

Impact of Unlicensed Riders on Motorcycle Crash Rates and its Counter Measures – a Case Study at Wolaita Zone, Snnpr, Ethiopia

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ABSTRACT

Motorcycle accidents constitute a major part of traffic crashes and emerging public health problem in developing countries and contribute significantly to the overall road traffic injuries. The main aim of this study is to evaluate the impact of unlicensed riders on motorcycle crash rates and its counter measures in the Wolaita zone that can be applicable to any other zones in Ethiopia. Multiple linear regression models are developed for the purpose of analysis to estimate the impact of unlicensed riders on the motor cycle crash rates in Wolaita zone. Motor cycle crash data from 2013 to 2017 is obtained from Wolaita zone traffic police offices.

A key finding of the current investigation is that across all motorcycle-involved accidents, unlicensed riders had higher rates of crash involvement and greater levels of fatal and injury severity than licensed riders. The impact of unlicensed riders on motor cycle crashes is calculated as deduction of the proportion of licensed rider's involvement in accidents from the proportion of unlicensed rider's involvements in accidents. The resultant impact of unlicensed riders on motor cycle crash rates when age of rider 25 and road width 9 meter is 29% for fatal accidents, 61.5% for serious injury accidents, and 49.4% for light injury accidents greater compared with validly licensed riders. Unlicensed riders are high risk group requiring further attention within the total driving population. As a whole, riders tend to be over-represented in more severe road crashes. However, this pattern is particularly the case for unlicensed riders. The study finding strongly justify the use of countermeasures, including improvement of driver school numbers and standards in remote areas, creating awareness to public, motor cycle impoundment, to control unlicensed riders and to reduce crashes caused by these riders.

Keywords - Motorcycle, Unlicensed Riders, Validly licensed riders, Multiple Linear Regression, Motorcycle Accident Rate

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I. INTRODUCTION

The injuries related to motorcycles contribute significantly to the number of road traffic deaths and injuries in Wolaita zone, taking out significant resources including money and the health worker time. In Wolaita zone, ten years ago, motorcycle numbers were low, but have been steadily increasing ever year. Now motorcycles are common in rural and urban areas in Wolaita zone. Motorcycles has become a means of commercial transportation but their operation is characterized as riders and their passengers without helmet, passenger overload and lack of license. Consequently, the contribution of motorcycle crash to injury-related deaths seems to be on the rise. Due to the problem related with unlicensed riders is

increasing at a faster rate because the rapid motorization and other factors.

In Wolaita zone, unlicensed motorcycle riders can represent a high-risk element within the driving community because they do not come to the attention of authorities unless they are pulling over. The three main types of unlicensed riders involved in motorcycle accidents are: - those with disqualified/suspended licenses, those with inappropriate licenses, and those who have never been licensed.

II. OBJECTIVES OF THE STUDY:

1. To identify the nature and causes of motorcycle accidents in Wolaita zone;

2. To apply crash modeling methods for Wolaita zone motorcycle crashes;
3. To compare the impact of unlicensed riders on motorcycle crash rates with licensed riders based on the developed models
4. To assess and suggest any measures to be taken to reduce unlicensed riders in Wolaita zone.

III. STATEMENT OF THE PROBLEM:

Motorcycle crash is among the most persuasive public health problems and deaths to Wolaita zone and whole nation. Motorcycle crash is one of significant tricky in Wolaita zone, due to unlicensed motorcycle riders constitute a significant part of the Wolaita zone driving population and known to confirm an elevated traffic safety risk to other road users. Many unlicensed motorcycle riders are young or otherwise lack sufficient funds to pay for accidents happen to their motorcycles, thus may make recovering this money difficult. The focus of this study is to evaluate impact of unlicensed riders on motorcycle crash rates and its counter measures in the Wolaita zone, from 2013 through 2017, specifically by comparing unlicensed riders to that with valid licensed riders by using predicted model.

IV. LITERATURE REVIEW:

Motorcycle injuries constitute a major but neglected emerging public health problem in developing countries and contribute significantly to the overall road traffic injuries (10). Motorcycle injuries are among the leading causes of disability and deaths and the main victims are the motorcyclists, passengers and pedestrians in their young reproductive age group (9). The problem is increasing at a faster rate in developing countries due to rapid motorization and other factors (3).

