OVER 31 THOUSAND ROAD CRASH DEATHS ESTIMATED ANNUALLY IN BANGLADESH: REALITY OR EXAGGERATION

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ABSTRACT

The estimation of annual road traffic fatalities in Bangladesh has long been a subject of contention, with significant discrepancies between international and national figures. According to the World Health Organization (WHO, 2021), Bangladesh experienced 31,578 road crash deaths annually, whereas government statistics—primarily police-reported—recorded only 4,636 fatalities in 2022 and 5,380 in 2024, nearly six times lower. Prominent NGOs and activist organisations, using media-based reports, documented 7,000–10,000 annual deaths, while national surveys and institutional studies, including the Bangladesh Health & Injury Survey (2005), estimated around 10,000 deaths annually. Conversely, national death registration-based data systems such as the Sample Vital Registration System (SVRS) and Medical Certification of Cause of Death (MCCoD) estimated annual deaths at around 13,000 in 2022, providing more moderate but consistent estimates. This study critically examines these discrepancies by analyzing reporting methodologies, particularly the WHO's estimation process, which categorizes Bangladesh among countries lacking complete death registration data, thereby relying on a negative binomial regression model. An attempt is made to evaluate the reliability of this model, which relies on proxy variables (e.g., GDP, road density), in the Bangladeshi context by comparing reported and estimated figures across multiple sources, examining issues of underreporting, and applying statistical tests to assess significance. Findings suggest that the WHO estimate may substantially overstate the actual burden of road crash fatalities in Bangladesh. By scrutinizing estimation methodologies, this paper contributes to the global discourse on road fatality reporting and advocates for context-specific adjustments in modeling to reflect the ground realities in low- and middle-income countries, such as Bangladesh.

Keywords: *Road crash deaths, data discrepancy, estimation process, WHO model, Bangladesh, Reliability.*

1. INTRODUCTION

The annual estimated road traffic deaths in Bangladesh were 31,578 according to the WHO in 2021. On the other hand, the official reported fatalities by the government of Bangladesh, mainly based on the police-reported crash database, are not more than 5000 each year; in fact, exactly 4636 in 2022. BRTA, as a transportation authority, has been publishing traffic crash and death statistics on a daily basis since last year. According to their records, the total number of deaths due to road traffic crashes in 2024 was 5,380. Almost 6 times lower than the WHO estimation. Some prominent road traffic activist organisations and NGOs also record and publish, primarily based on media reports, the annual number of road traffic deaths in Bangladesh. According to their records, annual road traffic deaths in Bangladesh varied between 7,000 and 10,000, which is five to three times lower than the WHO estimate. According to Jatri Kalyan Samity (JKS), 9,951 deaths were recorded, Road Safety Foundation (SRF) recorded 7,113 fatalities, and Nirapad Sarak Chai (Nischa) recorded 8,104 deaths in 2022. Different international and local organisations have conducted various studies, primarily based on questionnaire surveys, which have estimated the annual number of road traffic crashes in Bangladesh to be around 10,000. According to the Bangladesh Health & Injury Survey Report, January 2005, conducted by UNICEF, the estimated annual deaths from road traffic accidents in 2005 were 10,000 in Bangladesh. Moreover, according to the Sample Vital Registration System (SVRS), the estimated road crash deaths based on death registration were 13,394 in 2022, which is almost 2.35 times lower than the WHO estimation (SVRS, 2023). As per the Medical Certification of Cause of Death (MCCoD), the estimated road crash death rate considering the crude death rate in 2022 was 13488.

The question now is how the WHO estimates annual road traffic deaths by country. In the WHO estimation process, "countries are classified based on their Civil Registration and Vital Statistics (CRVS) data into: Group 1 (countries with death registration data), Group 2, Group 3 (countries with a population of less than 150,000), and Group 4 (countries without eligible death registration data). The novelty in the latest report is that former Group 2 has been subdivided into groups 2A and 2b based on the status of their data systems improvements" (WHO, 2023). Group 1 comprises 86 countries, mostly high-income; Group 2 includes 10 countries; Group 3 comprises 9 small countries; and Group 4 includes the remaining countries, where death registration data for at least 80% of the population are not complete and have populations exceeding 150,000. Bangladesh falls under group 4, i.e., countries without eligible death registration data. For those countries, deaths are estimated using a negative binomial regression model.

