

Trends and Determinants of Road Traffic Accident Human Death in Kembata Tembaro Zone, SNNPR, Ethiopia

Adinew Handiso^{1,*}, Gizachew Gobebo Mekebo², Agassa Galdassa²

¹Department of Statistics, Wachamo University, Hossana, Ethiopia

²Department of Statistics, Ambo University, Ambo, Ethiopia

Email address:

adinew.handiso@yahoo.co.uk (Adinew Handiso)

*Corresponding author

To cite this article:

Adinew Handiso, Gizachew Gobebo Mekebo, Agassa Galdassa. Trends and Determinants of Road Traffic Accident Human Death in Kembata Tembaro Zone, SNNPR, Ethiopia. *Science Journal of Applied Mathematics and Statistics*. Vol. 10, No. 5, 2022, pp. 85-89. doi: 10.11648/j.sjams.20221005.11

Received: September 9, 2022; **Accepted:** October 19, 2022; **Published:** October 27, 2022

Abstract: Globally, annually about 1.35 million people have unnatural deaths and 20 to 50 million people suffer from non-fatal injuries due to road traffic injuries. The road traffic accident contributes to poverty by causing loss of productivity, material damage, injuries, disabilities, grief, and deaths. The aim of this study was to examine trends and identify determinants of road traffic accidents human death in Kembata Tembaro zone, SNNPR, Ethiopia. A retrospective cross-sectional study design was employed. Both primary and secondary data were used. The Count models such as Poisson, Negative Binomial and Conway- Maxwell Poisson regression were applied and based on AIC and BIC, Negative Binomial model found to be best model. A total of 284 road traffic accidents have occurred in Kembata Tembaro zone from 2017 to 2020, which resulted in 169 lives loss and 232 serious and minor injuries. The study found that type of vehicle, collision type, driver error, weather condition, and light condition were significantly associated with expected number of persons to die in road traffic accidents. Overturning (IRR=1.885; 95% CI: 1.544 - 2.165) and right angle (IRR=0.658; 95% CI: 0.298 -0.957) as a collision type, inexperience (IRR=1.454; 95% CI: 1.04 - 2.227) and too fast (IRR=1.789; 95% CI: 1.149 - 2.785) as driver errors, motor cycle (IRR=1.453; 95% CI: 1.095-1.674) as type of vehicle, fog (IRR=1.520; 95% CI: 1.095 - 2.321) and rain (IRR=1.541; 95% CI: 1.045- 2.513) as weather condition, and day light (IRR=0.948; 95% CI: 0.676 - 0.990) as light condition were determinants of expected number of persons to die in road traffic accidents in Kembata Tembaro Zone, SNNPR, Ethiopia. Thus, awareness creation has to be made regularly to all parts of society regarding road traffic accident which results in loss of human lives and damage of property. Traffic police should give special attention to drivers who have no experience of driving, and to those who drive too fast. The drivers should be cautious when the weather condition is rainy and/or fog.

Keywords: Road Traffic Accident Human Death, Negative Binomial Regression Model, Kembata Tembaro Zone

1. Introduction

Road traffic accident includes collisions between vehicles, vehicles and pedestrians, and vehicles and animals or fixed obstacles [1]. It contributes to poverty by causing loss of productivity, material damage, injuries, disabilities, grief, and deaths [2]. Globally, annually about 1.35 million people have unnatural deaths and 20 to 50 million people suffer from non-fatal injuries due to road traffic injuries [3].

The road traffic accidents are leading cause of death for children and young adults aged 5-29 years. It causes

considerable economic losses to individuals, their families, and to nations as a whole [3, 4]. According to 2011 WHO report, the number of road traffic accidents in Ethiopia was 22786 which accounted for 2.77% of all the deaths in the country. Ethiopia stands 12th in road traffic accidents in the world [5].

Annually about 90% of road traffic deaths occur in low and middle income. The road traffic crashes are the worst in low and middle income countries, which result in around 3% loss of

GDP [6]. The WHO African Region has highest road fatality rates of all WHO regions, which is 26.6/ 100000 population relative to global rate of 17.5/100000 population. The Region owning only 2% of the world's vehicles, it contributes 16% to the worldwide deaths. The region will continue to have the highest road traffic death rates due to high rate of urbanization and motorization but lagging road infrastructural development as well as poor road and vehicles' safety [7].

