Analysis of Traffic Law Violations and Traffic Accidents with their Enforcements (In Case of Jimma Town)

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Abstract— More than about 1.24 million of people killed each year due to road traffic crashes worldwide. Out of these deaths, more than one fifth occur among pedestrians Promoting the level of road traffic law enforcement plays a great role in reducing traffic crashes. For assessing of traffic law enforcement, the registered data of traffic violation for the years 2015-2017 were taken from the Traffic Police Department to describe the activities of traffic police personnel in enforcing traffic laws. The violations were categorized into four groups: -those related to driving, vehicle, parking and others, and Traffic Law Enforcement into safety and other traffic law enforcement activities. The types of vehicles involved in the violations were categorized as cars, small load vehicles, motor-cycles, Bajaj and other. Traffic Police had registered a total of 77 traffic-law violation in the year 2015,65 in the year 2016, and 86 in the year 2017. Driving violation was the highest registered violation in the three years, and it was slightly higher in 2017. The categories of cars and small load vehicles were the highest registered vehicles in number of violations with in the three years. For motorized two wheeler vehicles the highest number of registered violation in the three years were the one that related to driving. Out of all vehicle related and other violations were registered more commonly for cars in 2015 and 2016 respectively. From the registered violations, parking related violation was occurred only in 2017. The safety related traffic law enforcement was 89.96 % of the total traffic law enforcement activity.

Keywords— Driving Violations, Enforcement, Traffic law, Violations.

I. INTRODUCTION

More than about 1.24 million of people killed each year due to road traffic crashes worldwide. Out of these deaths, more than one fifth occur among pedestrians [5]. According to [5], in each year, more than 270 000 pedestrians lose their lives on the world's roads. More than of the estimated amount of people are injured in traffic-related crashes while walking. These incidents cause much suffering and grief as well as economic hardship for families and loved ones. The key risks to pedestrians are well documented, and it include infrastructure in terms of a lack of dedicated facilities for pedestrians such as sidewalks, crossings and raised medians.

The traffic fatality rates however substantially differ across countries for example, the traffic fatality rate per 100,000 populations is found 8.7 in high-income countries, but in middle-income countries, the rate is recorded as 20.1 [4] .in addition, only 52% of the registered vehicles in the world are owned by middle-income countries even though 80% of road traffic fatalities take place in these countries [4]. It can be claimed that the reasons behind these regional difference between countries on traffic fatalities may also be related to enforcements of road behaviors as practices in a country [3].

As a low income country, Ethiopia has low number of vehicles with high traffic accidents compared to others. According to Ethiopian transport authority, road traffic injuries caused the loss of 2765, 3331, 3847 and 4352 Ethiopian lives in the year 2013, 2014, 2015 and 2016 G.C. respectively with major body injuries of 5047, 5888, 5839 and 7071 in the respective years. This is indicating

an increasing trend of road traffic accidents year by year though road traffic safety laws do exist and there are low number of vehicles in the country [6].

Enforcement of the existing road traffic law is paramount of importance to shape road user behavior. Worldwide there are many organizations that analyze road traffic crashes and maintain global crash statistics [2,4]. For instance, the [2] has proven track record in promoting the highly efficient practices in road safety such as helmet and seatbelt wearing, restrictions on drunk driving, implementing traffic regulations.

II.   MATERIALS AND METHODOLOGY

2.1 STUDY AREA

2.1.1 LOCATION

Jimma city which is the capital city of Jimma zone, Oromiya National Regional state, is located in southwest part of Ethiopia and 348 km away from the capital city. This city is located at an average altitude of 1700m above sea level and its astronomical location is 7º 4'North Latitude and 36º 5' East Longitude. It has a total area of 46.23 km2 (4623 ha.).

2.1.2 Population

Jimma city was reported to dwell a population of 120,960 during the third Ethiopian census [1], out of which 50.3% were males and 49.7% were females. It is shown by the [1] that Jimma is the largest city in southwest part of Ethiopia and 9th most populous city next to Dese, having an estimated total population of 177,943.

2.2 DATA COLLECTION METHOD

The registered traffic law violation data for the three consecutive years were taken from the Jimma city's traffic department office. The registered traffic law violation for the three years of 2015,2016 and 2017 have been taken from the department of traffic police of Jimma city and then be used for analysis.

Fig.1 Violations created due to inappropriate turning.

