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Red Light Running in Trinidad

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Abstract

Red Light Running (RLR) has been associated with road traffic collisions in many jurisdictions across the world. The study aimed at evaluating the factors related to red light running (RLR) in Trinidad and Tobago that could be incorporated into policies that would aim to reduce this tendency and its related costs. Using data collected from the Traffic Unit of Trinidad and Tobago and three major intersections in the country, analysis was done on the impact of time of the day, age of the driver, ethnicity, gender, type of the vehicle, location and day of the week which are related to RLR. The results showed that the highest number of RLR occurs during rush hours in the morning and also in the evenings. Also, Indo-Trinidadian and male drivers display a higher tendency towards RLR. It was also established that some junctions have higher RLR rates than others and that Fridays have more RLR cases than all the other days of the week. These findings are very similar to those made in other countries such as the USA. The study has resulted in specific findings that can be used to improve traffic safety policies in the country.

Keywords

Red Light Running, Road Traffic Collisions, Trinidad

1. Introduction

Trinidad and Tobago is a two-island country with the land territory of 5200 square kilometres [1]. It is located northeast of Venezuela and separated by a distance of circa 7 miles or 15 km [2]. In 2011, the population of Trinidad and Tobago equaled 1,328,019 inhabitants [3]. Dissimilar to the majority of the Anglophone Caribbean countries, Trinidad and Tobago is a mainly developed state whose financial situation is grounded on gasoline and petrochemicals [4], with a GDP per capita of 14,275.38 USD in 2013 [5].

The inhabitants of Indian and African background form nearly 80% of the residents and the remainders are of miscellaneous ethnicities, consisting of Chinese, Syrian-Lebanese, and European subgroups [4]. Reflecting the ethnic and cultural diversity, Roman Catholicism and Hinduism are the dominant religions, with about 40% of the population as followers of either. The remainder is divided among other Protestant Christian religions, Islam and Baptist religions to name a few [3]. Approximately 43.5% of the population has attained secondary and post-secondary education levels, with 6.2% attaining tertiary non-university level education and 8.4% tertiary university-level education [3].

Motor-powered means of transportation have habitually been the main form of conveyance on the two isles—an occurrence that has received impetus in 1995, when the total number increased considerably, owing predominantly to the importation of secondhand automobiles from Japan [6]. This factor has augmented traffic mobbing and challenged the ability of native motorway traffic specialists to strengthen safety principles for motorised means of transportation and road security [6]. According to St. Bernard and Matthews (2003), "motorisation increased four-fold from 63 registered vehicles per 1000 population in 1960 to 250 vehicles per 1000 population in 2000" [6]. Throughout the 1990s, there were about "144 fatalities, 131 fatal traffic crashes, 3014 injured persons, and 2199 nonfatal injury crashes per annum within the country" [6]. There are simple limitations regarding implementing traffic safety principles, for example driving under the influence of alcohol and compliance with speed limitation parameters.

As one of the most developed countries in the Caribbean, there exists a reliable road network that is expected to grow as the economy expands [7]. The country has several major highways that pass through intersections controlled by traffic lights. Good implementation of intersection control systems is therefore a critical aspect of road safety in the country. Studies in the developed countries, mainly in the USA, have shown that there are many factors that influence the level of success of various intersection traffic control systems [8]. Red Light Running (RLR) is one of the most common problems affecting safety at major intersections. Although reliable data does not exist for such problems in Trinidad and Tobago, studies in other countries such as the United States have shown that RLR is a major cause of road crashes at intersections and road fatalities.

Porter and Berry (2001) performed one of the most relevant and comprehensive studies on the area in the USA using telephone interviews on self-reported red light runners [9]. The study was done before red light cameras became mainstream devices in monitoring road intersections and was therefore not focused on. The study led to the conclusion that age and perceived consequences of red light running were significant predictors of red light running behavior, as young people were found to be more likely to violate red lights than older people. Most of the violators also thought it was very unlikely that the police would detect them. Many traffic law enforcement agencies have always operated on the premise that a more accurate monitoring technique can reduce the number of traffic law violations and so the use of red light cameras was adopted. Aeron-Thomas and Hess (2009) [10] performed a study that examined the impact of adopting red light cameras at intersections. Given that Porter and Berry (2001) [9] had found perception as an important predictor of red light violations, it would be expected that red light cameras would reduce intersection crashes by raising awareness among drivers. This was found to be true, but the reduction was only by an average of 30 %.

Martinez and Porter (2006) [11] did a study where the findings indicated that several attributes were important predictors of red light running and the resultant collision. Similar to Porter and Berry (2001) [9], age was a predictor, as younger people were more likely to be red light runners. A prior history with red light cameras was also noted, as those who had been at intersections with cameras were less likely to run red lights. Additionally, the use of safety belts and volume of traffic on the road were found to be predictors as well. The study however added new insights by revealing that those people who did not wear safety belts were also likely to run red lights. Yang and Najm (2007) [12] did a similar study to the one done by Martinez and Porter (2006) [11] in Sacramento California, but factored in a time period variable in the analysis. It was found that during rush hour, there were more red light violations, at lower speeds. Conversely there were less red light violations during off peak hours and late at night, but at higher speeds. Higher speeds are associated with more collisions and fatalities.

Another area of debate on improving road intersection collisions has been based on the timing of the various lights. Retting, Ferguson and Farmer (2008) [13] did a study that sought to establish whether differences in timing of the various lights had an impact on the rate of red light running. By adjusting the yellow light timing at various intersections, the study found that increasing the yellow light timing reduced the number of red light running. However, the reduction was not adequate; an observation that implies that other factors would have to be considered in improving road intersection safety.