Ethiopia, in Africa, is one of countries with high road traffic accidents. The road traffic accidents in Ethiopia is high costing about 0.8% - 0.9% of the GDP for the past consecutive years [8, 9]. The road traffic accident in Ethiopia is in high rate due to poor road infrastructure, poor traffic laws enforcement and other additional factors. The Poor quality of vehicles and the lower road safety are determinant factors of road traffic accidents in Africa in general and in Ethiopia particularly [5, 10, 11]. The road traffic accidents have been killing and making many individuals disabled [3]. It is good to collect relevant, accurate, and timely data analyse periodically to examine scope, trends, and severity of the road traffic accident and its consequences, and come up with possible solutions. Thus, this study aimed to examine trends and identify determinants of road traffic accident human death in Kembata Tembaro zone, SNNPR, Ethiopia. This study will have significant contribution to fill the lack of the data and provide information on determinants road traffic accidents human deaths.

2. Methods

2.1. Study Design and Data Source

The study was retrospective cross-sectional study conducted from January 2017 to June 2020. And, the data were obtained from both Primary and Secondary sources.

The secondary data were obtained from Kembata Tembaro zone traffic police office's documents.

2.2. Data Analysis Methods

Count regression models namely; Poisson, Negative Binomial (NB) and Conway Maxwell-Poisson (CMP) regression models were applied to identify determinants of road traffic accident death in Kembata Tembaro zone. Akaike information criterion (AIC) and Bayesian information criterion (BIC) were used to compare the candidate models, and the model with the smallest AIC and BIC value is considered as a better fit [12-15]. The data was analyzed by STATA software.

2.3. Study Variables

Response variable was number of persons died in road accidents from 2017 to 2020, and predictor variables included in the study were vehicle type, collision type, weather condition, driver error, and light condition.

3. Results and Discussion

3.1. Descriptive Analysis Result

There have been a total of 284 road traffic accidents which killed 169 people, in terms of gender, males constituted 130 (76%) and females 39 (24%), and 232 different levels of injury: serious injury of 172 (74.2%) males and 60 (25.8%) females, minor injury of 258 with 176 (68.2%) males and 82 (31.8%) females while property damage as a result of the crashes without including costs of injuries for road users was estimated to over 11 million birr in Kembata Tembaro zone from 2017 to 2020. Yearly, on average 71 road accidents occur resulting in average 43 lives lost (Table 1).

Table 1. Road traffic accident and its outcomes in Kembata Tembaro Zone from 2017 to 2020.

Year	Number of accidents	Accidents outcomes	Road traffic accidents outcomes			Estimated cost
			Male	Female	Total	
2107	104	Death	33	11	44	2,085,720
		Serious Injury	40	9	49	
		Minor Injury	72	27	98	
2018	67	Death	28	9	37	3,329,050
		Serious Injury	39	11	50	
		Minor Injury	40	15	55	
2019	63	Death	25	5	30	2,846,183
		Serious Injury	35	25	60	
		Minor Injury	30	19	49	
2020	50	Death	44	9	58	3,373,000
		Serious Injury	58	13	71	
		Minor Injury	34	21	55	
Total	284	-	478	174	652	11,633,953

3.2. Trends of Road Traffic Accidents and Human Deaths in Kembata Tembaro Zone

The number of road traffic accidents in Kembata Tembaro Zone decreased from year to year, from 2017 to 20120. It

decreased by about half from 104 in 2017 to 50 in 2020 (Figure 1). Regarding death, the number of road traffic accidents human deaths decreased from 44 in 2017 to 30 in 2019, but it raised to 58 in 2020 (Figure 2).

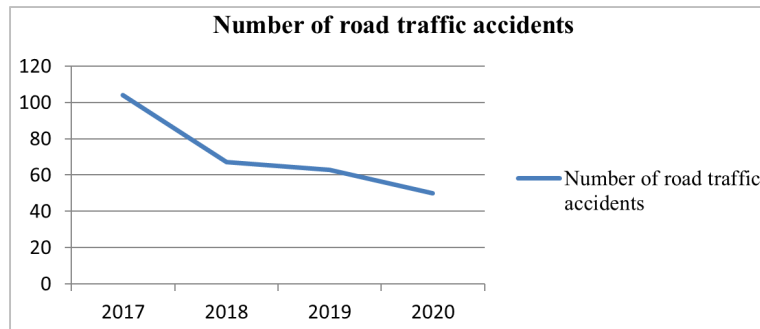


Figure 1. Trends of road traffic accidents in Kembata Tembaro, SNNPR, Ethiopia.

