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# Assessment of motorcycle crashes in South Omo Zone, Ethiopia

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**Abstract**
The main objective of this study is to assess the magnitude and factors associated with motorcycle crashes in the south Omo zone, Ethiopia. Four-year police-reported crash data included reports from (January 2014 to December 2017) about motorcycle crashes was conducted from records of four police stations of south Omo zone. First, descriptive statistics were used by using frequency distribution and percentages. Multinomial logistic regression model was used for analyses. The results indicate that a total of two hundred six motorcycle crashes have been registered in four police stations throughout the study year. The gender proportion of motorcycle crashes were happened by male riders only. The result of multinomial logistic regression model reveals that, severity of motorcycle crash increase with riders age of below 18 and between 31-50; low education level (5 to 8); insufficient riding experience (over 2 to 5); owners of motorcycle; long service year of motorcycle (over 5 to 10) and motorcycle with sudden mechanical problems are the main determinant factors for the occurrence of motorcycle crashes. Based on the study, among others, the most important factors for motorcycle crashes were failure to give priority for pedestrians, careless riding, over speeding and violating traffic rules.

**Keywords:** Motorcycle, crashes, magnitude, risk factors, South Omo Zone, Ethiopia

## 1. Introduction
Road traffic crashes have a significant impact on social, economic and public health sectors in Ethiopia. The data from world health organization report shows that low and middle-income countries bear the greatest burden of road traffic fatalities and injuries, which is ranked as the eighth leading cause of death for people of all age groups. Moreover, the report further stated that, in southeast Asia and the western pacific, the majority of deaths are among riders of motorized two and three-wheelers which represent 43% and 36% of all death respectively [1].

This fact suggests that the road traffic death rate in those countries had twice compared with high-income countries [2]. Nowadays, as a whole road traffic death becomes an embryonic major public health alarm and hinders the economic and social development of the country and affects thousands of lives, resulting in severe injuries [3]. In fact, several pieces of evidence from many studies show that most of the motorcycle crashes occur due to motorcycle rider error [4, 5]. According to the [6] data published in 2017, road traffic death in Ethiopia is reached almost 27,140 of total death including motorcyclists and the age-adjusted death rate is 36.36 per 100,000 of population [6]. According to [7], a study in Tanzania shown that motorcycles were the leading cause of road traffic crashes.