Huang and Chin (2009) [14] argued that previous studies of red light running driver and situation attributes have not been good enough in assessing the circumstances facing the driver before the collision occurs. They therefore developed models that simulated crashes and came up with data on relative exposure to crashes and relative propensity of crashes as a result of RLR. The study used data for the period between 1993 and 2002 from Singapore, one of the most urbanised countries in the world. The results showed that a model combining age and gender of the driver, type of the vehicle and condition of the road was a strong predictor of RLR collisions. The study led to the conclusion that each of these factors cannot be looked at in isolation which is a critical insight in decision making.

In one of the most recent studies, West at al. (2010) [15] focused on age and age related vision factors in predicting RLR. The study led to the conclusion that RLR is not common in older people, a finding that is in line with all the previous studies that have profiled red light violators by age. The study also led to the conclusion that red light violation was associated with the capabilities of the driver in terms of vertical field of vision. The more the driver pays attention to the vertical field of vision the less likely they are to run a red light.

This study aims at evaluating the factors associated with RLR in Trinidad and Tobago. This information is expected to form a basis for conclusions and recommendations that can be used to improve road safety in the country as well as inform other studies in the same area. This study also provides recommendations on measures that can be adopted to improve road safety at intersections in Trinidad and Tobago.

2. Methodology

In this section, the manner in which data for analysis will be collected is indicated. Several factors have been established as related to RLR. This study focuses on seven major variables *i.e.* time of the day, age of the driver, ethnicity of the driver, sex of the driver, and type of the vehicle, location and day of the week. These factors were selected since they provide information that can be used for policy recommendation.

2.1. Data Required

The data required for the study was on the actual data of RLR and collisions associated with it as well as the other details of those involved in accordance with the variables identified in the previous section.

2.2. Data Sources and Collection Methods

The police department in Trinidad has a Traffic Unit that enforces traffic related laws. Data for the study were collected during the month of September 2012. The data were collected from the Central Statistical Office of Trinidad and Tobago and cross-referenced with the information from the Traffic and Highway Patrol Unit of the Trinidad and Tobago Police Service. These were selected as the source of records regarding fatal Road Traffic Collisions (RTCs) in Trinidad. Once permission was granted, the records detailing fatal RTCs occurring between the years 2000-2011 were selected. However, only data from 2005-2011 could be utilised, as records detailing fatal RTCs prior to 2005 were incomplete. These records were used to pinpoint the intersections with both high and low fatal crash rates. Table 1 shows the number of fatal RTCs at the intersections within the above stated time period.

2.3. Site

Red light running is a major cause of collisions and road fatalities in countries such as the USA. Appreciating this, three separate intersections in Trinidad were chosen to observe red light running, based on several factors. Firstly, the occurrence of fatal RTCs at different intersections over the seven year period was considered. Secondly, in the absence of red light cameras, observers would have to be utilized and therefore would need to be situated in a manner that would allow these persons to discreetly observe and record at the intersections. Thirdly, the observers would need to be placed as close

Table 1. No. of fatalities by intersection during 2005-2011.

Location	No. of Fatal Collisions							
	2005	2006	2007	2008	2009	2010	2011	Total
6th Av. and 8th St. Int. Barataria				1				1
Bamboo Junction, La Romaine	7	1	10	8	6	4	4	40
BWIA and Oropune Rd. Int.						1		1
Caroni S. Bank Rd., Washington Junction				1				1
Caroni Savannah Rd., Pierre Rd. Int.	1							1
Clifford and McDonald St. Int.					1			1
Connector Rd. and Peterfield Int., Chaguanas				1				1
CRH and Curepe			1	1	1			3
CRH and O'Meara						1	1	2
CRH and Pasea				2				2
CRH and UBH Int					1			1
CRH and UWI Int.				1			1	2
CRH Aranjuez			4		1			5
CRH EL Socorro TL	1	1			2	1		5
CRH Mausica		2						2
CRH Piarco Int.	1	1			1			3
CRH Trincity TL				1	1			2
CRH Valsayn Bamboo Junction			2					2
CRH, Maloney	1				2			3
Diego Martin Highway Crystal Stream TL						1		1
Diego Martin Highway Four Roads TL						1		1
Lady Young Rd., Morvant and Park St. Int.		1						1
Macoya-PBR	1	3	2	4	2	0	2	14
Mon Dasir Rd., Fyzabad Seereram Junction				1				1
Morne Diablo Junction							1	1
Navet Rd. TL							1	1
Oropuche Rd., Siparia and Villabera St. Int.		1						1
PBR and Belle Smythe St. Curepe	1							1
PBR and Bon Air Rd. TL							1	1
PBR and Curepe		1						1
PBR and Eastern Main Road Int.						1		1

Continued

PBR and Mausica TL						2	1	3
PBR and Pasea							1	1
PBR and San Juan TL					1	2		3
PBR and UBH Int.			1					1
PBR and UWI							1	1
PBR Arouca, Five Rivers Junction				1				1
PBR Barataria and Morvant Junction					1			1
PBR Laventille Pashley St. Int.	1							1
PBR Mt Lambert Int.				1	1			2
PBR Mt. Hope UBH Ext. TL	1							1
PBR St. Augustine Int.		1						1
PBR Tacarigua Dinsley Junct.			1					1
PBR Tacarigua TL	1							1
Piccadilly and Queen St. Int.		1						1
San Fernando Bypass and Rushworth St. Int.							1	1
SMR Marabella and Frederick St. Int.		1						1
SMR McBean St Mary's TL			2	2				4
SMR Point Fortin, Dam Rd., Junction		1						1
SS Erin Rd.	3	5	2	4	3	1	1	19
Tarouba TL					1			1
UBH Chaguanas Jerningham Junction							1	1
UBH, Charlieville Marching Junction				1				1
Wrightson Rd TL						1		1

Int. = Intersection; PBR = Priority bus route; TL = Traffic light; UBH = Uriah Butler Highway; UWI = University of the West Indies.

to the lane to be observed as possible, so that the view of the cars and intersection traffic lights would remain unobstructed. Fourthly, observer safety had to be considered, as many intersections contained little more than a small sidewalk, grassy verge or a narrow median and were not conducive to having persons situated there. High crime areas of the island were also avoided. As illustrated in Table 1, The Bamboo Junction in La Romaine had the highest prevalence of fatal RTCs, followed by the SS Erin Road and the Macoya intersections. The Bamboo junction was the first selected due to the large number of fatalities. The second intersection selected was the Macoya intersection as it also demonstrated a high prevalence of road fatalities compared to other intersections. The third intersection was chosen based on a need for a control and so Navet Road was selected, as there was a low occurrence of road traffic fatalities, allowed for unhindered observation of the intersection and assured observer safety.