The parameters $\beta 1$, $\beta 2$, $\beta 3 \cdots \beta n$ were estimated by fitting the negative binomial regression model to estimated total road traffic deaths for all country-years in the range 2000-2016, for the 2018 report meeting the completeness criteria by using the number of roads of traffic deaths from countries from group 1, i.e., the countries with death registration data. The independent parameters are GDP, vehicles per capita, road density, national speed limits on rural roads, national speed limits on urban roads, health system access, alcohol apparent consumption, population working, percentage motorbikes (model B only), corruption index (model B only), national policies for walking/cycling (model C only), and population. The "countries that are still in the process of enhancing their system for recording road traffic deaths and the completeness of death registration data, particularly for the causes of death related to road traffic incidents, is relatively low, at around 30 %" is considered under Group 2B in the latest global status report on road Safety, (WHO, 2023). It is noted that "for these countries without death registration data at least 80% complete and with populations greater than 150,000, a regression mode was used to estimate total road traffic deaths. At the same time, Bangladesh has a death registration system with cause of death, which covers more than 80% of the total deaths, compared to the estimated deaths by the Bangladesh Sample Vital Statistics 2023(SVRS report).

According to the government death registration record, the total deaths in 2022 were more than 837 thousand, and the SVRS-reported estimated deaths were 985 thousand. On the other hand, the

registered death is above 98% compared to the crude death rate, 837 thousand vs 854 thousand. From this perspective, it is relatively reliable. As per the death registration data, the deaths caused by road traffic crashes were 13,394 in 2022 and 15299 in 2024. Moreover, the Medical Certification of Cause of Death (MCCoD) maintains a separate database based on the death records in hospitals, particularly in government hospitals, which includes the cause of death. They recorded a total of around 136 thousand deaths, which is around 15.9 per cent and 16.22 per cent of total crude deaths or registered deaths in Bangladesh in 2022, respectively. In the case of the cause of death, the road traffic crash death is 2146, 1.6% of the total MCCoD recorded deaths. According to this record, the total estimated road traffic deaths in Bangladesh are expected to be between 13,227 and 13,488.

In this study, the author has attempted to evaluate the reported and estimated road traffic deaths by different government and non-government organisations in Bangladesh. Using different statistical tests, try to evaluate the significance of the differences. Assess the WHO estimation process, their models, and the use of attributes, and try to justify to what extent it is effective for cases in Bangladesh. Finally, try to conclude the actual magnitude of road traffic crash deaths in Bangladesh, which is vitally important for our policy and other safety-related initiatives and priority setting.

Assessment of the WHO estimation process, modeling parameters, and their reliability and validity in the Bangladesh context would be one of the significant contributions of this paper. At the outset, the paper will describe the data quality and issues related to underreporting. The recorded and estimated number of road crashes in Bangladesh by various organisations, activists, and studies will also be explored. The main contribution would be the assessment of the WHO estimation process and justification for the Bangladesh context, whether it is reliable or exacerbation".

By examining data quality, underreporting issues, and the effectiveness of the WHO model, this research aims to provide a more accurate understanding of the true magnitude of road crash deaths in Bangladesh, which is crucial for evidence-based policymaking and resource allocation. The findings will contribute significantly to the ongoing discourse on road safety data and its implications.