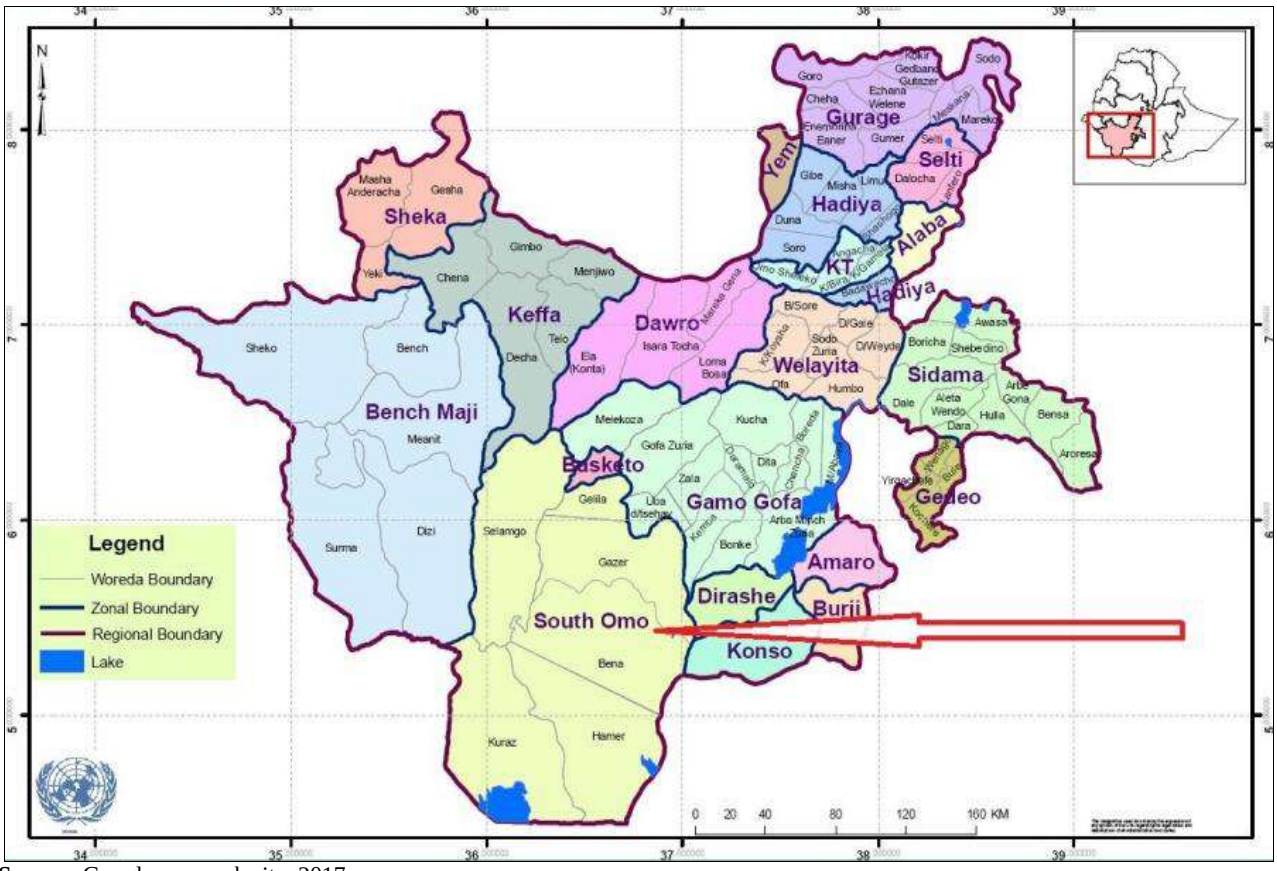
A recent study conducted on road traffic crashes reported that almost 40% and 31.2% of road traffic injury on both Arbaminch and wolayta city respectively, were in motorcycles [8]. In addition to these, the study conducted on Bahir Dar, Ethiopia among 524 road traffic injuries, 108 and wolayta zone, SNNPR of Ethiopia among 240 road traffic injuries, 75 were due to motorcycle crashes [9]. Due to rapid motorization and urbanization, most of the rural and urban communities have used this mode of transport for a daily activity without due training [10].

The study carried out in Mekelle city, northern Ethiopia reported that road traffic crash affects not only south economy but also it is a human security threat in developing countries [11]. A recent study conducted in Cambodia, found that overall road traffic fatality is increased by 23% from 2007 to 2011. However, among the dead in 2011, 88% were occurred in vulnerable road user like motorcyclist (66%) [12].

## 2. Materials and Methods

### 2.1 Description of the study area

The study area is located in south omo zone. It is located in the Ethiopian Southern Nations, Nationalities and Peoples' Region (SNNPR). Its administrative city is Jinka, which is seven hundred fifty (750 Km) from Addis Ababa (capital city of Ethiopia) and five hundred thirty (530 Km) from Hawassa, which is main region of southern nation's nationality and peoples region (SNNPR) of Ethiopia and also it is bordered on the south by Kenya, on the southwest by the Elemi Triangle, on the west by Benchi Maji, on the northwest by Keffa, on the north by Konta, Gamo Gofa, and Basketo, on the northeast by Dirashe and Konso, and on the east by the Oromia region.




**Source:** Google map web site, 2017

**Fig 1:** Map of the study area with Southern Nations, Nationalities, and People's regions of Ethiopia.

### 2.2 Study Design

Descriptive cross-sectional study was conducted in south omo zone, Ethiopia and included all recorded motorcycles crashes on relevant police reports obtained from four main police stations in South Omo zone that include reports from January 2014 to December 2017. The register covers only motorcycle crashes occurring within the south omo zone.

### 2.3 Data collection procedure and source of data

The secondary data were collected from, south omo zone from selected traffic police offices (SOZTPO) which is from prepared data record checklist book, road, and transport development department (RTDD) and also central statistical Authority (CSA), as well as other information sources.