The Macoya intersection is four way, with a single carriageway containing northbound and southbound traffic, crossing another single carriageway with eastbound and westbound traffic. The latter is known as the Priority Bus Route, which serves as the public transportation of the country and is therefore used by buses, taxis and some private vehicles. The Bamboo intersection consists of a northbound and southbound dual carriageway crossing a single carriageway, eastbound and westbound road. The Navet Road intersection in Mon Repos, San Fernando, consists of an eastbound and westbound single carriageway, intersecting with a northbound and southbound dual lane carriageway. Traffic can either turn to the north onto the dual carriageway, or cross both sides of the carriageway to turn south.

2.4. Observer Placement

Data from the Traffic Unit provided descriptions of the intersection collisions and the locations. Information included the directions the vehicles were travelling prior to the collision, the distance from intersection landmarks (e.g. light poles) and the possibility of traffic light violations. This information was utilized to select the lane that two observers would be placed for recording instances of red light running. At the Macoya intersection, the observers were placed to collect data specifically regarding vehicles on the northbound lane, which was a single lane. At the Bamboo intersection, the observers were instructed to record instances of RLR on the southbound lane. However, due to the fact that the southbound road consisted of three lanes, the observers were instructed to record information about drivers that were travelling straight ahead. Drivers that were in the lanes to turn east and west were excluded. At the Navet Road intersection, the observers were placed by the lane to turn south in order to observe drivers making a right turn. This was perceived as the more risky manoeuvre at this intersection due to oncoming traffic.

The observers were positioned on the sidewalk, next to the lane under observation, facing the oncoming traffic. The exception was the Bamboo intersection where the observers were required to stand on the sidewalk, nearest to the lane that turned eastbound and observe the middle lane. The observers were requested to wear traffic safety vests, which are commonly used in Trinidad by road workers, members of construction crews, sanitation workers and miscellaneous personnel that may be carrying out works near a roadway. This allowed the observers, while visible, to still be able to disguise their true purpose. They were instructed to stand a reasonable distance from the traffic light at the intersection.

2.5. Materials

The observers were required to collect data for seven days, from Monday to Sunday, during the hours of 6:00 am - 9:00 am and 3:00 pm - 6:00 pm. A checklist was created to collect information on red light running and demographic data. Similar to the study performed by Porter and England (2000), the observation unit was a light cycle and each row represented information for a single driver. Demographic information for each driver included 1) Age (estimated); 2) Sex; 3) Ethnicity; 4) Vehicle type (private, taxi, public transport); 5) Seatbelt Use. A stopwatch was also given to the observers.

2.6. Procedures

2.6.1. Observer Training

Two observers were selected to collect the data at the intersections. Meetings were held with the authors and observers to discuss the checklist, address any questions and make adjustments before the final list was created. Pilot testing was done at the Macoya intersection to ensure the checklist could be utilized in the existing format before the process of data collection was begun. Authors also visited various sites while data collection was occurring in order to ensure that the methodology was being followed.

2.6.2. Observations

Formal observations began during the month of September 2013, where each intersection was observed for one week during the hours of 6:00 am - 9:00 am and 3:00 pm - 6:00 pm. These represented rush hour times, a period where collisions are more likely to occur [12]. The duration of the entire light cycle was measured and recorded using the stopwatch, as well as the intervals between the each light phase (green-yellow-red-green). For each light cycle, the number of vehicles entering and crossing the intersection while the light was red was recorded. A red light runner was defined as a vehicle entering the intersection after the onset of the red light. Vehicles that were already in the intersection at the onset of the red light (*i.e.* vehicle entered the intersection on a yellow light), were not included. Due to the difficulty of recording information about multiple red light runners, the observers were instructed to collect information characteristics about the last vehicle to enter the intersection on the red light [16]. This was defined as a vehicle entering the intersection just before the traffic light turned green and so the timing of the red-green phase was used to determine this. Emergency vehicles were excluded.

The observers utilized the checklist and recorded the characteristics of the driver, including estimated age, sex, ethnicity, seatbelt use, as well as type of vehicle. However, they were instructed to record only the details that they were certain of. Vehicles with heavily tinted windows were often excluded as visibility was compromised.

3. Results

3.1. Characteristics of Red Light Runners

From the findings and as indicated here, it was apparent that a huge proportion of the observed drivers were male 94.3%, while the remaining 5.7% were female. 39.73% of the individuals were estimated to be of Afro-Trinidad ethnicity, 46.37% of Indo-Trinidad ethnicity while the remaining 13.90% are of mixed ethnicities as indicated in **Table 2**. It is also clear that the largest proportion of the sample was comprised of persons who were estimated to be between 30 and 39 years of age (45.9%). 23.01% of the observed

Table 2. Characteristics of the sample.