(source: from Jimma city's traffic department office)

2.3 Data Analysis

After completing data collection, the quantitative and qualitative data have been analyzed.   The computer software application that is Statistical Package for the Social Science (SPSS), which is useful for the quantitative data analysis, was used to analyze the data obtained from intended sources. The results were presented in quantitative and qualitative terms in the form of tables, bar graphs and percentages.

2.4 TRAFFIC LAW ENFORCEMENT ACTIVITY

Various vehicles and traffic law violations were subdivided into different groups in order to make important recommendation for action and this subdivision is used in the analyses. One possible thing is that vehicle driver may not be available in some traffic violations or when traffic police are unable to stop the person committing the violation but records the vehicle registration number of the vehicle driven by that driver.

2.4.1 Categories of Vehicles

Five categories of vehicles were used and shown below.

Cars – this category included automobile, pick-ups and tax

Motorized two-wheelers or motorcycles

Small-load vehicles – the vehicles that carry a small amount of load within the city limits were included in this category.

Bajaj- these are three-wheeler commercial passenger vehicles that are meant to carry three adult passengers

Others – this category included buses, trucks, truck trailers, tractors, jeeps and other vehicles.

There are also violations caused by carts and non-motorized cycles, and also there is violation for which the vehicle type causing it is unknown.

Fig.2 Accidents caused by violations of different categories of vehicles.

(Source: from Jimma city's traffic department office)

2.4.2 Categories of Traffic Law Violations

The traffic law violations were subdivided into four categories of violations for further analysis.

Driving violations – these included disobeying/jumping a traffic signal, driving on the wrong side of the road (driving opposite to the direction of the traffic), khat (impaired cognitive skill), lack of giving priority for another driver(vehicle), lack of giving pedestrian priority, lack of giving adequate gap in traffic, overtaking another vehicle at steep grade, overtaking another vehicle at a curve, making unexpected turning after overtaking, overtaking a vehicle from the wrong side, rash driving, speeding, drink–driving, making inappropriate turning, disregard traffic police commands, making unexpected driving of stopped vehicle, fatigue driving, inattention driving , three people riding on a two-wheeler meant for two people and use of mobile phone while driving.

Parking violations – these included improper stopping (parking in a no parking zone and parking in a manner that obstructs the flow of traffic).

Vehicle violations – these violations were related to poor condition of vehicle and included worn brakes, worn(bald) tires, tire burst, and steering problems

Other violations – all the other violations were combined under this category and included carrying extra number of passengers, improper lighting, violations related to road condition problems, violations related to pedestrian errors and the like(unknown).

Table 1 Categories of traffic law violations

Traffic law violation	Year 2015	Year 2016	Year 2017
Driving violations	69	58	79
Parking violations	0	0	1
Vehicle violations	4	1	0
Other violations	4	6	6

III.   RESULT AND DISCUSSION

3.1 Violations of Road Traffic Laws

Table 2 Correlation coefficient for total violation with violated traffic laws.

	Total violations	
	Correlation	Sig. (2-tailed)
Drink driving (Drunk driver)	.971	.154
Driving on the wrong side of the road	-.971	.154
Lack of giving priority for another driver	.500	.667
Lack of giving pedestrian priority	-.971	.154
Overpassing another vehicle at steep grade	-.240	.846
Making unexpected turning after overpassing	-.232	.851
Lack of giving adequate gap in traffic	.997*	.045
Overpassing another vehicle at a curve	.971	.154
Speeding	.148	.905
Improper overtaking	.971	.154
Inappropriate turning	.240	.846
Making unexpected driving of stopped vehicle	-.545	.633
Improper stopping	.971	.154
Fatigue	.971	.154
Worn brake	-.721	.488
Tire burst	-.277	.821
Pedestrian problem	-.693	.512
*. Correlation is significant at the 0.05 level (2-tailed).		

Based on Table 2, the relationship between registered total violation and various types of violated traffic laws were tested using Pearson correlation. Result showed that total violation was positively correlated with lack of giving adequate gap in traffic (r=0.997, p<0.05). Some of the driver did not need to give adequate gap and attempt to take a short route in order to either save time or fuel, thereby committing violation. The registered total violation has a positive correlation with drink driving, lack

of giving priority for another driver, overpassing another vehicle at a curve, Speeding, improper overtaking, inappropriate turning, improper stopping, Fatigue. And it has a negative correlation with driving on the wrong side of the road, lack of giving pedestrian priority, overpassing another vehicle at steep grade, making unexpected turning after overpassing, making unexpected driving of stopped vehicle, worn brake, tire burst, pedestrian problem. The registered violation has no relation with Khat (impaired cognitive skill), Disregard traffic police commands, Disregard traffic lights, Disregard stop sign, Disregard of "give priority sign", Inattention driving, Improper lighting, carrying extra number of passengers(overloading), Worn(bald) tires, Steering problem, Problem of road condition.