While all motorists come under Vulnerable Road users and are at risk of injury and death due to collisions, the prevalence of crashes and severity is far higher for motorcycles. For instance, U.S. motorcycle crash rates are 90% higher (per vehicle-33 mile traveled [VMT]) than those for passenger cars and light trucks (8). Study in Ghana concludes that, motorcyclists are about three times more likely than car occupants to be injured in a crash and 16 times more likely to die. Contrary to a car crash, in a motorcycle crash, the riders often absorb all kinetic and compressive energy resulting from the crash (5). With a high and increasing proportion of VRUs, developing countries are facing a major public health challenge regarding VRU injuries. For example, motorized two-wheelers account for more than 70% of road traffic deaths in Thailand and 44% in Colombo, Sri Lanka (1)

The motorcyclists tend to over-speed and over load their motorcycles for quick returns. It is

because of that recklessness, indiscipline and lack of respect for other road users by the motorcyclists who are mainly youths, are the major cause of road related deaths and injuries. The majority of the motorcyclists do not wear any protective gear, hence aggravating the risks of getting severe head injuries (7).

In Tanzania a motorcycle as a means of commercial transport but their operation is characterized by non-helmet use by riders and their passengers, passenger overload, lack of certified driver training and valid licensing, over speed and reckless driving, poor regulation and law enforcement and possible use of alcohol and drugs (6).

The lowest estimate in the proportion of all driving completed by unlicensed drivers or riders corresponds to the highest level of crash risk and. It should not be forgotten that in terms of road safety, unlicensed riders were including too excesses ranging from the deliberately negligent to the experienced driver who has driven regularly for several years without being involved in any crashes (2).

Unlicensed riders are the major problem for road safety in many countries. In Ethiopia, unlicensed motorcycle riders can represent a high-risk element within the driving community. According to (4), the Addis Ababa Traffic Management Bureau says there are more unlicensed drivers and riders on the streets than ever before and this is causing an increase in fatal traffic accidents

V. DATA COLLECTION:

In the present study, the motorcycle accident data is collected from different traffic police stations in the Wolaita zone for the years 2013 to 2017. The data collection includes the type of accident, reasons of accident occurrence, vehicles involved, license status of riders, age of the riders, experience of riders, etc.

VI. ANALYSIS OF ACCIDENT DATA:

The data collected is analyzed to evaluate the impact of unlicensed riders on motorcycle crash rates in Wolaita zone by considering the various influencing parameters for the motorcycle accidents such as road width, age of riders, experience of riders and average annual daily traffic volume. In order to estimate the influence of each variable, a multiple linear regression equation is developed from the data collected by correlating all the influencing parameters by using the statistical package of social science (SPSS) version 20 software.

VII. RESULTS AND DISCUSSION:

A total of 520 motorcycle accidents are included in the study. From those 377 (72.5%) accidents are recorded by unlicensed riders and 143 (27.5%) are validly licensed riders.

VIII. DISTRIBUTION OF MOTOR CYCLE ACCIDENTS – YEAR WISE:

The table 1 shows the details of Motor Cycle accident data that occurred in the past five years. As the table indicates, there are a large number of accidents caused by an unlicensed rider. As a whole, riders tend to be over represented in more severe road crashes. However, this pattern was particularly the case for unlicensed riders. For example, while 31.4% of the riders involved in fatal crashes in Wolaita zone between 2013 and 2017 are validly licensed, the equivalent proportion for unlicensed riders is 68.6%.

Table 1: Distribution of MC accidents – Year wise
 (Source of data: Traffic Police stations, Wolaita zone, Ethiopia)

Year	Unlicensed riders			Licensed riders	
	FA	SI	LI	FA	SI
2013	14	30	33	2	7
2014	23	44	37	12	11
2015	22	29	36	7	14
2016	18	18	10	14	9
2017	32	23	8	15	10

IX. DISTRIBUTION OF MC ACCIDENTS – PERSON WISE

Figure 1 shows that, 39% and 44% who died in crashes in last five years were riders and pedestrians respectively in the Wolaita zone