	Navet Rd. Traffic Light	Bamboo Junction, La Romaine	Macoya Eastern Main Road, Tunapuna	Total
Sex				
Male	57	232	138	**427**
Female	3	9	14	**26**
Total	60	241	152	**453**
Age				
<20	0	5	0	**5**
20 to 29	14	58	33	**105**
30 to 39	24	106	78	**208**
40 to 49	15	54	36	**105**
50 to 59	7	17	4	**28**
> 60	0	1	1	**2**
Total	60	241	152	**453**
Ethnicity				
Afro-Trinidadian	4	93	83	**180**
Indo-Trinidadian	33	123	54	**210**
Mixed	23	25	15	**63**
Total	60	241	152	**453**
Seat Belt				
Yes	54	228	140	**422**
No	6	13	12	**31**
Total	60	241	152	**453**
Type of Vehicle				
Motorcycle	0	0	0	**0**
Passenger (Taxi)	7	23	7	**37**
Passenger (Ord)	35	151	122	**308**
Maxi-Taxi	1	6	1	**8**
Pickup/Recreation	10	46	17	**73**
Construction/Trailer/Tractor	7	14	5	**26**
Bus	0	1	0	**1**
Total	60	241	152	**453**

drivers were estimated to be between 20 and 29 years of age, identical to the estimated number of individuals between 40 and 49. 46.36% of the observed drivers appeared to be of Indo-Trinidadian origin, 39.73% were of Afro-Trinidadian origin, while the remaining 13.91% were of mixed ethnicity. Furthermore, a large proportion of the individuals wore seat belts (92.06%) while the remaining 7.94% did not wear seatbelts. It is also clear from Table 2 that a large proportion of the individuals used ordinary passenger vehicles (69.99%), while 16.11% used pickup or recreational vehicles, 8.17% used passenger taxi vehicles and 7.95% used construction trailers. The rest of the reported vehicles types were negligible.

Table 3 indicates the instances of red light running classified according to the timing of the day measured from 6:00 am - 9:00 am and 3:00 pm to 6:00 pm. Table 4 outlines the instances of red light running depending on the days of the week.

3.2. Times and Prevalence of RLR at the Various Locations

The data from the Macoya/Eastern Main Road Tunapuna intersection presents a low standard deviation across all timings, indicating that red light running is prevalent at all times during the peak times. In Table 3, the standard deviation indicates the dispersion from the mean. A high standard deviation indicates that there exists a large variation from the average number of incidences and the highest and lowest individual counts. The highest disparity occurs between 8:00 - 9:00 am and 3:00 pm - 4:00 pm, which represent the timing when peak times are tapering off and starting respectively.

A high level of standard deviation is experienced in the Bamboo Junction, between 3:00 - 4:00 pm. During this period, traffic is highest at this junction. This junction is also important in the flow of traffic in the country, implying that a huge volume of traffic is experienced at this point. This is also supported by the high level of standard deviation compared to the other locations.

Table 3. Red light running based on timing of the day.

Time	Macoya Eastern Main Road Tunapuna	Bamboo Junction La Romain	Navet Rd Traffic Light	Mean	Std. Deviation
6:00 am - 7:00 am	10	36	11	19	10.41633
7:00 am - 8:00 am	32	42	13	29	10.41633
8:00 am - 9:00 am	29	42	9	26.67	11.75443
3:00 pm - 4:00 pm	37	45	9	30.31	13.36664
4:00 pm - 5:00 pm	26	41	8	25	11.68332
5:00 pm - 6:00 pm	18	35	10	31	12.51
Total	**152**	**241**	**60**	**160.98**	**70.14706**

Table 4. Red light running on a day to day basis at the various locations.

Day/Location	Macoya EMR Tunapuna	Bamboo Junction La Romain	Navet Rd	Total
Monday	5	41	2	48
Tuesday	22	43	15	80
Wednesday	34	38	15	87
Thursday	53	40	16	109
Friday	29	36	12	77
Saturday	3	37	0	40
Sunday	6	6	0	12
Total	**152**	**241**	**60**	**453**

3.3. Location Measured against Number Who Broke Lights

Ha: *Location is a predictor of instances of broken lights*.

Ho: *Location is not a predictor of instances of broken lights*.

The location was deemed an influence on the instances of broken lights due to intensity of traffic. However, the analysis indicated a Pearson Chi-Square value 12.532 ($p < 0.05$), as seen in Table 5. This indicates that the location is a significant predictor of the instances of broken lights.

3.4. Gender Measured against Instances of Broken Lights

Ha: *Gender of driver is a predictor of instances of broken lights*.

Ho: *Gender of driver is not a predictor of instances of broken lights*.

The gender of the driver was deemed a factor that could influence the aspects of the drivers' capabilities. In Table 5, the Pearson Chi-Square value 0.453 ($p > 0.05$) indicated that indeed the gender of the driver is a not significant predictor of the instances of broken lights.

3.5. Regression Analysis

Regression analysis was subsequently carried out; to establish if significant differences existed in the results. The regression analysis relied on the dependent variable classified as numbers who ran the lights, just like in the Chi-Square tests. The findings indicated that location and ethnicity were significant predictors of the instances of broken light. The findings indicated a t-value of 2.0000 ($p < 0.05$) for location and t-value of 2.419 ($p < 0.05$). The rest of the results are indicated in the following schedule (Table 6).

3.6. Fatalities Recorded from the RTCs

Figure 1 and Figure 2 are an indication of the nature of road traffic collisions, which

Table 5. Pearson Chi-Square results.

Measure	Value	Df	Asymp. Sig. (2-Sided)
Age	3.594[a]	10	0.964
Ethnicity	7.361[a]	4	0.118
Use of Seat Belts	.963[a]	2	0.618
Type of Vehicle Used	7.935[a]	10	0.635
Day of the Week	13.807[a]	12	0.313
Time of Day	8.042[a]	10	0.625
Location	12.532[a]	4	0.014
Gender	0.453[a]	2	0.797

Table 6. Regression analysis for the outcomes.