2. CRASH DEATH ESTIMATIONS BASED ON DEATH REGISTRATION

2.1 Medical Certification of Cause of Death (MCCoD)

The government medical hospital issues a death certificate for their patients who died, along with the cause of death, which is generally referred to as a death certificate. It is technically known as a "Medical Certificate of Cause of Death (MCCoD)". The hospital also maintains a death record database with the cause of death. This comprehensive database is frequently available on the Directorate General of Health Services (DGHS) web portal's dashboard. Although they only record government hospital patients who die within the hospital, which accounts for around 20% of Bangladesh's overall yearly death rate, their database is more accurate and dependable. According to the MCCoD records, there were 2,146, 2,819, and 3,162 reported deaths from road traffic accidents in 2022, 2023, and 2024, respectively. Given this death toll, Bangladesh's total estimated road traffic deaths in 2022 were 13,488, 14,306 in 2023, and 17,426 in 2024 (Table 1).

Table 1: Medical Certification of Cause of Death (MCCoD)

Year	MCCoD reported death	RTA death of MCCoD	Total deaths in Bangladesh (Crude death)	% reported in MCCoD	Total RTA death is estimated with respect to total crude death
2022	135,827	2,146	853700	16%	13488
2023	169,271	2,819	859050	20%	14306
2024	175,077	3162	965007	18%	17429

MCCoD (2025). https://dashboard.dghs.gov.bd/pages/dashboard_mccod_road_traffic.php

2.2 Bangladesh Sample Vital Statistics

The Bangladesh Bureau of Statistics (BBS) publishes Annual Bangladesh Sample Vital Statistics Reports (SVRS) on populations, including death records and causes of death under the Sample Vital Registration System (SVRS) in the Digital Platform Project. The report provides the estimated crude death rate and the percentage of deaths due to various causes in Bangladesh. From 2019 to 2023, Table 2 shows the SVRS-reported Total and RTA deaths in Bangladesh by year. According to these statistics, there were 11,612 RTA deaths in Bangladesh in 2019 and 17,292 in 2023. In 2021, the road traffic fatalities in Bangladesh were 13,861, whereas the WHO reported 31,578.

The Global Burden of Diseases reported that road traffic deaths were 11,589 in 2010, 11,368 in 2019, and 11,097 in 2021, as per this SVRS report (ATO, 2024).

Table 2: SVRS-reported total and RTA deaths in Bangladesh by year

Year	Total Population Million	Crude death rate per 1000 population.	Total death as per SVRS	Death as per Macrotrend	RTA death rate per 1000 population	RTA death
2019	165.88	4.9	812812	817325	0.07	11612
2020	168.08	5.1	857208	977019	0.07	11766
2021	170.07	5.7	969399	1051004	0.0815	13861
2022	171.74	5.82	999526.8	853700	0.107	18376
2023	172.92	6.1	1054812	859050	0.1	17292

Source: SVRS, (2022); SVRS (2023); macrotrends, (2025)

2.3 Registrar General (RG) registration data

The Office of the Registrar General, Birth and Death Registration, maintains birth and death records for the entire country. This is Bangladesh's official birth and death registration system administered by the local government division. Along with the well-organised offline registration system, they also maintain the BDRIS software for online birth and death registration. In this work, we attempted to access those databases. By the way, we have got three months of death data from July to September 2021. According to the records, there were 2,09,287 deaths over three months. Given the medical death rate (%), the anticipated RTA death rate is 13,394 in 2021 and 13,526 in 2022 (Table 3). This projected value also closely matches the SVRS report.

Table 3: Death registration data by Registrar General

Death Registration	Number
3-month death July 21-Sep 21	2,09,287
Estimated Total Annual Deaths in 2021	8,37,148
Estimated Road Traffic deaths, 21	13,394
Estimated Road Traffic deaths, 22	13,526

Source: ORG (2024), https://orgbdr.portal.gov.bd/site/page/c581251e-af9e-49fc-83c7-fd07de435f17

2.4 Summary of RTA death based on the Death registration

Figure 1 shows the estimated RTA deaths based on the death registration of three different sources, including MCCoD, SVRS, and Registrar General, in four consecutive years, 2021 to 2024. The data shows that the numbers are very close to each other and the differences are not statistically significant.