### 2.4 Method of data Analysis

Multinomial logistic regression model was used to assess the association between the dependent and independent variables, outcome of motorcycle crashes with demographic characteristics related to motorcycle riders such as age, sex, educational background, riding experience and rider motorcycle relationship and cause of the accident road user, road condition, weather condition, light condition, motorcycle year of service. At Initial level, odds ratio (OR) and corresponding confidence intervals i.e. (95% CI) were used to assess the relationships between dependent and independent variables. If P-values less than 0.05 ($P<0.05$) were considered statistically significant

## 3. Result and Discussion

### 3.1 Demographic characteristics of the motorcycle riders

There are no crashes that happened through females at all during the four years' period. This study finding shows that almost males are more frequently affected by motorcycle crashes than females in the study area. However, the male predominance in motorcycle crashes was previously reported by many studies [12, 13]. In addition to this, the present study findings show that male riders are found to involved in most crashes but are significant risk factors in fatal, serious and slight crashes compared to females, which is implied that men have riskier behaviors compared to women. This finding is also consistence with the investigations done on Iran [14]. Moreover, the other findings from studies conducted in Cambodia found that males are much more likely to die in motorcycle crashes roughly seven times more frequently than females [12]. However, the reason for the predominance might be the fact that males are more likely involved in this type of occupation than females which were seen from the real world.

**Table 1:** Frequency distribution of age of riders involved in motorcycle crashes in police traffic offices of South Omo Zone from January 2014-December 2017.

| Age of riders | Frequency | Percent (%) |
|---|---|---|
| Below 18 | 32 | 15.5 |
| Between 18-30 | 111 | 53.9 |
| Between 31-50 | 40 | 19.4 |
| 51 and above | 9 | 4.4 |
| unknown | 14 | 6.8 |
| Total | 206 | 100.0 |

The finding of this study shown that more than half of the motorcycle crashes, were caused by between 18-30 years of age, in line with this finding, this age group was the most affected age group not only for motorcycle crashes but also other motorized vehicle crashes.

**Table 2:** Frequency distribution of rider's education level involved in motorcycle crashes in police traffic offices of South Omo Zone from January 2014-December 2017.

| Education level | Frequency | Percent (%) |
|---|---|---|
| 0-4 | 36 | 17.5 |
| 5-8 | 110 | 53.4 |
| 9-10 | 12 | 5.8 |
| 11-12 | 14 | 6.8 |
| Above 12 | 14 | 6.8 |
| Unknown | 20 | 9.7 |
| Total | 206 | 100.0 |

Multinomial logistic regression is used when the dependent (response) variable is categorical. For crash severity (fatal, serious injury, slight injury and property damage) as the dependent variable, twelve independents (explanatory) variables were selected from the data set. The severity indicators, that is, number of fatalities, number of injuries such as serious and slight injuries and property damage, are studied with multinomial logistic regressions.

**Table 3**: Results of multinomial logistic regression on crash severity Source: Own survey from multinomial logistic regression Output.

| Explanatory variables | | Motorcycle crashes severities | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fatal | | | | serious injury | | | | Slight injury | | | |
| | | B | Std. error | sig. | Exp(b) | B | std. error | sig. | Exp(b) | B | std. error | sig. | Exp(b) |
| Age | Below 18 | | | | | | | | | 3.19 | 1.54 | 0.038* | 24.25 |
| | 18-30 | | | | | | | | | | | | |
| | 31-50 | | | | | | | | | 3.98 | 1.62 | 0.014* | 53.25 |
| | Above 50 | | | | | | | | | | | | |
| | unknown | | | | | | | | | | | | |
| Education level | 0 to 4 | | | | | | | | | | | | |
| | 5 t0 8 | | | | | 2.19 | 1.02 | 0.03* | 8.98 | | | | |
| | 9 to10 | | | | | | | | | | | | |
| | 11 to12 | | | | | | | | | | | | |
| | Above 12 | | | | | | | | | | | | |
| | Unknown | | | | | | | | | | | | |
| Experience of riders | 0 to 2 | | | | | | | | | | | | |
| | Over 2 to 5 | -3.38 | 1.636 | 0.039* | 0.034 | | | | | | | | |
| | Over 5 to 10 | | | | | | | | | | | | |
| | 11 and Above | | | | | | | | | | | | |
| | Unknown | | | | | | | | | | | | |
| Relationship with motorcycle | Hired | | | | | | | | | | | | |
| | Owner | 3.52 | 1.686 | 0.037* | 33.65 | 2.37 | 1.21 | 0.05* | 10.7 | | | | |
| | unknown | | | | | | | | | | | | |
| | other** | | | | | | | | | | | | |
| Service of motorcycle | 0 to 1 | | | | | | | | | | | | |
| | Over 1 to 2 | | | | | | | | | | | | |
| | Over 2 to 5 | | | | | | | | | | | | |
| | Over 5 to10 | 3.56 | 1.809 | 0.049* | 35.31 | | | | | | | | |
| | Above 10 | | | | | | | | | | | | |
| | Unknown | | | | | | | | | | | | |
| Motorcycle defects | yes | | | | | -3.23 | 1.02 | 0.002* | 0.04 | | | | |
| | No | | | | | | | | | | | | |