Coefficients[a]						
Variables		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	1.168	0.159		7.359	0.000
	Location	0.040	0.020	0.096	2.000	0.046
	Time	0.002	0.011	0.008	0.163	0.870
	Day	−0.010	0.011	−0.040	−0.852	0.395
1	Sex	0.085	0.078	0.052	1.088	0.277
	Ethnicity	−0.064	0.026	−0.116	−2.419	0.016
	Age	−0.003	0.021	−0.006	−0.128	0.898
	Presence of Seatbelt	−0.088	0.078	−0.059	−1.137	0.256
	Type of Vehicle	0.019	0.019	0.053	1.017	0.309

[a]Dependent variable: no. who broke light.

occurred at the three locations under study in this report. Figure 1 indicates the number of fatalities in the various collisions, while Figure 2 posits the number of fatal collisions. A high number of fatal collisions coupled with a high number of fatalities indicated that a large number of individuals were affected by the collisions. It is clear that the highest number of collisions were reported in Bamboo Junction, followed by Macoya and finally Navet Rd. These findings are similar to those relating to the number of fatalities across the 7 years analysed. Regression analysis performed on the data regarding the fatality of collisions in the roads is presented above.

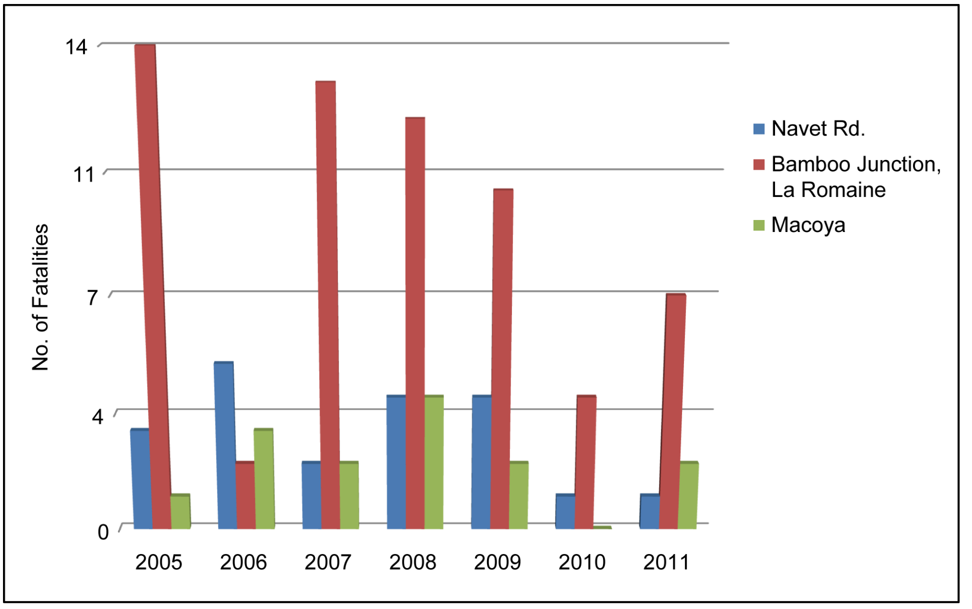

Figure 1. Number of fatalities recorded from RTCs for the period 2005-2011.

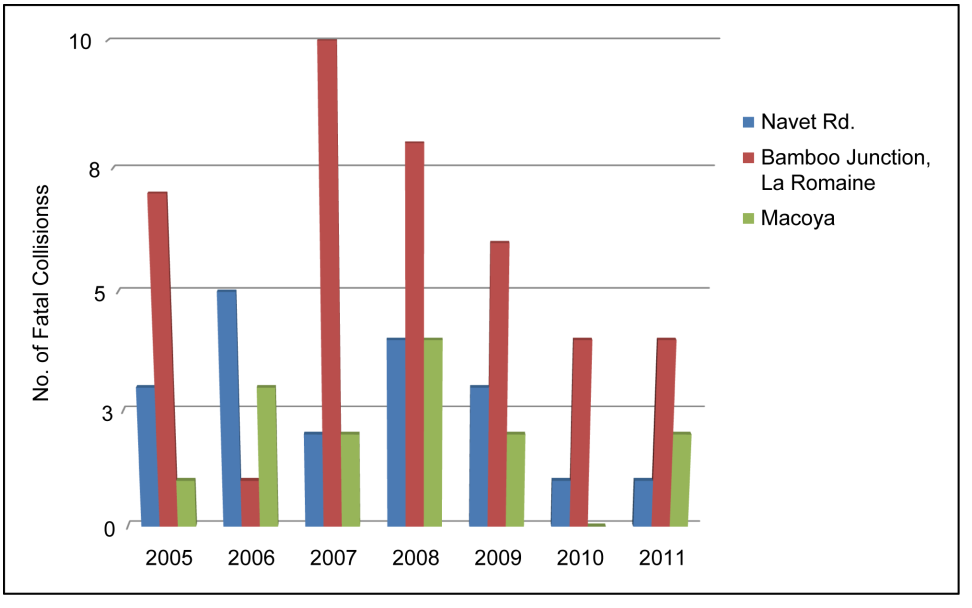

Figure 2. Number of fatal collisions.

4. Discussion

From the results in the previous sections several observations were made. From the results of the measures of central tendencies on the various categories, it was clear that the Bamboo Junction, La Romain had the highest level of red light running, as indicated on Table 2. The clear evidence of higher incidences of red light running on this junction showed that location played an important role in the prediction of drivers' behaviour. Consequently, Chi-Square tests indicated that location was a significant predictor of the instances of broken lights in the study. This was duplicated in the regression analysis, performed to test conformity. A reportedly high prevalence of broken lights at the Bamboo junction indicated that road users in that junction were more delinquent. It is thus imperative for the authorities to establish reasons for the level of RLR at this point. As suggested by numerous theorists, it is not only vital to study red light running, but to appreciate the extenuating and contributing factors to this practice [17]-[19].

As a traffic offence, it is important to appreciate the implication of the practice and investigate if it is an isolated occurrence or not. Through these studies, it was confirmed that red light running is often coupled with other road rule offences such as failure to use seat belts, repeat offences for minor offences, as well as failure to obey speed limit guidelines. The results also showed that a significant majority of the red light runners were males. This finding was consistent with findings that have been made in other countries including the USA [9] [17]. Porter and Berry [9] aligned their study with the identification of the prevalence and contributing factors to red light running across the US. Findings indicated that although most instances went unreported or unpunished, the most common reasons were petty and the fact that the driver was moving at a considerably high speed to make the right decision. Similar findings were established in the study by Wen (2008) [17].