In the year 2015, 77 number of traffic violation was registered out of which one was caused by a cart and the other one was caused by non-motorized bicycle. The more number of violation during this year was occurred due to lack of giving pedestrian priority and making unexpected turning after overcoming another vehicle in which each of them accounts 24.68% (19 in number) of the total recorded violations. Lack of giving adequate gap in traffic (too follow closely) was the second violation in content, which accounts about 11.69% of the total recorded violation.

For the year 2016, the more number of violation was that of speeding which holds about 32.31% (21 in number) of the total recorded violations. Lack of giving pedestrian priority was the second higher one that accounts about 29.23%(19 in number) of the total registered violation. Violation relating to making unexpected driving of stopped vehicle is the third higher registered violation, holding about 7.69%(5 in number) of the total. Violation relating to lack of giving adequate gap in traffic (follow too closely) was the highest registered violation during the year 2017 which accounts about 41.86% (36 in number) of the total. Speeding was the second major registered violation and its percentage was 22.1% of the total. Lack of giving pedestrian priority was the third major registered violation and holds 8.1% of the total.

3.2 Categories of Vehicles Involved in Violations

Table 3 Correlation coefficient of violation with different categories of vehicles.

		Total violation	Cars	Motor cycles	Small load vehicles	Bajaj	Other
Total violat	Pearson	1	.999*	.999*	.991	.981	-.45

ion | Correlation | | | | | | 4 |

| Sig. (2-tailed) | | .033 | .033 | .088 | .125 | .700 |

*. Correlation is significant at the 0.05 level (2-tailed).

Depending on the result of Table 3, total violation was positively correlated with Cars among the categories of vehicles (r=0.999, p<0.05). This indicates that the involvement of cars causing violation increases as a total road traffic violation increases. Total violation was also positively correlated with Motor cycles category of vehicles (r=0.999, p<0.05And a total violation has negative correlation with other categories of vehicles. The highest number of violation was that of cars and the second one was that of small load vehicles from the category of vehicle in the year 2015. For the year 2016 the highest registered violation was that of cars, and the second one was that of small load vehicles. In the year 2017, cars occupy the highest registered violation while small load vehicle were of the next one in the case of registered violation. When combining together the violations of the three years; cars were involved in 34.21 %, small load vehicles were involved in 29.39%, other category of vehicles involved in 17.1%, motor vehicles involved in 9.21%, and Bajaj involved in 8.33% of the total violations. These indicates that the majority of the registered traffic violations were that of cars and small load vehicles from the 3 years under the categories of vehicles. The results and finding of [7] analysis states that commercial vehicles involvement in pedestrian crashes is associated with a greater probability of 41% pedestrian fatality that was so analogous to the result of this study. [9] also examined pedestrian injury in Ghana and concluded heavy vehicles are risk factors.

Table 4 Distributions of traffic law violations registered in the years 2015,2016 and 2017 for the various categories of vehicles

Type of vehicle	Year 2015	Year 2016	Year 2017
Car	26 (33.77%)	22(33.8%)	30(36.05%)
Driving	23(29.90%)	19(29.2%)	27(31.4%)
Parking	0(0%)	0(0%)	0(0%)
Vehicle	3(3.89%)	1(1.5%)	0(0%)
Other	0(00	2(3.0%)	3(3.49%)

	Year 1	Year 2	Year 3
Two wheeler motorized cycles	7(9.09%)	5(7.7%)	9(10.47%)
	7(9.09%)	4(6.2%)	8(9.3%)
Driving	0(0%)	0(0%)	0(0%)
Parking	0(0%)	0(0%)	0(0%)
Vehicle	0(0%)	1(1.5%)	1(1.16%)
Other			
Small load vehicles	22(28.57%)	21(32.3%)	24(27.91%)
	21(27.27%)	20(30.8%)	22(25.58%)
Driving	0(0%)	0(0%)	0(0%)
Parking	0(0%)	0(0%)	0(0%)
Vehicle	1(1.3%)	1(1.5%)	2(2.33%)
Other			
Bajaj	7(9.09%)	2(3%)	10(11.63%)
Driving	7(9.09%)	1(1.5%)	10(11.63%)
Parking	0(0%)	0(0%)	0(0%)
Vehicle	0(0%)	0(0%)	0(0%)
Other	0(0%)	1(1.5%)	0(0%)
Other	12(15.58%)	14(21.5%)	13(15.12%)
Driving	11(14.29%)	13(20%)	12(13.95%)
Parking	0(0%)	0(0%)	1(1.16%)
Vehicle	1(1.3)	0(0%)	0(0%)
Other	0(0%)	1(1.5%)	0(0%)
Non-motorized cycles and carts	3(3.9%)	1(1.5%)	0(0%)
	0(0%)	1(1.5%)	0(0%)
Driving	0(0%)	0(0%)	0(0%)
Parking	0(0%)	0(0%)	0(0%)
Vehicle	3(3.9%)	0(0%)	0(0%)
Other			
Total	77(100%)	65(100%)	86(100%)