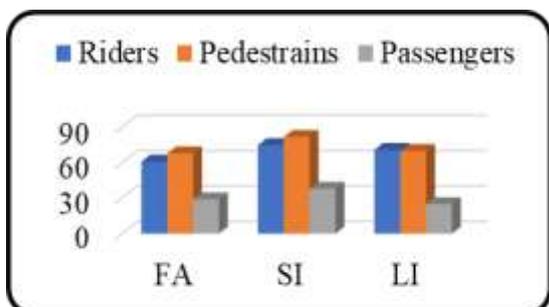


Figure 1. Distribution of MC accidents - person types (Source of data: Traffic Police stations, Wolaita zone, Ethiopia)

X. DISTRIBUTION OF MOTOR CYCLE ACCIDENTS - PAVEMENT SURFACE CONDITIONS WISE

The pavement surface conditions have also effects on the safety of Motor Cycle. Poor pavement surface condition is a prime factor for the causation of accidents. However, most of the Motor Cycle accidents in Wolaita zone occurred on good pavement surface conditions (asphalt) shown on the chart in Figure 2

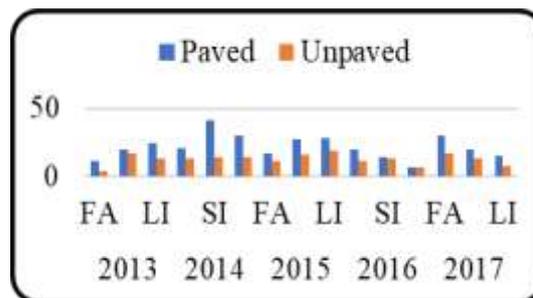


Figure 2. Distribution of MC accident by pavement surface conditions (Source of data: Traffic Police stations, Wolaita zone, Ethiopia)

XI. DISTRIBUTION OF MC ACCIDENTS – AGE GROUP WISE

Table 2 show that there were higher number of accidents met by younger people in the age group of 18-30 years. People in this age group were more vulnerable to participate in various activities of the society. These age group represented alone about 63% and 66% of deaths from Motor Cycle accidents of Unlicensed and licensed riders respectively.

Table 2. Distribution of MC accident by age group
 (Source of data: Traffic Police stations, Wolaita zone, Ethiopia)

Age group	Unlicensed riders			Licensed riders	
	FA	SI	LI	FA	SI
<18	7	4	6	0	0
18-30	71	97	86	33	31
31-40	18	13	13	12	9
41-50	3	5	2	3	2
> 50	3	0	1	1	0

XII. CRASH PREDICTION MODELS FOR UN LICENSED MOTOR CYCLE RIDERS BY USING MULTIPLE LINEAR REGRESSION

Multiple Linear Regression equation was developed to predict the fatal, serious and light accidents of Un licensed motor cycle riders from the collected accident data and by using SPSS Software.

The rate of fatal, serious and light accidents is considered as dependent variable and the influencing parameters such as age of the riders (AG), existing road width (RW) and average annual daily traffic (AADT) are considered as independent variables. In unlicensed riders model experience is not included due to there was no data in the traffic police file. In order to explain the severity of fatal, serious and light accidents by un licensed motor cycle riders in Wolaita Zone, graphs are developed correlating the various age groups, traffic volumes and road width as shown in the figures 3 to 5. The rate of fatal, serious and light accidents by unlicensed rider's increases as the traffic volume increases and decreases as the road width and age of the rider's increases.

The following are the models developed to predict the rate of change of motorcycle accidents by unlicensed motor cycle riders in the Wolaita Zone.

$$FAR = 27.15 - 0.282AG - 1.588RW + 0.004AADT$$

$$R^2 = 0.97 \quad F = 158.65$$

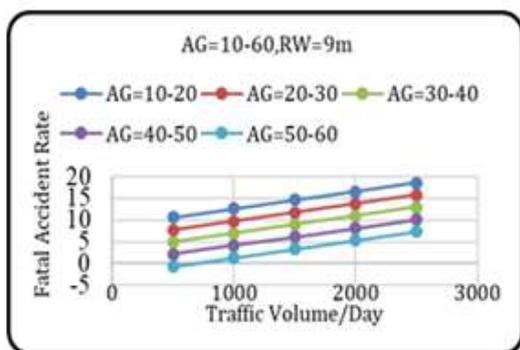


Figure 3. Development of graph for the analysis of various Fatal accidents of Un licensed Riders in Wolaita Zone