While many theories are available explaining the high proportion running red lights, the tendency to take more risk is the most plausible. The tendency of drivers to run red-lights is not in any way related to their insolence and ignorance about the risks associated with the practice. Most of the drivers are fully aware of the numerous fatalities that have resulted from the practice in the country and across the globe. However, these drivers are also aware of the numerous instances where running a red-light went unnoticed and was not a threat to the safety of other road users. Although this is categorically a traffic offence, it did not amount to discourtesy, since it was not at the expense of any individuals' rights [20]. The study focused on the factors influencing red light running, specifically behavioral tendencies. By use of data from an intersection at San Mateo in California, it was possible for red light runners to commit the offence without necessarily causing risks or intending to do so.

Age was found to be an insignificant predictor of the instances of broken lights through both Chi-Square Tests and Regression analysis. The low level of significance contradicts findings by a study by McKnight and McKnight (2010) [21], which indicated that younger drivers were more careless and experimental, thereby increasing the chances of them flouting the traffic rules and resulting in the breaking of lights. However, it is important to note that a large proportion of the drivers were comprised of individuals in the middle age category, thus reducing the skewedness of the outcomes.

The study revealed that ethnicity was not significant in predicting propensity for red light running and breakage of red lights, according to the Chi-Square Tests. From the results it is clear that Indo-Trinidadian had the highest rate of red light running. Regression analysis however indicated that ethnicity was a significant predictor of the instances of broken lights. This may however be related to the distribution of the various ethnic groups in the country. These results were inconsistent with findings in other countries that have shown that ethnicity played a major role in predicting red light running behaviour [12]. Yang and Najm [12] established that drivers of certain ethnicities were most prone to running red lights, where Hispanics and South Americans were viewed as the ethnicities most prone to this practice. Although ethnicity was not directly related to running red lights, these individuals were also highly delinquent. As a result, their predisposition to running red lights was poised on their tendencies to criminal activity, rather than possessing aspects which are based on ethnic groupings [22].

The comparison of the mean number of people who broke the red light by day of the week revealed that Friday had the highest rate of running [23]. On the same note, Chi-Square tests indicated that the day of the week was a reliable predictor of the propensity for broken lights. The Chi-Square tests were different from results of the Regression analysis, which directed that this variable was not a significant predictor. The results from Chi-Square tests were in line with the findings in the study by Transport Research Centre (2007) [23], where it was indicated that certain days of the week presented significant challenges in management of traffic, with Friday standing out as the most prominent. As the last working day of the week, the high capacity propagates a higher propensity for breakage of lights [9].

With regard to the time of the day, it was clear that the hours between 8:00 am and 9:00 am as well as between 5:00 pm and 6:00 pm have the highest level of red light running (**Table 3**). However, the Chi-Square tests and Regression analysis indicated that time of the day was not a significant predictor of the instances of broken lights [9]. Since most of the readings were taken during peak hours, there is a high possibility that the results were not all-inclusive. These hours correspond to the rush hours when the volume of traffic on the roads is highest. As a result, time of day of day was not a significant predictor of the instances of broken lights, since the period considered can be classified as peak times of the day.

The day of the week was also found to be an insignificant predictor of the instances of broken lights. Porter and Berry (2001) [9] indicated that traffic densities varied based on days of the week, with the highest volumes reported at the close of the week. Fridays reported the highest densities of traffic. However, there was no significant relationship between the increase in traffic density and instances of broken lights.

It was also recognisable that most of the drivers who ran the red lights wore seatbelts. These findings are closely associated with those of Olukoga, Legall and Odekunle, (2011) [1], who established that use of seatbelts was for compliance reasons, rather than safety reasons. As a result drivers running red lights used seatbelts as a way of reducing the possibility of getting caught in a multiplicity of offences, as opposed to the fact that indeed the use of seatbelts reduced fatalities.

Further results from the Chi-Square tests and Regression analysis, indicated that the location was a significant predictor of the instances of broken lights. Locations with a high intensity of traffic tend to have high instances of traffic lights due to the frequent delays in traffic. In such locations, depending on the intensity of traffic, it is possible to experience characteristics of rush hours in most occasions. In rush hours, it is consistent that a huge proportion of the traffic is headed in the same direction, ensuring the possibility that that there will be imbalances in the allowance of timings at the red lights. For example, if traffic entering the city is higher in volume than traffic leaving and all the red lights are set to operate at similar intervals, then traffic in the intersections heading out of town will experience durations which are slightly disproportional. Eventually, waiting lines will be experienced for traffic entering town, while other roads are empty. This finding is also consistent with findings in other countries. The explanation that has been provided is that during the rush hour people usually face more pressure to save time, given the time lost in jams [24]. As indicated in the study by Weldegiorgis and Jha [24], urban areas tended to be busiest, especially during rush hour. In their study, they established an approach through which monitoring could be utilised to reduce congestion and capacity issues at prime intersection. As a result, the two locations where high incidences of fatal collisions and fatalities were reported were also areas where incidences of red light running was highest, as indicated in **Table 2** and **Table 3**. Bamboo and Macoya intersections reported the highest volumes of traffic and the highest incidences of reported broken lights after red light running. Consequently, the fact that they reported a higher number of fatal collisions and fatalities for each of the collisions indicated that red light running was closely associated with fatalities.

It was also recognizable that most of the drivers who ran the red lights wore seatbelts. The Chi-Square tests and Regression analysis indicated that use of seatbelts was not a significant predictor of the instances of broken lights. The high prevalence of use of seatbelts among drivers who ran red lights was an indication that they were speeding in addition to but exuding high levels of awareness regarding traffic safety. The use of seatbelts was not found to be a significant predictor of the instances of broken lights. However, the use of seatbelt is touted as part of the most prominent aspect of prevention of fatalities during traffic collisions [20] [24].