Overall P value less than (**$p$<0.05) and **Friends, relatives. According to Table 3 from multinomial logistic regression output, the results of the present study also revealed that the educational status of the rider was a predictor of motorcycle crashes. This finding was in agreement with previous studies on road traffic collision in Ethiopia and other studies in low and middle-income countries like Kenya [15]. This might lead to, poor knowledge of traffic signs on the road and violating traffic rules and regulations were also found to be a significant factor responsible for high rates of crashes among motorcycle riders. Furthermore, findings from other study revealed that riders with higher education level were the groups that were not at fault of crashes compared with those with low education levels [14]. This might be attributed to the fact that because individuals with low education levels have usually less knowledge of traffic rules and regulations

**Table 4**: Frequency distribution of experience of riders involved in motorcycle crashes in police traffic offices of South Omo Zone from January 2014-December 2017

| Experience of riders | Frequency | Percent (%) |
|---|---|---|
| 0 to 2 | 33 | 16 |
| over 2 to 5 | 114 | 55.3 |
| over 5 to10 | 15 | 7.3 |
| 11 and above | 14 | 6.8 |
| Unknown | 30 | 14.6 |
| Total | 206 | 100.0 |

The present findings show that the riding experience of motorcycle riders on the road have an indirect relationship with fatal crashes. However, an increase in the riding experience of riders over two to five years of the riding experience is expected to reduce the relative log odds of fatal crash by 3.38. This result is indirectly suggesting that the other experienced riders and unknown experienced riders in all crash at all severity levels. This finding is parallel with the finding from Ethiopia [16]. In addition to this, the present study findings also revealed that, riding experience was also the other determinant factor for motorcycle crashes and almost above half of total crashes. From the results, it was clear that the majority of riders are just been recent in motorcycle riding. This may be as a result of economic hardship and the increase in the rate of unemployment. This study is inconsistence with the result of other studies found from Kenya which is 47.6% occurs over one to two years of riding experience followed by over three to four (3 to 4) years of riding experience [17]. This might be due to insufficient skills to control motorcycles for those who have not sufficient experience in riding.

**Table 5:** Frequency distribution of rider's motorcycle relationship involved in motorcycle crashes in police traffic offices of South Omo Zone from January 2014-December 2017

| Rider motorcycle relationship | Frequency | Percent (%) |
|---|---|---|
| Hired | 51 | 24.8 |
| Owner | 112 | 54.4 |
| Unknown* | 24 | 11.7 |
| Other** | 19 | 9.2 |
| Total | 206 | 100.0 |

*Riders who are neither hired nor owners and **Friends, relatives of the owner, ranted.

The result of this study also revealed that the relation of the motorcycle rider with the motorcycle is a significant factor with the 'other (like friends, relative)' set as a reference. This factor indicates that the relative log odds increased by 3.52 for fatal crashes and 2.37 for serious crashes. This suggests that the severity of crashes increased when a motorcycle was ridden by the owner rather than others like relatives or friends. This finding is inconsistence with the study conducted on Nairobi and found that 73.7% of motorcycle crashes were happened by hired riders [18]. Mostly, this might be, the owners of the motorcycle are over confidential to ride their motorcycle and assumes them just like skilled and experienced riders and finally leads to crash without any care. In addition to this, the finding of this study also revealed that rider versus motorcycle relationship, motorcycle crashes were common among owner ones than hired riders. This is due to most of the motorcycle riders in the area have their own motorcycles which are used for their commercial transport purposes. This finding is consistency with the study conducted in Nigeria, 43.6% [19]. And, the possible reason might be the general increase in the use of motorcycles for commercial transport purposes. This could be the number of motorcycles in this area could be greater compared with our country.