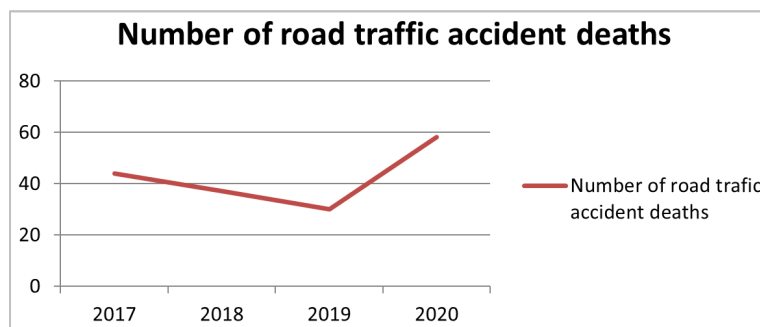


Figure 2. Trends of road traffic accident human deaths in Kembata Tembaro Zone, SNNPR, Ethiopia.

3.3. Model Comparison

As Negative Binomial model has smallest values of the AIC and the BIC, it best fits the data as compared to the other models (Table 2).

Table 2. Model comparison.

Model	AIC	BIC
Poisson model	2342.22	2140.98
Negative Binomial model	1961.70	1858.86
Conway Maxwell-Poisson model	2205.14	2103.91

3.4. Results of the Negative Binomial Regression Model

Table 3 revealed that estimated rate of number of persons died in road accidents were significantly associated with type of vehicle, collision type, driver error, weather condition, and light condition. The estimated number of persons died in road traffic accidents was statistically positively associated with overturn for the collision type. Contrary, right angle collision was negatively associated with estimated number of persons died in road traffic accidents. The number of persons died in road traffic accidents for overturn collision was 1.885 (95% CI: 1.544 - 2.165) times higher compared to hit off road collision, whereas the number of persons died in road traffic accidents in right angle collision was 0.658 (95% CI: 0.298 - 0.957) times lower compared to hit off road collision.

For variable driver error, inexperience of drivers, and too fast with IRR 1.454 (95% CI: 1.04 - 2.227) and 1.789 (95% CI: 1.149 - 2.785) respectively were significantly associated with the number of persons killed in road traffic accidents. The number of persons died in road traffic accidents due to

drivers inexperience was 1.454 times higher compared to drivers loss control and it was 1.789 times higher with too fast driving compared to loss control. The motor cycle had also significant contribution in the number of persons died in road accidents with IRR of 1.453 (95% CI: 1.095-1.674) indicating the number of persons died in road accidents was 1.453 times higher with motor cycle compared to other cars.

Furthermore, fog and rain with the IRR of 1.520 (95% CI: 1.095 - 2.321) and 1.541 (95% CI: 1.045- 2.513) respectively were statistically positively associated to the number of persons died in road traffic accidents. The number of persons died in road traffic accidents that occur in fog was 1.520 times higher compared to when the weather is other and it was 1.541 times higher with rain compared to other weather condition. From variable light condition, day light condition with IRR 0.948 (95% CI: 0.676 - 0.990) was significantly associated with the number of persons died in road traffic accidents indicating the number of persons killed in road traffic accidents that occur in day was 0.948 times lower compared to the night street light on.

Table 3. Negative Binomial Regression Model result for factors associated with number of road traffic accident deaths in Kembata Tembaro Zone, SNNPR, Ethiopia.

Covariates	Category	Estimates	SE	IRR	Df	P-Value	95% CI for IRR	
							Lower	Upper
Collision Type	Intercept	-.579	.4702	.560	1	.218	.223	1.408
	Overturn	.823	.3525	1.885	1	.017	1.544	2.165
	Rear-end	.228	.3554	1.256	1	.521	.626	2.522
	Ran off	-.027	.3778	.973	1	.943	.464	2.041
	Sideswipe	-.048	.3738	.953	1	.898	.458	1.983
	Right angle	-.418	.4053	.658	1	.023	.298	.957
	Head on	.251	.4230	1.286	1	.553	.561	2.946
	Hit on road	-.715	.4542	.489	1	.116	.201	1.192
	Hit off road	0 ^a	.	1	.	.	.	.
Driver error	Inexperience	.374	.2176	1.454	1	.006	1.04	2.227
	In at tent	.230	.2309	1.259	1	.319	.800	1.979
	Too fast	.581	.2259	1.789	1	.010	1.149	2.785
	Too close	.626	.2403	1.870	1	.193	1.168	2.995
	No signal	.326	.2400	1.385	1	.174	.866	2.217
	Loss control	0 ^a	.	1	.	.	.	.
Type of vehicle	Motor cycle	.343	.1900	1.453	1	.023	1.095	1.674
	Minibus	.128	.2060	1.137	1	.533	.759	1.702
	Pickup	-.099	.2521	.905	1	.693	.552	1.484
	Car	0 ^a	.	1	.	.	.	.
Weather condition	Clear	.206	.2014	1.228	1	.307	.828	1.823
	Fog	.419	.2160	1.520	1	.043	1.095	2.321
	Rain	.433	.2494	1.541	1	.033	1.045	2.513
	Others	0 ^a	.	1	.	.	.	.
Light condition	Day	-.053	.1725	.948	1	.034	.676	.990
	Night no street light	-.119	.1976	.888	1	.548	.603	1.308
	Night street light off	-.189	.2295	.828	1	.411	.528	1.298
	Night street light on	0 ^a	.	1	.	.	.223	1.408

