is witnessed from the results of this study while Djibouti does not show considerable improvement because of low income and lack of due resources.

8. Limitation

This current study has two limitations that the research needs to be highlighted.

firstly, this study uses secondary data collected from the police of these two respective countries (China, Djibouti), however we can suspect the accuracy and reliability of these data for two reasons, the first is the period of these data is short (five years is insufficient) so this shows that they are unreliable, and second reason is that the government of each country does not provide the accurate number of road accidents for political reasons or sometimes underestimate the number of road accidents when collecting road accidents data on the whole territory of the country (negligence of some regions ex: rural area).

In order to properly determine the reliable and accurate road accident data of two countries in this study, it would be preferable in the future to use primary data.

the second limitation of this study is that, in this study we have just evaluated the quantitative dimension that means that we analyzed the statistical data of road accidents taken by the police department of each country concerned but it will be necessary to do also a psychological analysis to reveal the reason that leads individuals to be involved in a road accident.

9. Recommendation

After getting the aforementioned findings, it is highly essentials for the government of Djibouti to comply with the safety parameters promulgated by the world organizations for catering more safety to inhabitants.

For China it is equally important to comply further on to the measures set by the international organizations for more robust traffic management in urban areas considering the findings of this paper for more effective results. The traffic police department in Djibouti needs more training for effective control of traffic to reduce the menace of roads accidents and eventually mitigating the severity of injuries and fatalities.

There is always room for improvement. The infrastructure of roads in Djibouti needs to be revised for more safety and fewer accidents. China needs to deploy more stringent measures in thickly populated urban areas where congestion of traffic is normally high on a daily basis. In this regards, the findings of this paper are highly significant to be considered for formulating and fabricating sound and effective traffic management policies and regulation to overcome traffic road accidents and eventually catering lower mortality and less severe injuries

References

[1]. WHO. Global status report on road safety, (2015). M. Stanislav, S. Henrikas, Transport 28, 108-115, (2013).

[2]. Javed, S.A., Syed, A.M., & Javed, S. (2018). Perceived Organizational Performance and Trust in Project Manager and Top Management in Project-based organizations: Comparative Analysis using Statistical and Grey Systems methods. Grey Systems: Theory and Application. DOI:10.1108/GS-01-2018-0009

[3]. Liu, P., Huang, J., Wang, W., Xu, C., 2013. Effects of transverse rumble strips on safety of pedestrian crosswalks on rural roads in China. Accid. Anal. Prev. 43, 1947-1954.

[4]. Wang, Y., Hasseberg, M., Wu, Z. Laflamme, L., 2014. Distribution and characteristics of road traffic crashes in the Chaoyang District of Beijing, China. Accid. Anal. Prev. 40, 334-340.

[5]. World Health Organization, 2013. Global Status Report On Road Safety: Time for Action

[6]. Haddon, Jr W., 1968. The Changing approach to the epidemiology, prevention, and amelioration of trauma: the transition to approaches etiologically rather than descriptively based. American Journal of Public Health, 58, 1431–1438

[7]. ZHANG, X., YAO, H., HU, G., CUI, M., GU, Y., & XIANG, H. (2013). Basic Characteristics of Road Traffic Deaths in China. Iranian J Publ Health, 42(1), 7-15.

[8]. Huang H, Yin Q, Schwebel DC, Li L, Hu G (2016) Examining Road Traffic Mortality Status in China: A Simulation Study. PLoS ONE 11(4): e0153251. doi:10.1371/journal.pone.0153251

[9]. Status report on road safety in countries of the WHO African Region 2009. Brazzaville: WHO Regional Ofce for Africa; 2010.

[10]. Global status report on road safety 2015. Geneva: World Health Organization; 2015.

[11]. Juillard C, Labinjo M, Kobusingye O, Hyder AA (2016). Socioeconomic impact of road trafc injuries in West Africa: exploratory data from Nigeria. Inj Prev. 2010

[12]. Chen Y, Wang K, King M, He J, Ding J, Shi Q, et al. (2016) Differences in Factors Affecting Various Crash Types with High Numbers of Fatalities and Injuries in China. PLoS ONE 11(7): e0158559. https://doi.org/10.1371/journal.pone.0158559

[13]. Djibouti 2017 Crime & Safety Report. (n.d.). Retrieved April 10, 2018, from https://www.osac.gov/pages/ContentReportDetails.aspx?cid=21764

[14]. Javed, S. A., & Liu, SF. (2018). Predicting the Research Output/Growth of Selected Countries: Application of Even GM (1, 1) and NDGM Models. Scientometrics, 115(1), 395-413. DOI:10.1007/s11192-017-2586-5

[15]. Javed, S. A. & Javed, S. (2015). The impact of product's packaging color on customers' buying preferences under time pressure. Marketing and Branding Research. 2 (1), 4-14

[16]. Javed, S. A., & Liu, SF. (2017). Evaluation of Project Management Knowledge Areas using Grey Incidence Model and AHP. Proceedings of the 6th IEEE International Conference on Grey Systems and Intelligent Services. Stockholm, Sweden: IEEE. DOI: 10.1109/GSIS.2017.8077684

[17]. Javed, S. A. & Javed, S. (2015). The impact of product's packaging color on customers' buying preferences under time pressure. Marketing and Branding Research. 2 (1), 4-14.