From the figure 3, for a road width of 9 m, for a traffic volume of 1000 veh/ day, the number of fatal accidents by un licensed riders were 10 when the motor cycle riders at the age of 20 to 30 years, whereas for the same traffic volume and road width, the number of accidents is limited to 2, when the age of motor cycle riders were in the range of 50 to 60 years. Similarly, for the same road width, as the traffic volume increases to 2000 veh/ day, the number of fatal accidents by un licensed riders are observed to be 14, for the age group of 20 to 30

years and is found to be 6 for the age group of 50 to 60 years.

$$SIAR = 27 - 0.358AG - 1.48RW + 0.005AADT$$

$$R^2 = 0.975 \quad F = 186$$

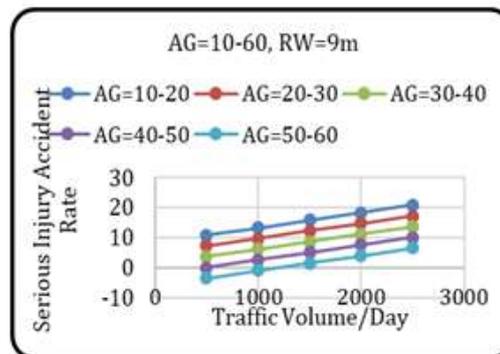


Figure 4. Development of graph for the analysis of various serious injury accidents of Un licensed Riders in Wolaita Zone

From the figure 4, for a road width of 9 m, for a traffic volume of 1500 veh/ day, the number of serious injury accidents by un licensed riders are 13 when the motor cycle riders are at the age of 20 to 30 years, whereas for the same traffic volume and road width, the number of accidents are limited to 2, when the age of motor cycle riders are in the range of 50 to 60 years. Similarly, for the same road width, as the traffic volume increases to 2500 veh/ day, the number of serious injury accidents by un licensed riders are observed to be 18, for the age group of 20 to 30 years and found to be 7 for the age group of 50 to 60 years.

$$LIAR = 23.64 - 0.18AG - 1.45RW + 0.003AADT$$

$$R^2 = 0.98 \quad F = 356$$

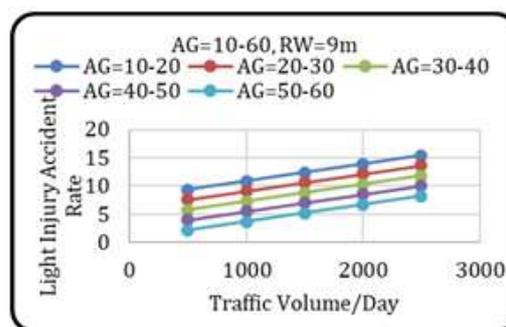


Figure 5. Development of graph for the analysis of various light injury accidents of Un licensed Riders in Wolaita Zone

From the figure 5, for a road width of 9 m, for a traffic volume of 1000 veh/ day, the number of light injury accidents by un licensed riders are 9 when the motor cycle riders at the age of 20 to 30 years, whereas for the same traffic volume and road width, the number of accidents were limited to 4,

when the age of motor cycle riders were in the range of 50 to 60 years. Similarly, for the same road width, as the volume increases to 2000 veh/ day, the number of light injury accidents by un licensed riders were observed to be 12, for the age group of 20 to 30 years and is found to be 7 for the age group of 50 to 60 years.

XIII. CRASH PREDICTION MODELS FOR LICENSED MOTOR CYCLE RIDERS BY USING MULTIPLE LINEAR REGRESSION

Multiple Linear Regression equation is developed to predict the fatal, serious and light accidents of licensed motor cycle riders from the collected accident data and by using SPSS Software. The rate of fatal, serious and light accidents is considered as dependent variable and the influencing parameters such as age of the riders (AG), riders experience (EXP), existing road width (RW) and average annual daily traffic (AADT) are considered as independent variables.

The following are the models developed to predict the rate of change of motorcycle accidents by licensed motor cycle riders in the Wolaita Zone.

$$FAR = 36.95 - 0.113AG - 4.276EXP - 2.05RW + 0.002AADT$$

$$R^2 = 0.96 \quad F = 53$$

In order to explain the severity of fatal accidents by licensed motor cycle riders in Wolaita Zone, different graphs are developed correlating the various age groups, rider's experience, traffic volumes and road width.