### 3.2 Vehicle (motorcycle) related factors

**Table 6:** Frequency distribution of Motorcycle factors involved in motorcycle crashes in police traffic offices of South Omo Zone from January 2014-December 2017.

| Service of a Motorcycle (Years) | Frequency | Percent (%) |
|---|---|---|
| 0 to 1 | 23 | 11.2 |
| over 1 to 2 | 62 | 30.1 |
| over 2 to 5 | 46 | 22.3 |
| over 5 to10 | 20 | 9.7 |
| 11 and above | 6 | 2.9 |
| Unknown | 49 | 23.8 |
| **Motorcycle defects** | | |
| Yes | 34 | 16.5 |
| No | 172 | 83.5 |

The log odds of a fatal crash with a motorcycle of over five to ten years' service is increased by 3.564 with the odds ratio of 35. 313. This result shows that the risk of motorcycle crashes is fortunate for those motorcycles which have the service years of over five to ten years. However, the service year of a motorcycle is also showing a significant difference with the occurrence of crashes using a one-way analysis of variance. In fact, the number of service years of motorcycle increases, the condition (performance) of the vehicle (motorcycle) is also decreased. This could be due to a lack of maintenance or on-time service within an important period. the result shows that motorcycle which has defects or mechanical problem was a significant factor for serious crashes and the relative odd ratio of serious crashes than a motorcycle with no defects is 0. 040. Thus,

this result shows that motorcycle with a mechanical problem or any problem has increased serious crashes unless the immediate measurement is implied. On the other hand, motorcycles with no defects or mechanical problems contribute less involvement in the severity of traffic crashes. In addition to this, a motorcycle with the mechanical problem is associated with a relative log odd of 3.23 and this revealed that decrease being in a serious crash than property damage. However, the presence of motorcycle defects or mechanical problems has a significant effect in reducing the severity of traffic crashes. This finding is in line with that of studies conducted in Nigeria and Iran found that sudden mechanical defects lead to crashes especially on commercial motorcycles [5].

### 3.3 Environmental factors

The result of the descriptive analysis shows that a large number of crashes happened by dry air condition 179 (86.9%) followed by Moisture 19 (9.2%). This might be due to several factors like over speeding, overtaking other vehicles, careless riding and so on; that the riders take under dry air condition. The present study findings show that riding on weather conditions shows statically significance difference with the occurrence of motorcycle crashes. This study is also revealed that almost one hundred seventy-nine (86.9%) of the motorcycle crashes were happened in the dry air condition during four years followed by the moisture, accounted nineteen (9.2%). This finding is consistent with the group of other studies reported from Sweden, New Zealand and southeastern Iran [20].

Concerning the light condition, almost 108 (52.4%) of the crashes happened during Nighttime and 98 (47.6%) of crashes happened during day time. Of course, the visibility state at the time of the crash can be influenced by the lighting condition of the roads. However, a researcher of this study observed from the study area is that most of the time, commercial motorcycle riders run their business at night time and carry two or more than two passengers including them at a time to get additional coinage. The finding of this study revealed that more motorcycle crashes happened in the night time and shows statically significance difference with the occurrence of motorcycle crashes. This finding is similar with other studies reported from Northern Laos [21] and in contrast, studies found from Ethiopia and Rwanda showed that motorcycle crashes most of the time happened at the day time [22].

The majority of motorcycle crashes, happened on a gravel road. This could be observed visually by the author of this study and fact from the data collected from police stations revealed that most of the road surface in the study area is gravel road compared to another type of pavements. Gravel type of road is not comfortable especially for a motorcycle rather than other motorized vehicles. Unlike other studies found from Sweden and Ethiopia [4]. This finding is consistent with previous studies from Kenya and Malaysia found that rainy season was one the main factor to increase the motorcycle crashes, which happened in rainy weather condition were due to difficulties to control motorcycles [23]. Moreover, this finding explained that road and weather conditions are considered to greatly influence the motorcycle rider behavior on the traveling road. Moreover, this finding explained that road and weather conditions are considered to greatly influence the motorcycle rider behavior on the traveling road. The majority of severity crashes happened by motorcycles with pedestrian and rollover. The reason for those severities is attributed to failure to give priority, careless riding and were over speeding which was shown on Table 7. This finding is almost similar to the recent finding conducted by [16].