[18]. Javed, S. A., & Ilyas, F. (2018). Service Quality and Satisfaction in Healthcare Sector of Pakistan – The Patients' Expectations. International Journal of Health Care Quality Assurance, 31(6). DOI:10.1108/IJHCQA-08-2016-0110

[19]. Liu, P., Huang, J., Wang, W., Xu, C., 2011. Effects of transverse rumble strips on safety of pedestrian crosswalks on rural roads in China. Accid. Anal. Prev. 43, 1947-1954.

[20]. Huang, Y.H., Zhang, W., Morphy, L., Shi, G., Lin, Y., 2011. Attitudes and behavior of Chinese drivers regarding seatbelt use. Accid. Anal. Prev. 40, 889-897.

[21]. Huang, Y.H., Rau, P.L.P., Zhang, B., Roetting, M., 2008. Chinese truck drivers' attitudes toward feedback by technology: A quantitative approach. Accid. Anal. Prev. 40, 1553-1562.

[22]. Kong, C., Yang, J., 2010. Logistic regression analysis of pedestrian casualty risk in passenger vehicle collisions in China. Accid. Anal. Prev. 42, 987-993.

[23]. Savolainen, P.T., Mannering, F.L., Lord, D., Quddus, M.A., 2011. The statistical analysis of highway crash-injury severities: A review and assessment of methodological alternatives. Accid. Anal. Prev. 43, 1666-1676.

[24]. MacLeod, K.E., Griswold, J.B., Arnold, L.S., Ragland, D.R., 2011. Factors associated with hit-and-run pedestrian fatalities and driver identification. Accid. Anal. Prev. 45, 366–372.

[25]. Holubowycz, O.T., Kloeden, C.N., McLean, A.J., 1994. Age, sex, and blood alcohol concentration of killed and injured drivers, riders, and passengers. Accid. Anal. Prev. 26, 483–492.

[26]. Massie, D.L., Campbell, K.L., Williams, A.F., 1995. Traffic accident involvement rates by driver age and gender. Accid. Anal. Prev. 27, 73–87.

[27]. Hayakawa, H., Fischbeck, P.S., Fischhoff, B., 2000. Traffic accident statistics and risk perceptions in Japan and the United States. Accid. Anal. Prev. 32, 827–835.

[28]. Zhang, J., Lindsay, J., Clarke, K., Robbins, G., Mao, Y., 2000. Factors affecting the severity of motor vehicle traffic crashes involving elderly drivers in Ontario. Accid. Anal. Prev. 32, 117–125.

[29]. Valent, F., Schiava, F., Savonitto, C., Gallo, T., Brusaferro, S., Barbone, F., 2002. Risk factors for fatal road traffic accidents in Udine, Italy. Accid. Anal. Prev. 34, 71–84.

[30]. Yau, K.K.W., 2004. Risk factors affecting the severity of single vehicle traffic accidents in Hong Kong. Accid. Anal. Prev. 36, 333–340.

[31]. Yau, K.K.W., Lo, H.P., Fung, S.H.H., 2006. Multiple-vehicle traffic accidents in Hong Kong. Accid. Anal. Prev. 38, 1157-1161.

[32]. Kim K., Brunner I.M., Yamashita E., 2008. Modeling fault among accident-involved pedestrians and motorists in Hawaii. Accid. Anal. Prev. 40, 2043-2049.

[33]. Hasselberg, M., Vaeza, M., Laflamme, L., 2005. Socioeconomic aspects of the circumstances and consequences of car crashes among young adults. Social Science & Medicine, 60, 287–295.

[34]. Bedard, M., Guyatt, G.H., Stones, M.J., Hirdes, J.P., 2002. The independent contribution of driver, crash, and vehicle characteristics to driver fatalities. Accid. Anal. Prev. 34, 717–727.

[35]. Derrig, R.A., Segui-Gomez, M., Abtahi, A., Liu, L.L., 2002. The effect of population safety belt usage rates on motor vehicle-related fatalities. Accid. Anal. Prev. 34, 101–110.

[36]. Fosgerau, M. Speed and income, 2005. Journal of Transport Economics and Policy, 39, 225-240.

[37]. Factor, R., Mahalel, D., Yair, G., 2008. Inter-group differences in road-traffic crash involvement.

Accid. Anal. Prev. 40, 2000-2007.

[38]. Zhuang, X., Wu, C., 2011. Pedestrians' crossing behaviors and safety at unmarked roadway in China. Accid. Anal. Prev. 43, 1927-1936.

[39]. Zhang, W., Huang, Y.H., Roetting, M., Wang, Y., Wei, H., 2006. Driver's views and behaviors about safety in China - What do they NOT know about driving? Accid. Anal. Prev. 38, 22-27.

[40]. Hijar, M., Carrillo, C., Flores, M., Anaya, R., Lopez, V., 2000. Risk factors in highway traffic accidents: a case control study. Accid. Anal. Prev. 32, 703–709.

[41]. Al-Ghamdi, A.S., 2002. Using logistic regression to estimate the influence of accident factors on accident severity. Accid. Anal. Prev. 34, 729–741.

[42]. Wang, Y., Hasseberg, M., Wu, Z. Laflamme, L., 2008. Distribution and characteristics of road traffic crashes in the Chaoyang District of Beijing, China. Accid. Anal. Prev. 40, 334-340.

[43]. Yakovlev, P.A., Inden, M., 2010. Mind the weather: a panel data analysis of time-invariant factors and traffic fatalities. Economics Bulletin, 30, 2685-2696.