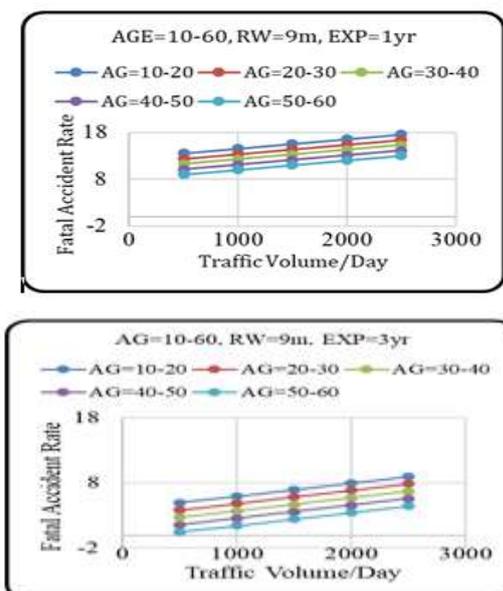


Figure 6. Development of various graphs for the for various fatal accidents of licensed Riders in Wolaita Zone

Figure 6 above indicates that the rate of fatal accidents by licensed riders increases as the traffic volume increases and decreases as the road width, rider's experience and age of the rider's increases. For example, for a road width of 9 m, for a traffic volume of 1000 veh/ day and 1-year experience of riders, the number of fatal accidents by licensed riders are 14 when the motor cycle riders are at the age of 20 to 30 years, whereas for the same traffic volume, riders experience and road width, the number of accidents are limited to 10, when the age of motor cycle riders are in the range of 50 to 60 years. Similarly, for the same road width and the traffic volume, the experience of rider increases to 3 years, the number of fatal accidents by licensed riders are observed to be 5, for the age group of 20 to 30 years and is found to be 2 for the age group of 50 to 60 years.

$$SIAR = 18.36 - 0.141AG - 1.64EXP - RW + 0.002AADT$$

$$R^2 = 0.92 \quad F = 28$$

In order to explain the severity of serious injury accidents by licensed motor cycle riders in Wolaita Zone, different graphs are developed correlating the various age groups, rider's experience, traffic volumes and road width.

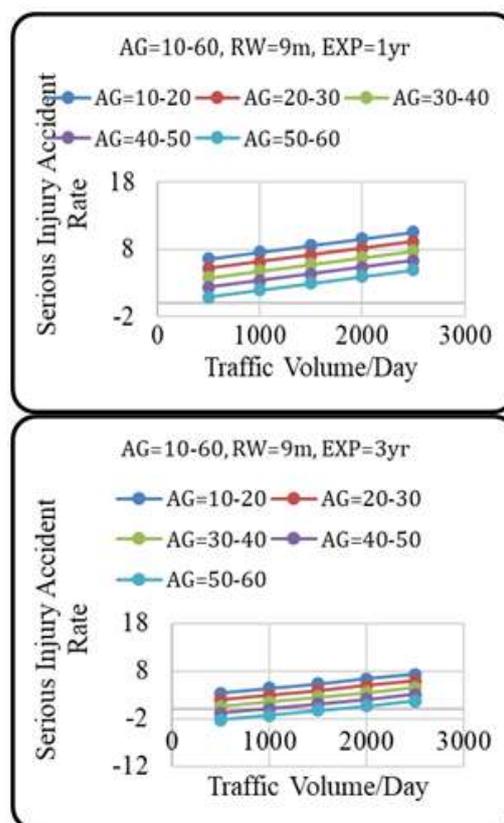


Figure 7. Development of various graphs for the analysis of various serious injury accidents of Licensed Riders in Wolaita Zone

Figure 7 above indicates that the rate of serious injury accidents by licensed riders increases as the traffic volume increases and decreases as the road width, rider's experience and age of the rider's increases. For example, for a road width of 9 m, rider's experience of 1-year, for a traffic volume of 2000 veh/ day, the number of serious injury accidents by licensed riders are 9 when the motor cycle riders are at the age of 20 to 30 years, whereas for the same traffic volume and road width, the number of accidents are limited to 4, when the age of motor cycle riders are in the range of 50 to 60 years. Similarly, for the same road width and traffic volume, as the rider's experience increases to 3 years, the number of serious injury accidents by licensed riders are observed to be 5, for the age group of 20 to 30 years and is found to be 1 for the age group of 50 to 60 years.

$$LIAR = 13 - 0.138AG - 0.624EXP - 0.607RW + 0.002AADT$$

$$R^2 = 0.96 \quad F = 47$$

In order to explain the severity of light injury accidents by licensed motor cycle riders in Wolaita Zone, different graphs are developed correlating the various age groups, rider's experience, traffic volumes and road width.