Table 4: Estimated RTA deaths based on death registration by different organizations in different years

Year	MCCoD	SVRS	RG	MCCoD Vs SVRS	SVRS Vs RG	RG Vs MCCoD
2021	13357	13861	13394	ANOVA	ANOVA	ANOVA
2022	13488	18376	13526	P=0.18 F (2.28) <F*crit* (5.99)	P=0.06 F (5.40) <F*crit* (5.99)	P=0.68 F (0.18) <Fcrit (5.99)
2023	14306	17292	14470	Welch's t-test	Welch's t-test	Welch's t-test
2024	17429	17356	15378	P=0.18 t (-1.51) <tcrit (2.45)	P=0.08 t (2.32) <tcrit (2.78)	P=0.08 t (-0.43) <tcrit (2.78)

To test the significance of the difference, the study first applied two tests, ANOVA one-way and Welch's t-test. Null Hypothesis (Ho): There is no significant difference in the two population means, i.e., means are equal ($\mu_1 = \mu_2$). The ANOVA test relies on equal variance assumption and gives more reliable results for the homogeneity of variance of the sample. As there are unequal variance (heteroscedasticity) issue, the study also conducted Welch's t-test for unequal variances. The tests show that the p-value is greater than 0.05 and F is less than F *crit* for ANOVA, and t is less than t *crit*, which supports the null hypothesis, i.e., there are no significant differences among the estimated deaths of the three sources.

2.5 Death Estimation by other international organizations

2.5.1 UNICEF

According to a different study, the Bangladesh Health & Injury Survey Report, published in January 2005, there are at least 10,000 traffic crash fatalities annually, and 50 injured people seek emergency care for every injury death, or 500,000 visits to emergency rooms (Rahman, 2005).

2.5.2 TRL

According to 2003 Transport Research Laboratory (TRL) research on road crash costs in Bangladesh, there were 1,700,301 crashes; of those, 11,049 resulted in fatalities, 102,136 in serious injuries, 311,890 in minor injuries, and 1,275,226 in property damage crashes (Silcock, 2003). According to this analysis, there were an estimated 529,880 road traffic crash injuries in total, including 12,792 fatalities and 165,464 seriously injured people (TRL, 2003). In this estimation, a household survey was used. Based on a comparison of statistics and official police reports, the study proposes that only one-third of all traffic fatalities and 2% of serious injuries are reported to the police.

2.5.3 Local NGOs and Activist groups

2.5.3.1 Difference in reporting among different local safety activists/organizations

As mentioned earlier, there are remarkable differences in crash records compiled by different activist organizations. Table 5 presents the official crash and death records, as well as reports from various local NGOs and road safety activist organizations, for 2021. Road traffic crashes, fatalities, and injuries reported by different activist groups in different years are presented in Table 6.

Table 5: Road crashes and deaths reported by different organizations in 2021

Organization	Crashes	Deaths
Police	5,472	5,088
Jatri Kalyan Samity	5,629	7,809
Nirapad Sarak Chai	3,793	4,289
Road Safety Foundation	5,371	6,284
Accident Research Institute (ARI), BUET	3203	3775

Source: The Daily Star, 24 January 2022; ARI, 2025

Table 6: Reported road traffic crashes, fatalities, and injuries by different activist groups in different years

Year	Jatri Kalyan Samity			Nirapad Sarak Chai (Nischa)			Road Safety Foundation		
	Crashes	Fatalities	Injuries	Crashes	Fatalities	Injuries	Crashes	Fatalities	Injuries
2019	5516	7855	13330	4702	5227	6953			
2000	4891	6686	8600						
2021	5629	7809	9039	3,793	4,289		4735	5831	7379
2022	6749	9951	12356		8104				
2023	6261	7902	10372					7113	
2024	6359	8543	12608				6927	7294	12019

Source: Own publications of the groups published in different newspapers.