Finally, the gender of the driver was found to be an insignificant predictor of the instances of broken traffic lights, through both the Chi-Square tests and Regression analysis. Most studies about the capabilities of drivers have indicated that male drivers were more careless and likely to commit collisions compared with female drivers [16]. However, the propensity to run red lights in the study was found to be unrelated to the gender of the driver. Although male drivers were considered most delinquent [25], the fact that most of the observed drivers were male, slightly skewed the results for this study. As a result, in order to ascertain the reliability of this variable, there is a need to collect data that is evenly distributed across the genders.

5. Conclusions

Traffic safety is an important aspect in the protection of collisions and loss of life. It is the role of government to ensure safety on the roads through development of reliable infrastructure and guidelines for the usage of roads. Due to the multiplicity of drivers on the roads, it is necessary for the establishment of laws and standards. In this study, focus is directed towards traffic offences in the category of red light running in Trinidad and Tobago.

This quantitative study was focused on identifying the factors contributing to red light running in Trinidad and Tobago. Data for analysis were collected from large intersections, which possessed large volumes of traffic. The researcher was successful in collecting and analysing the data required to answer the research questions. Overall it was clear that a model including all the variables included would be very weak in predicting the probability of red light running in Trinidad and Tobago.

The results have also shown that the factors related to RLR are to a large extent similar among countries with respect to issues such as location, gender, ethnicity, time of the day, and day of the week. In terms of gender, male drivers were viewed as the most prone to run red lights, compared to female drivers. This was closely supported by studies from other locations where female drivers were considered more likely to obey traffic rules compared to male drivers.

Use of seat belts and gender of the driver were found to play a significant role in the propensity to run and break red lights. The close link between gender and delinquency is duplicated in running of red lights in Trinidad and Tobago. Use of seat belts revealed two conflicting aspects. First, the use of seat belts indicates awareness to the dangers of careless driving. On the other hand, it could be a sign that the driver has pre-meditated red light running and speeding, hence the need to use seatbelts. Finally, with regard to timing, the variations in traffic due to peak hours influence the propensity to run lights. First, during peak hours, the huge volumes of traffic create a scenario which is close to the circumstances which propagate high prevalence of red light running in urban locations compared to rural areas. Secondly, most individuals are in a rush, thus making it easier for drivers who are not keen on observing traffic rules to run and break red lights. Lastly, there is market inequality in the usage of the roads at that time, creating the perception that the allocation of red-light times is inequitable. However, age and time of day were not direct predictors of breakage of lights, as indicated in the Pearson Chi-Square tests.

While the rate of RLR is low in Trinidad and Tobago, the Traffic Unit can still improve the safety of the roads by targeting intersections such as the Bamboo Junction which have the highest rates and also by adjusting their policies to address more the challenges faced by Indo-Trinidadian and male drivers. The Traffic Unit also needs to develop policies targeting rush hours and Fridays. Policies targeting these areas have the potential to decrease the rate of RLR even further. However, further research is required to establish the factors which influence the instances of broken lights. Although some factors discussed herein are significant, there is a need to establish whether these factors are directly or indirectly related to broken lights.

6. Recommendations

Red light running is highly risky and propagates the occurrence of fatal collisions on the roads. Although it may appear safe and harmless in some instances, it is against traffic rules. The imperative nature of laws contributes to sanity in society since all individuals operate on an even keel. When an individual runs a red light, other drivers and road users are not aware of his intentions and expectations, resulting to the confusion that leads to collisions. As a result, the following recommendations are befitting. These recommendations are based on the findings from the study.

- It is important to carry out nationwide campaigns on road safety and conforming to road rules. Ideas and examples can be taken from successful international road safety campaigns such as the Pinkie Campaign in NSW, Australia. The use of the Pinkie campaign as a case study for evaluating potential responses to road safety is important. Trinidad and Tobago and New South Wales (Australia) share a lot of similarities insofar as road collisions are concerned. In both countries, speeding is the biggest cause of fatal car collisions. Significantly enough, the speeding problem in both countries is driven by a "boy racer" attitude whereby speeding is viewed as a means of not only achieving recognition and approval but also of asserting or demonstrating one's power or manhood.
- The establishment of strict laws regarding red-light running should be established. Although laws are not absolute solutions to criminal tendencies, strict penalties are bound to limit the propensity of a large proportion of the population from running red lights.
- Increased vigilance at the specific intersections in order to ensure that individuals do not run red lights is also necessary. In most locations, prominent intersections are manner by police officers who provide assistance to the drivers in addition to ensuring deterrence of delinquency. These police are a necessary element in enforcement of traffic laws, thereby make it possible for other implements to play their roles, such as speed guns and speed cameras.
- Make provisions for human influence in control of traffic. This can be achieved through overriding the red lights with police officers who will be able to make decisions based on the situation. Most locations are actually using this system to ease traffic, while ensuring the safety of road users. Such officers could function to direct traffic during the peak times and then leave the red lights to control traffic during the rest of the day. It is common knowledge that traffic officers override the authority of red lights when on locations, and this does not compromise the reliability of traffic signs and red lights in any manner.
- Enhance the skills and competencies of drivers. This can be done right from the institutions where driving and use of motor vehicles is done. This will provide the drivers with the necessary skills and provide them with information about traffic courtesy and the impact of the road rage. The availability of such information will play a major role in deterring individuals from running red lights, especially for drivers who are not aware of the risks they present to other road users.