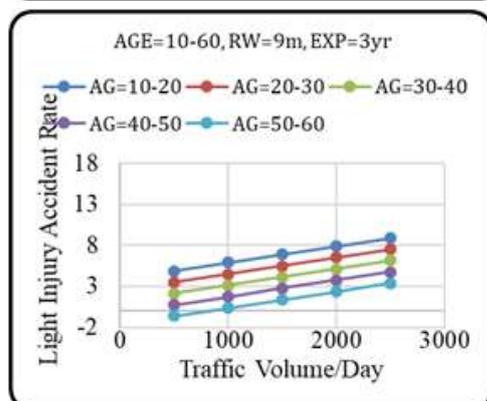
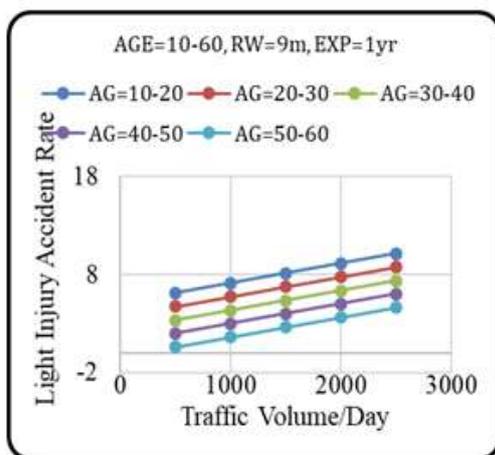


Figure 8. Development of various graphs for the analysis of various light injury accidents of Licensed Riders in Wolaita Zone

Figure 8 above indicates that the rate of light injury accidents by licensed rider's increases as the traffic volume increases and decreases as the road width, rider's experience and age of the rider's increases. For example, for a road width of 9 m, for a traffic volume of 1000 veh/ day and rider's experience of 2-years, the number of light injury accidents by licensed riders are 6 when the motor cycle riders are at the age of 20 to 30 years, where as for the same traffic volume, rider's experience and road width, the number of accidents are limited to 1, when the age of motor cycle riders are in the range of 50 to 60 years. Similarly, for the same road width and rider's experience, as the volume increases to 2000 veh/ day, the number of light injury accidents by licensed riders are observed to be 8, for the age group of 20 to 30 years and is found to be 3 for the age group of 50 to 60 years.

XIV. COMPARISION OF LICENSED AND UNLICENSED RIDERS BASED ON PREDICTED MODELS

Based on the Multiple Linear Regression Modals developed both for Licensed and Un Licensed Motor Cycle riders for the years 2013 to 2017, a comparative table is prepared indicating the severity of fatal, serious injury and light injury accidents by Un Licensed riders as compared to Licensed riders.

The table below summarizes that, the percentage reduction of accidents by Licensed Motor Cycle riders as compared to Un Licensed Motor Cycle riders was calculated for an average age of riders 25, road width of 9 meter, traffic volume of (500, 1000, 1500, 2000) and rider's experience of (1, 2, 3, 4years) and the results are shown in the Table 1 From the table below, it is found that when the Motor Cycle rider average age is 25 years, having an experience of 4 years, with 9 m road width and 500 AADT, the percentage reduction of fatal accidents by Licensed Motor Cycle riders as compared to Un Licensed Motor Cycle riders is 100%, followed by 96.19% for Serious Injury and 65.86% for Light Injury. Similarly, for the same conditions exists with increase in traffic volume to 2000 AADT, the percentage of reduction of fatal accidents by Licensed riders as compared to Un Licensed riders is 79.06%, followed by 77.76% for Serious Injury and 53.75% for Light Injury.