**Table 7:** Frequency distribution of Environmental factors involved in motorcycle crashes in police traffic offices of South Omo Zone from January 2014-December 2017.

| | Frequency | Percent (%) |
|---|---|---|
| **Road condition** | | |
| Dry | 179 | 86.9 |
| Moisture | 19 | 9.2 |
| Muddy | 8 | 3.9 |
| **Light condition** | | |
| Daytime | 98 | 47.6 |
| Nighttime | 108 | 52.4 |
| **Surface type** | | |
| Asphalt road | 64 | 31.1 |
| Gravel road | 92 | 44.7 |
| Earth road | 50 | 24.3 |
| **Weather condition** | | |
| Good | 91 | 44.2 |
| Rainy | 100 | 48.5 |
| Other* | 15 | 7.3 |
| **Cause of crashes** | | |
| Over speeding | 54 | 26.2 |
| Failure to give priority for pedestrian | 68 | 33.0 |
| Careless riding | 64 | 31.1 |
| Follow to closely | 13 | 6.3 |
| Overtaking other Vehicles | 7 | 3.4 |
| **Type of Severity** | | |
| Rollover | 53 | 25.7 |
| Motorcycle with Motorcycle | 21 | 10.2 |
| Motorcycle with another vehicle | 29 | 14.1 |
| Motorcycle with pedestrian | 76 | 36.9 |
| Motorcycle with fixed objects | 15 | 7.3 |
| Other** | 12 | 5.8 |

***Cloudy, Windy and ****with animals

### 3.4 The magnitude of motorcycles crashes in south Omo Zone

**Table 8**: The type of road users Injured by Motorcycle crashes

| No. | Peoples injured | Fatal | Serious injury | Slight injury | Total | Percent (%) |
|---|---|---|---|---|---|---|
| **1** | Motorcycle riders | 17 | 26 | 11 | 54 | 30.86 |
| **2** | Pedestrians | 15 | 53 | 35 | 102 | 58.29 |
| **3** | Passengers | 4 | 9 | 6 | 19 | 10.80 |
| | Total | 36 | 88 | 52 | 175 | 100 |

This finding is inconsistent with the finding from Rwanda which is found that about motorcycle rider (46.8%)and pedestrian (28.6%) [31].

This finding is similar to the report from world health organization (2015) literature stating pedestrians are the most victimized by road traffic crashes. This revealed more focus on the attitudes of pedestrians, design of roads in addressing pedestrian facilities.

**Table 9**: Frequency distribution of Motorcycle crash victims between four police stations of South Omo Zone, Ethiopia from January 2014 to December 2017.

| Year | Frequency of victims | Percent (%) |
|---|---|---|
| January 2014 - December 2014 | 28 | 16 |
| January 2015- December 2015 | 30 | 17.05 |
| January 2016- December 2016 | 43 | 24.57 |
| January 2017- December 2017 | 74 | 42.05 |