2.5.4 Official Record by police and BRTA

Recently, the BRTA has begun compiling gross crash statistics by district daily. Although the primary source of this record is police records, except for a few records from local correspondences, there are significant differences in every attribute between the BRTA record and the Police record. A comparative picture between the BRTA report and the police headquarters crash report in the last three months is shown in Table 7. In case of crashes, the differences are very low; in July, the police record is more than that of BRTA. However, the number of fatalities and injuries is significantly higher in the BRTA record; in the case of injury, it is around 200%.

Table 7: Crash report by BRTA and Bangladesh police

Attributes	July 2023		August 2023		September 2023	
	Police HQ	BRTA	Police HQ	BRTA	Police HQ	BRTA
Crashes	574	566	454	458	437	454
Fatalities	494	533	360	376	363	410
Injuries	503	934	327	659	329	609
Vehicular Involvement						
Bus	159	153	96	112	81	84
Truck	130	143	118	130	114	136
Motorcycle	143	189	104	145	113	150
Microbus	45	26	33	13	31	12
Other	301	107	253	129	257	119

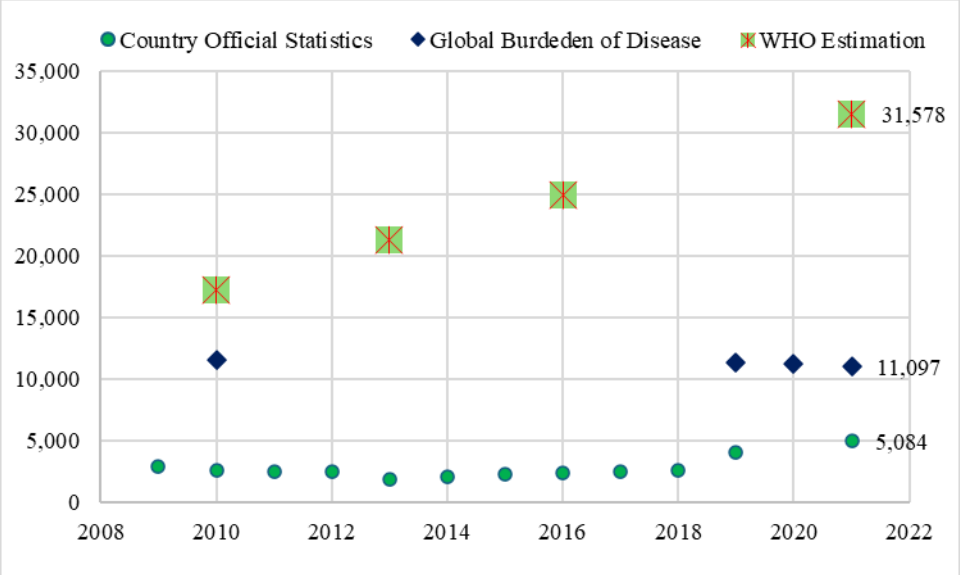
Source: BRTA, 2023

3. WHO ESTIMATION

The WHO assessed the number of traffic-related deaths by nation. A comparison between the police-recorded death toll and the WHO estimation is shown in Table 8. There is a range of five to twelve between the police-reported fatality and the WHO estimation. Even statistics compiled by advocacy groups Nirapad Sharak Chai (NISCHA), Bangladesh Jatri Kalyan Samity (BJKS), and the National Committee to Protect Shipping, Roads, and Railways (NCPSRR), based on newspaper scanning, indicate that accident-related deaths are two to four times more common. Figure 2 illustrates the differences between reported and estimated deaths as reported by various prominent organisations, country official statistics, WHO estimates, and the Global Burden of Diseases.