4. Conclusion

This study was aimed at examining trends and identifying determinants of road traffic accidents in Kembata Tembaro Zone. Count regression models such as Poisson, Negative Binomial and Conway Maxwell-Poisson were fitted. Based on AIC and BIC of the respective fitted models, Negative Binomial model appeared best fit of the data. The Negative Binomial model revealed that motor cycle as type of vehicle, inexperience and too fast as driver errors, improper overtaking and right angle as a collision type, fog and rain as weather condition and day light as light condition were determinants of the expected number of persons died in road traffic accidents in Kembata Tembaro Zone. Thus, awareness creation has to be made regularly to all part of society regarding road traffic accident which results in loss of human lives and damage of property. Traffic police should give special attention to drivers who have no experience of driving, and to those who drive too fast. The drivers should be cautious when the weather condition is rainy and/or fog.

Abbreviations

AIC: Akaike information criterion

BIC: Bayesian information criterion

CI: Confidence interval

GDP: Gross domestic product

IRR: Incidence Rate Ratio

SNNPR: Southern Nations Nationality and People Region

WHO: World Health Organization

Data Availability

The data used in this study are available from corresponding author upon reasonable request.

Competing Interest

All authors declare that they have no competing interest.

References

- [1] Organization for Economic Cooperation and Development (OECD). Health statistics 2019 definitions, sources and methods, 2019. Available: HEALTH_STAT_12 Injuries in road traffic accidents.pdf [extracted on June 3, 2022].
- [2] World Health Organization. Global status report on alcohol and health 2018. World Health Organization; 2019 Feb 14.

- [3] World Health Organization. Global launch: decade of action for road safety 2011-2020. World Health Organization; 2011.
- [4] WHO. Global plan: decade of action for road safety 2011–2020. Geneva: WHO, 2010.
- [5] World Health Organization. World health rankings: Live longer live better. World Health Organization web site. 2011.
- [6] WHO. Road Traffic Injuries Home Page: WWW.Who.Int/Violence-Injury-Prevention. 2015.
- [7] Med instruktion för Trafikverket F. Svensk för fattnings samling (2010: 185).
- [8] Ethiopian Federal Police Commission. Road Safety in Ethiopia Case Study. UNECA (2008).
- [9] Persson A. Road traffic accidents in Ethiopia: magnitude, causes and possible interventions. *Advances in transportation studies*. 2008; 15: 5-16.
- [10] Abuhamoud MA, Rahmat RA, Ismail A. Transportation and its concerns in Africa: a review. *The Social Sciences*. 2011; 6 (1): 51-63.
- [11] Woldu AB, Desta AA, Woldearegay TW. Magnitude and determinants of road traffic accidents in Northern Ethiopia: a cross-sectional study. *BMJ open*. 2020 Feb 1; 10 (2): e034133.
- [12] Regesa BH, Mekebo GG. Longitudinal Count Data Analysis of Factors Affecting Epileptic Seizure of Patients in Case of Gondar Referral Hospital, Northwest Ethiopia. *American Journal of Bioscience and Bioengineering*. 2020; 8 (4): 59-69.
- [13] Pan W. Akaike's information criterion in generalized estimating equations. *Biometrics*. 2001 Mar; 57 (1): 120-5.
- [14] Argawu AS, Mekebo GG. Risk factors of under-five mortality in Ethiopia using count data regression models, 2021. *Annals of Medicine and Surgery*. 2022 Sep 22: 104764.
- [15] Aga MA, Woldeamanuel BT, Tadesse M. Statistical modeling of numbers of human deaths per road traffic accident in the Oromia region, Ethiopia. *PLoS one*. 2021 May 19; 16 (5): e0251492.