3.3 Categories of Violations

Table 5 Coefficient of correlation between total violation and various categories of violation.

		Total violation	Driving violations	Parking violations	Vehicle violations	Other violations
Total viola	Pearson n	1	.998*	.822	-.160	-.082

	tion	Correlation				
		Sig. (2-tailed)	.035	.386	.898	.948

*. Correlation is significant at the 0.05 level (2-tailed).

Among the categories of violations, driving violations have positive relation with the total registered violations (r=0.998, p<0.05). Other violations have negative relationship with the total violations. The highest registered violation was that of driving related violation in the 3 years (89.61% in year 2015,89.23% in the year 2016, and 91.86% in the year 2017). Parking related violation was registered only in the year 2017 representing about (1.16%) of the total. Out of the total, 5.19% and 1.54 % of vehicle related violations were registered in the year 2015 and 2016, and no vehicle related violation in the year 2017.Other related violation occupied 5.19% in year 2015,9.23% in year 2016, and 6.98% in the year 2017. By combining the violation of the three years, driving violation holds about 90.35% of the total, other violation holds about 7.02% of the total and vehicle violation was 2.19%.

3.4 Violations Related with the Driving Experience

Table 6 Coefficient of correlation between violation and driving experience of driver.

		Total violations	Haven't license	below 1 year	1-2 year	2-5 year	5-10 year	Above 10 year
Total violations	Pearson Correlation	1	.997	.608	1.00**	.998*	.040	.949
	Sig. (2-tailed)		.050	.584	.008	.044	.974	.205

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The total registered violation has a positive and strong relation with driving experience with in the range of 1-2 year (r=1, p<0.01). Positive and relatively strong correlation was also observed between total violation and driver having driver experience of 2-5 year (r=0.998,

p<0.05). Out of the total violation in year 2015, 33.77% of violations was caused by drivers whose driving experience was within the range of 2-5 year and was the highest registered violation relating to driving experience. The next higher driving experience of driver that violate traffic law was those having below one year driving experience in which its involvement was about 20.78% of the registered traffic law violations. This indicates that drivers having 1-5 year driving experience were the major violators of traffic laws within this year.

In the year 2016, drivers having driving experience within the range of 5-10 year were the higher violators holding about 32.3% of the total violations. Driving experience within the range of 2-5 year was the second higher representing about 27.69% of the total violations. 12.3% of the total violations were related to those drivers having above 10 year driving experience. Driving experience for about 18.46 % of the total violation were not known.

For the year 2017, the majorities of the registered traffic law violations were caused by the drivers having 2-5 year of driving experience which represents about 36.05 % of the total violations. Violations performed by drivers having 5-10 year of driving experience represents 27.91 % of the total. And 9.3 % of the registered violations were related to drivers having 1-2 year of driving experience. From this result, the majority of the drivers vulnerable to traffic law violations were those having 2-5 year of driving experience. Out of the total violation of the three years, drivers having driving experience of the range 2-5 year contributed 32.89% of the total, 5-10 year driving experience have contributed 25% of the total and above 10 years have contributed 11.4% of the total. 1-2 year have contributed 10.1% of the total. The result of this finding was analogous to that of [5] that articulates young and novice drivers are subjected to an increased risk of road traffic crashes compared to older and more experienced drivers. [10] determined novice drivers increase the fatality of traffic crashes which is nearly similar to this result.

3.5 Age of the Driver

Table 7 Correlation between age of driver and registered total violation

		Total violation	Below 18 year	18-30 year	31-50 year	above 51
Total violation	Pearson Correlation	1	.957	1.000*	.913	-.012
	Sig. (2-tailed)		.188	.011	.268	.993

*. Correlation is significant at the 0.05 level (2-tailed).