Table 8: WHO estimation and police-reported official statistics

WHO report	Year	Modelled number of road traffic deaths		Police reported crash deaths	Differences (times)
		Point estimate	90% Confidence interval		
(WHO, 2010)	2007	20,038	14882–29155	3,749	5
(WHO, 2013)	2010	17,289	15415–19164	2,443	7
(WHO, 2015)	2013	21,316	17349–25283	1,782	12
(WHO, 2018)	2016	24,954	20730–29177	2,376	10.5
(WHO, 2021)	2021	31,578	27441-35716	5,084	6
Average		23,035		3,125	7



Source: ATO, 2024; IHME, 2024; WHO, 2023

4. WHO ESTIMATION PROCESS

- WHO classifies the countries into four groups based on their CRVS data into: Group 1 (countries with death registration data), Group 2, Group 3 (countries with a population of less than 150,000), and Group 4 (countries without eligible death registration data). In the 2023 report, former Group 2 has been subdivided into Groups 2A and 2B based on the status of their data system improvements.
- As per the WHO 2018 report, "Group 1 includes 86 countries which have good death registration data completeness for the year estimated at 80% or more, or average completeness for the decade, including the country-year was 80% or more. Group 2 for India, Thailand, and Viet Nam, data on total deaths by cause were available for a single year or very few earlier years. For the 9 small countries with populations of less than 150,000 that lacked eligible death registration data, regression estimates were not used. Group 4 for these countries without death registration data, at least 80% complete and with populations greater than 150,000, a regression model was used to estimate total road traffic deaths. Bangladesh falls under this group. Some average attributes of the countries under different groups are shown in Table 9.

Table 9: Country by group and covariates

Group	Countries	Population Density/Sq. Km	GDP per capita	Vehicles per 1000 persons	Percent of Motorbike
1	86	334	21,628	440	13
2	3	319	3,123	412	74
3	9	225	11,809	431	13
4	77	128	3,045	128	20

- For countries lacking reliable death-registration data, particularly the countries under group 4, WHO uses a negative-binomial regression model to estimate the number (and rate) of road-traffic deaths.
- The outcome is deaths (or death rate per 100,000 population), and the model uses the country's total population as an offset term (so the model essentially estimates a rate).
- The model uses a set of covariates such as GDP/GNI, vehicle ownership, road density, proportion of motorcycle use, and others, as shown in Table 9. A time series was created for each covariate for the period specific to each country.

4.1.1 Model framework

- WHO estimated national road traffic deaths using a negative binomial regression model, trained on countries with high-quality death registration data.
- That is: WHO uses reported fatalities from countries with reliable vital registration systems (typically ≥ 80% completeness and medically certified causes of death), i.e., (countries under Group 1) as the dependent variable to build (train) the model.
- The dependent variable is the number of reported road traffic deaths, with total population as an offset (i.e., modelling deaths per person, but using count form) (WHO 2018, Annex E).

4.1.1.1 Mathematical form

The model's log-form is generally:

$$\log(E[Y_i]) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \log(Pop_i) \qquad (\text{offset} = \log(Pop_i)) \tag{1}$$

$$E(Y_i) = \exp\left(\beta_0 + \sum_j \beta_j X_{ij} + \log(Pop_i)\right) \tag{2}$$

Where:

- Y_i="Number of road traffic deaths in country " i" (from official, validated records"
- Pop_i= total population (offset),
- X_{ij} = covariates or explanatory variables (GDP per capita, vehicles per 1000 people, etc.), (See following table)
- β's = estimated coefficients.

The parameters β1, β2, β3 ⋯ βn (equation 1) were estimated by fitting the negative binomial regression model to estimated total road traffic deaths for all country-years in the range 2000-2016 for report 2018 and 2020-21 for the report 2023, meeting the completeness criteria by using the number of road of traffic deaths from countries from group 1 described above. The explanatory note (Explanatory Note 3) describes how the regression models (Models A, B, C) used different subsets of these covariates.