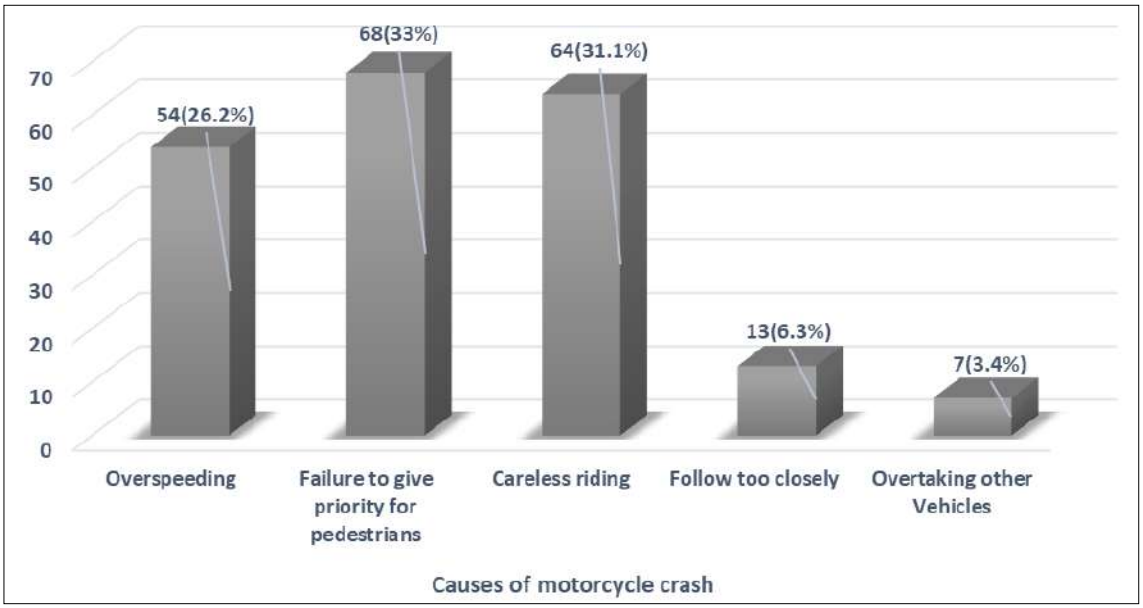



**Figure 2**: Distribution of Motorcycle crashes by causes in woredas of south Omo zone traffic police offices from (January 2014-December 2017).

These finding is also in agreement with the finding from southeast Iran in which human factors like careless riding, violating traffic laws and speeding were the most important causal factors accounting for 90% of motorcycle crashes [7].

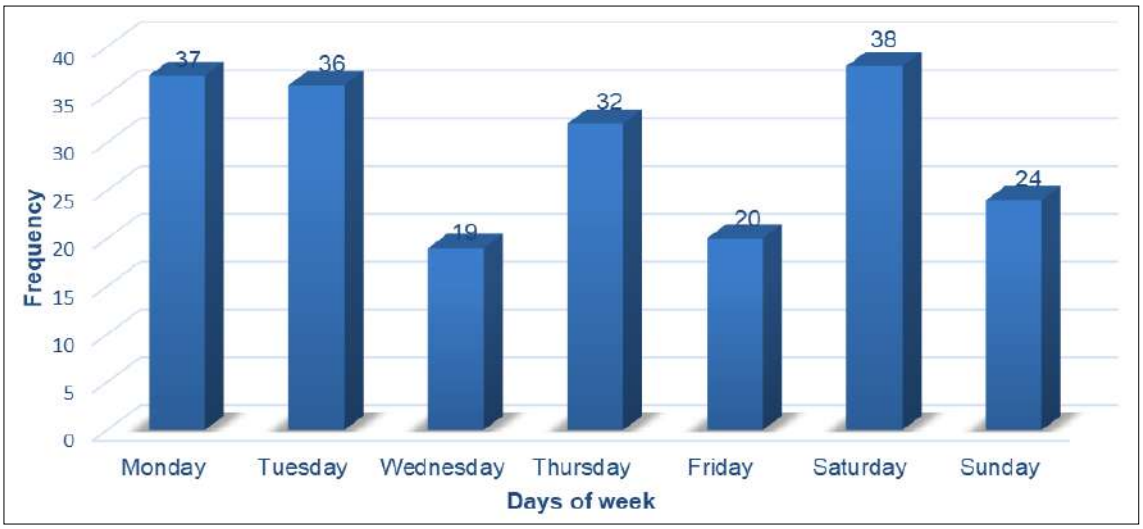



**Fig 3**: Distribution of motorcycle crashes happened by day of the week in police traffic offices of south Omo zone (January 2014 to December 2017)

Actually, Saturday and Monday are the two main market days in the study areas specially Jinka and Debub Ari towns. During these days, the number of other motorized and non-motorized traffic like carts as well as the number of pedestrians coming from a nearby rural area is high

## 4. Conclusion

Overall, the trend of motorcycle crashes from (January 2014 to December 2017) showed increasing patterns for both fatal and non-fatal crashes. However, the finding of the study indicated that motorcycle riders are the primarily responsible factors to cause motorcycle crashes than vehicle (motorcycle) and environmental factors. Most of the motorcycle crashes occurred by motorcycle riders' fault. The highly significant factors determined to increase the severity of motorcycle crashes are determined to be male riders with the age of below 18 and 18-30 years, education level specifically with five to eight; riding experience of over to two to five years and owners of the motorcycles. As most of the severity of motorcycle crashes happened by motorcycle with pedestrians. Most of the motorcycle crashes occurred by riders' errors like failure to give priority, careless riding and over speeding were the main cause leads to crashes.

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## 6. Conflict of Interest

There is no conflict of interest

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