Depending on the result of Table 7, There was a positive and strong relationship between total violation and driver age of the range 18-30 year (r=1, p<0.05). Violation was also positively correlated with age of the driver of below 18 years,31-50 year. During the year 2015, 53.25 % of the total registered violation was caused by drivers whose age was within the range of 18-30 year. Drivers whose age was within the range of 31-50 year and below 18 years have contributed 23.38 % and 11.69 % to the total registered violations respectively. This indicates that drivers whose ages were within the range of 18-30 years were highly contributed to the total violation.

In the year 2016, 46.15% of the total violations were caused by the drivers whose ages were within the range of 18-30 years and 26.15 % of the violations were done by the drivers whose ages were within the range of 31-50.

For the year 2017, 53.49 % of the total violations were caused by the drivers whose ages were within the range of 18-30 year. And 23.26 % of the violations were from the drivers whose ages were within the range of 31-50 year. For the total violation of the three years; drivers whose age was within the range of 18-30 year contributed 51.31% to the total, within the range of 31-50 contributed 24.12% of the total, below 18 years contributed 12.28% to the total and above 51 years old contributed 6.14% to the total. [8] reached the same conclusion that young drivers under 25 increase crash severity.

3.6 Safety Traffic Law Enforcement

By taking the traffic law enforcement activities for the three years together, the safety related traffic law enforcement was 89.96 % of the total activities performed by the traffic police. Greater amount of traffic law enforcement activities related to cars, motorized two-wheeler, small load vehicles, Bajaj, and others was safety TLE (safety traffic law enforcement). Out of driving violations, the main violations were related to lack of giving pedestrian priority, lack of giving adequate gap (follow too closely), and speeding. And the left of them could be considered as other violations of driving violation category

From the total of safety TLE activities, violation related to lack of giving pedestrian priority accounts 19,19 and 7 in the year 2015,2016, and 2017; violations related to lack of giving adequate gap accounts about 9,3, and 36 in each of the respective three years; violation relating to speeding accounts about 7,21, and 19 in each year respectively; and violations relating to others accounts about 35,15, and 21 in the three years respectively.
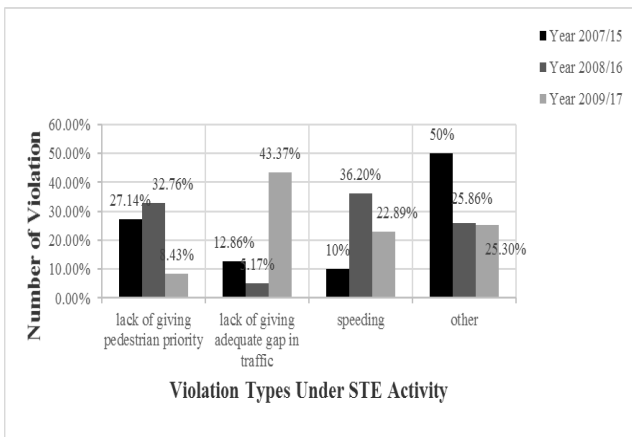
Fig.3 Distributions of the types of driving violation categorized as safety traffic law enforcement(TLE) activity for the three years combined in Jimma city.

IV.   CONCLUSIONS

The data of registered traffic law violation for the three years was also used in the analysis. Driving violation was registered in a greater number during the period of the three years, and it was slightly higher in 2017.The categories of cars and small load vehicles were the most registered vehicles for violations for the three years. The safety related traffic law enforcement was 89.96 % of the total traffic law activities performed by the traffic police. Out of driving violations, the main violations were related to lack of giving pedestrian priority, lack of giving adequate gap (follow too closely), and speeding. Total violation was positively correlated with Cars and Motor cycles among the categories of vehicles. The highest registered violation was that of driving related violation in the 3 years (89.61% in year 2015,89.23% in the year 2016, and 91.86% in the year 2017. The total registered violation has a positive and strong relation with driving experience with in the range of 1-2 year (r=1, p<0.01), and also with driver having driver experience of 2-5 year. During the year 2015, 53.25 % of the total registered violation was caused by drivers whose age was within the range of 18-30 year. In the year 2016, 46.15% of the total violations were caused by the drivers whose ages were within the range of 18-30 years and 26.15 % of the violations were done by the drivers whose ages were within the range of 31-50. For the year 2017, 53.49 % of the total violations were caused by the drivers whose ages were within the range of 18-30 year.

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