4.1.1.2 Covariates by model (X_{ij})

The covariates that were used for estimating road traffic deaths included the following:

Table 10: The covariates that were used for estimating road traffic deaths

Covariate	Model A	Model B	Model C	Source
ln(GDP per capita)	✓	✓	✓	World Bank / WHO DB
ln(Vehicles per 1,000 persons)	✓	✓	✓	GSRRS survey
Road density	✓	✓	✓	IFs database
Max speed (rural)	✓	✓	✓	GSRRS survey
Max speed (urban)	✓	✓	✓	GSRRS survey
Health system access index	✓	✓	✓	IHME / IFs
Alcohol consumption (L/adult 15+)	✓	✓	✓	WHO DB
Working-age population (15-64 %)	✓	✓	✓	UN WPP 2017
% motorbikes	✗	✓	✗	GSRRS survey
Control of corruption index	✗	✓	✗	World Bank
Walking/cycling policy (dummy)	✗	✗	✓	GSRRS survey
Total population (offset)	✓	✓	✓	UN WPP 2017

Source: WHO (2018), *Global Status Report on Road Safety 2018*, Annex E – Table E3 and E4, pp. 292–293.

From Table 9, it is clear that the countries in Group 1 are primarily developed countries. Almost all the attributes that influence transport systems, either directly or indirectly, include road infrastructure, traffic environment, operational conditions, users' behaviors, vehicle conditions, law and enforcement, among others. The transportation systems of developed countries differ significantly from those of developing or underdeveloped countries, particularly in countries like Bangladesh (Mahmud et al., 2018). So, it is utterly irrational for the trained model to consider that the attributes related to the Group 1 country would apply to the Group 4 countries. Even the traffic system and other parameters differ from country to country within the group of four countries. Although the economic conditions and culture share many similarities, the traffic system and environment are not similar to or closely related to those of our neighboring countries.

Let me explain further with some particular covariates.
GDP per capita: In most cases, GDP does not reflect the actual picture of the traffic environment. In terms of GDP per capita, Bangladesh is going to reach the status of a middle-income country. However, the traffic environment and discipline of many lower-income countries are far better than those in Bangladesh.

Vehicles per 1,000 persons: In Bangladesh, the number of unregistered informal vehicles, such as auto-rickshaws, autos, and tempos, is exceptionally high, possibly exceeding the number of registered vehicles. Those vehicles are not included in the statistics, but they are the primary safety concern. Moreover, the vehicle configuration and characteristics are not similar to those of any country in the world. Most of the private vehicles are reconditioned vehicles. Illegal modifications of heavy freight are also common, creating significant safety concerns. Moreover, the fitness issues of the vehicles are also common problems. Most underdeveloped and developed countries face these types of unique problems. Therefore, the safety impact of vehicles is not comparable or replaceable between different countries.

Road density: The quantity could be the same, but the environment and, therefore, the safety risk are not the same. Road geometry, environmental conditions, operational conditions, road and roadside hazards, encroachments, and exposure are significantly different in Bangladesh compared to any other

country in the world. Therefore, the safety effect of road density in Bangladesh is not comparable to that of any other country worldwide.

Max speed (rural & urban): Most countries in Group 4 have no speed limit rules, or if they do, those rules are not enforced. Even though there is minimal on-road enforcement of speed limits in the Group 4 countries, having or not having a maximum speed limit restriction makes almost no sense in countries like Bangladesh.

Working-age population (15-64 %): The exposure of the working-age population to the road, use of vehicle types, trip distance, and many issues related to the safety risk of the working-age population.

Population: Bangladesh is the most densely populated country in the world. High density in urban areas varied between 50,000 and 200,000 per square kilometer. However, exposure to the road is not comparable to that in the developed world. Whereas, in many developed countries, population density is disproportionately very low, and exposure to roads is also disproportionately different. So, the effect of population on traffic safety could not be similar or comparable between different countries, particularly between LIC and HIC countries.