References

[1] Olukoga, A., Legall, G. and Odekunle, A. (2011) Pattern of Seat Belt Use by Drivers in Tri-

nidad and Tobago, West Indies. *BMC Research Notes*, **4**, 201.
http://dx.doi.org/10.1186/1756-0500-4-201

[2] Encyclopedia of the Nations (2016) Americas (Trinidad and Tobago).
http://www.nationsencyclopedia.com/Americas/index.html

[3] Central Statistical Office (2011) Trinidad and Tobago 2011 Population and Housing Census Demographic Report.
https://guardian.co.tt/sites/default/files/story/2011_DemographicReport.pdf

[4] Mutabazi, M. (2007) Trinidad Motorists Understanding of Safety Belt Issues, a Survey and Review. *West Indian Medical Journal*, **56**, 234-235.
http://dx.doi.org/10.1590/S0043-31442007000300008

[5] Trading Economics (2016) Trinidad and Tobago GDP per Capita.
http://www.tradingeconomics.com/trinidad-and-tobago/gdp-per-capita

[6] St Bernard, G. and Matthews, W. (2003) A Contemporary Analysis of Road Traffic Crashes, Fatalities and Injuries in Trinidad and Tobago. *Injury Control and Safety Promotion*, **10**, 21-27. http://dx.doi.org/10.1076/icsp.10.1.21.14104

[7] Meighoo, K. (2008) Ethnic Mobilisation vs. Ethnic Politics: Understanding Ethnicity in Trinidad and Tobago Politics. *Commonwealth & Comparative Politics*, **46**, 101-127.
http://dx.doi.org/10.1080/14662040701838068

[8] Schlundt, D., Warren, R. and Miller, S. (2004) Reducing Unintentional Injuries on the Nation's Highways: A Literature Review. *Journal of Health Care for the Poor and Underserved*, **15**, 76-98. http://dx.doi.org/10.1353/hpu.2004.0012

[9] Porter, B.E. and Berry, T.D. (2001) A Nationwide Survey of Self-Reported Red Light Running: Measuring Prevalence, Predictors, and Perceived Consequences. *Accident Analysis and Prevention*, **33**, 735-741. http://dx.doi.org/10.1016/S0001-4575(00)00087-7

[10] Aeron-Thomas, A. and Hess, S. (2009) Red-Light Cameras for the Prevention of Road Traffic Crashes. *Cochrane Database of Systematic Reviews*, Article ID: CD003862.

[11] Martinez, K.L. and Porter, B.E. (2006) Characterizing Red Light Runners Following Implementation of a Photo Enforcement Program. *Accident Analysis and Prevention*, **38**, 862-870. http://dx.doi.org/10.1016/j.aap.2006.02.011

[12] Yang, C.Y. and Najm, W.G. (2007) Examining Driver Behavior Using Data Gathered from Red Light Photo Enforcement Cameras. *Journal of Safety Research*, **38**, 311-321.
http://dx.doi.org/10.1016/j.jsr.2007.01.008

[13] Retting, R.A., Ferguson, S.A. and Farmer, C.M. (2008) Reducing Red Light Running through Longer Yellow Signal Timing and Red Light Camera Enforcement: Results of a Field Investigation. *Accident Analysis & Prevention*, **40**, 327-333.
http://dx.doi.org/10.1016/j.aap.2007.06.011

[14] Huang, H. and Chin, H.C. (2009) Disaggregate Propensity Study on Red Light Running Crashes Using Quasi-Induced Exposure Method. *Journal of Transportation Engineering*, **135**, 104-111. http://dx.doi.org/10.1061/(ASCE)0733-947X(2009)135:3(104)

[15] West, S.K., Hahn, D.V., Baldwin, K.C., Duncan, D.D., Munoz, B.E., Turano, K.A., Hassan, S.E., Munro, C.A. and Bandeen-Roche, K. (2010) Older Drivers And failure to Stop at Red Lights. *The Journals of Gerontology Series A*: *Biological Sciences and Medical Sciences*, **65**, 179-183. http://dx.doi.org/10.1093/gerona/glp136

[16] Retting, R.A. and Williams, A.F. (1996) Characteristics of Red Light Violators: Results of a Field Investigation. *Journal of Safety Research*, **27**, 9-15.
http://dx.doi.org/10.1016/0022-4375(95)00026-7

[17] Wen, W. (2008) A Dynamic and Automatic Traffic Light Control Expert System for Solving

the Road Congestion Problem. *Expert Systems with Applications*, **34**, 2370-2381. http://dx.doi.org/10.1016/j.eswa.2007.03.007

[18] Porter, B.E. and England, K.J. (2000) Predicting Red-Light Running Behavior: A Traffic Safety Study in Three Urban Settings. *Journal of Safety Research*, **31**, 1-8. http://dx.doi.org/10.1016/S0022-4375(99)00024-9

[19] Wu, C., Yao, L. and Zhang, K. (2012) The Red Light Running Behaviour of Electric Bike Riders and Cyclists at Urban Intersections in China: An Observational Study. *Accident Analysis and Prevention*, **49**, 186-192. http://dx.doi.org/10.1016/j.aap.2011.06.001

[20] Grembek, O., Zhou, K. and Zhang, W. (2009) Red Light Running Collision Avoidance. California PATH Research Report. http://www.its.berkeley.edu/publications/UCB/2009/PRR/UCB-ITS-PRR-2009-15.pdf

[21] McKnight, A.J. and Mcknight, A.S. (2010) Young Novice Drivers: Careless or Clueless? *Accident Analysis and Prevention*, **35**, 921-925. http://dx.doi.org/10.1016/S0001-4575(02)00100-8

[22] Sinhmar, P. (2012) Intelligent Traffic Light and Density Control using IR Sensors and Microcontroller. *International Journal of Advanced Technology & Engineering Research (IJATER)*, **2**, No. 2

[23] Transport Research Centre (2007) Managing Urban Traffic Congestion. European Conference of Ministers of Transport. http://www.itf-oecd.org/sites/default/files/docs/07congestion.pdf

[24] Jhai, M., Mishra, S. and Weldegiorgis, Y. (2011) Investigating Positive and Negative Utilities of Red Light Cameras through a Binary Probit Analysis. http://onlinepubs.trb.org/onlinepubs/conferences/2011/RSS/2/Jha,,M.pdf

[25] Lumsden, K. (2013) Boy Racer Culture: Youth, Masculinity and Deviance. Taylor & Francis Group, UK.