Table 3. Motor cycle Accident Rates for Unlicensed and Licensed riders at road width 9m

AG	EXP	RW	AADT	Unlicensed Riders			Licensed Riders			% reduction of FA	% reduction of SI	% reduction of LI
				FA	SI	LI	FA	SI	LI			
25	1	9	500	8.33	7.2	7.6	12.9	5.20	4.46	-54.81	28.15	41.20
25	2	9	500	8.33	7.2	7.59	8.6	3.56	3.84	-3.20	50.83	49.42
25	3	9	500	8.33	7.2	7.59	4.3	1.92	3.22	48.40	73.51	57.64
25	4	9	500	8.33	7.2	7.59	0	0.28	2.59	100.00	96.20	65.86
25	1	9	1000	10.33	9.7	9.09	13.9	6.20	5.46	-34.52	36.33	39.90
25	2	9	1000	10.33	9.7	9.09	9.6	4.56	4.84	7.09	53.19	46.77
25	3	9	1000	10.33	9.7	9.09	5.3	2.92	4.22	48.71	70.04	53.63
25	4	9	1000	10.33	9.7	9.09	1	1.28	3.59	90.32	86.90	60.50
25	1	9	1500	12.33	12.2	10.6	14.9	7.20	6.46	-20.81	41.17	38.97
25	2	9	1500	12.33	12.2	10.6	10.6	5.56	5.84	14.05	54.58	44.86
25	3	9	1500	12.33	12.2	10.6	6.3	3.92	5.22	48.92	67.99	50.76
25	4	9	1500	12.33	12.2	10.6	2	2.28	4.59	83.78	81.40	56.65
25	1	9	2000	14.33	14.7	12.1	15.9	8.20	7.46	-10.93	44.37	38.27
25	2	9	2000	14.33	14.7	12.1	11.6	6.56	6.84	19.07	55.50	43.43
25	3	9	2000	14.33	14.7	12.1	7.3	4.92	6.22	49.07	66.63	48.59
25	4	9	2000	14.33	14.7	12.1	3	3.28	5.59	79.07	77.77	53.76
Average percentage value										29.01	61.53	49.39

XV. CONCLUSIONS:

Motorcycles are found as the major mode of transportation in the Wolaita zone and their number was increasing rapidly year after year during the period from 2013 to 2017 in rural areas including a large number of urban regions. Most of the riders and their passengers on moving motorcycles were found without helmet. Also, motorcycles were overloaded by more than one passenger. Riders were mostly unlicensed. As a result, road traffic injuries associated with motorcycle crashes were increasing rapidly and most fatalities were on urban and rural roads.

The findings of this study demonstrate motorcycle crash-related injury and death were serious and frequent public health problem in Wolaita zone. Unlicensed riders continue to represent a problem for road safety in Wolaita zone. For instance, when the Motor Cycle riders average age is 25 years, having an experience of 1,2,3 and 4 years, with 9 m road width and 500,1000,1500 and 2000 traffic volume, the average percentage reduction of fatal accidents by Licensed riders as compared to Un Licensed riders is 29%, followed by 61.53% for Serious Injury and 49.4% for Light Injury. The study found that unlicensed riders were a high risk group requiring further attention within the total driving population. As a whole, riders tend to be over represented in more severe road crashes. However, this pattern was particularly the case for unlicensed riders and hence all riders should be licensed.

The study found that the occurrence of fatal, serious injury or light injury accidents were

depending on the riders age and experience of the motor cycle riders and also upon the available road width and traffic volume. The analysis clearly indicated that the rate of accidents increased as the traffic volume increased. Similarly, the rate of accidents was decreased as the rider age, available road width and experience of the motor cycle riders increased. Statistical data indicated the need and advantage of driving license to avoid many types of accidents both on highways and urban roads.

XVI. RECOMMENDATIONS:

- ✓ Stringent rules and regulations are to be implemented by the enforcement authorities
- ✓ Driving licenses of all motorized riders are to be strictly verified time to time by the traffic police
- ✓ Vigilance by the traffic police should be increased on to the drivers of age group 20 to 35 years
- ✓ Attention by the Road Transport Authorities has to be further increased in Wolaita Zone by full-fledged checking before sanctioning the licenses for the motor cycle riders

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