5. CONCLUSIONS

Many factors dictate traffic safety, and their impacts and effects vary from country to country. Traffic systems, environments, and connected attributes vary across different countries. Due to geographic, social, economic, and cultural differences, traffic conditions vary significantly across different countries. This difference is particularly pronounced and high between high-income countries (HICs) and lower- and middle-income countries (LMICs). Even so, there are considerable differences in many high-income countries. The traffic environment between the USA, EU, China, Russia, and Australia is entirely different. To some extent, there are similarities among European countries, primarily due to their shared geographic and cultural conditions. All of those developed countries are under Group A. Nevertheless, that is entirely different from the developing countries like Bangladesh. Therefore, a model trained for those countries cannot be directly applied to developing countries or those in group 4. From this perspective, a fundamental problem exists in the WHO estimation process. WHO trained and developed the model using the data from the country that has reliable death registration and other data, mainly HIC countries, and used the fitted model to predict deaths for other countries where data are incomplete, inconsistent, or missing. Therefore, the WHO estimation is unreliable, as it has considered the impact or effect to be the same as that of developed countries for a particular covariate in the countries where it has been applied. However, that could be considered an inaccurate hypothesis and cannot happen, particularly for LMIC countries like Bangladesh.

For instance, the marginal effect or impact of population density in EU or AU countries could not be the same for countries like Bangladesh. The same issues apply to many other covariates as well. Some considered variables may not be influential or relevant for other nations because their impact is dependent on many other factors, such as the effects of establishing a maximum speed limit, which is contingent upon the level of enforcement and may vary between countries. Data reliability is also an issue. For example, in the case of Bangladesh, there are a vast number of unregistered vehicles. The study attempted to evaluate the actual estimation model and also tried to get the raw data table of covariates used in the WHO model but was unsuccessful. Therefore, it was difficult to empirically evaluate the model bias or error for Bangladesh using formal metrics. Therefore, the study applies a qualitative approach to critique the model. However, empirical evaluation could a future research direction.

Moreover, the WHO used simple negative binomial regression, although this is the base model for crash count data modeling, it has several limitations, such as static impact and no segmentation. The

effect of all covariates could not be static, but somewhat random. Several derivatives have been developed to overcome these limitations, such as Random Parameter NB and latent class segmentation based on NB, which enhance the model's performance and accuracy, as well as improve outcome estimates. As a result, instead of a generalised model, the WHO might create a country-specific model or conduct country-specific estimation using reference death registration data, such as MCCOD or Bangladesh's death registration data, or by performing a sample survey, as in the SVRS report.

This study made several attempts to collect the exact model estimation from the WHO, including at least the coefficient and its degree of significance. Despite repeated attempts, we were unable to accomplish this. Also attempted to redevelop the model estimation using data linked to covariates. However, some of the covariate/independent variable data could not be collected or were missing in secondary sources for different nations, such as. Health system access index, alcohol consumption (Liters per Adult 15+), and other factors.

Finally, based on the above analysis and discussion, it can be concluded that the WHO estimation method has some fundamental limitations, and the estimated outcome of 31,578 in 2021 for Bangladesh is exaggerated. Then, the question is: What could be a more accurate and reliable estimate of the annual road traffic deaths in Bangladesh? Official reported deaths are around 4,000. NGOs or activists compiled data on deaths that vary between 5,000 and 9,000. The estimates of international organizations are around 10,000. The global burden of diseases was reported to be 11,097 in 2021. However, estimates from the hospital-based MCCoD death register indicate that 13,357 people died in traffic accidents in 2021. According to the SVRS and the Registrar General, these estimates are 13,861 and 13,394, respectively. For the year 2024, these estimates are 17,429, 17,356, and 15,378 for MCCoD, SVRS, and Registrar General, respectively. There is no discernible variation between the three-death registration-based estimates, which show nearly identical numbers. Additionally, these estimates are remarkably close to those of other international organisations. This suggests that Bangladesh may have around 15,000 road traffic fatalities annually in 2021, which is at least half of the WHO estimate.

DECLARATION OF USE OF AI

The authors acknowledge the use of artificial intelligence (AI) tools in the writing of this manuscript. AI tools (ChatGPT & QuillBot) were used solely for language refinement, including grammatical correction, standard, and fluency. All intellectual content, including research design, data collection, data analysis, interpretation of results, and conclusions, was fully developed and verified by the authors. All AI-assisted text was thoroughly reviewed and edited by the authors to ensure accuracy and compliance with scholarly standards. No AI tools were used in conducting the research or generating original scientific content.

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