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An Analysis of Road Traffic Accidents in Rajbiraj Municipality, Nepal: Pre versus Post-Covid Comparison

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Abstract

Road traffic accidents is an important public safety concern in Nepal. This study reveals a descriptive and exploratory analysis of officially reported annual road traffic accident data. The data is from Rajbiraj Municipality for the period 2019–2024 which include pre and post covid period. The dataset consists of counts of vehicle accidents, human deaths, injuries, and animal casualties. Study focuses on descriptive statistics, rate calculations, correlation study, and an exploratory Poisson regression model. Results of the study demonstrate a substantial increase in reported accidents after 2020, from mean annual accidents 359.5 in 2019–2020 to 1,794.0 in 2021–2024. During the same time, fatalities per 1,000 accidents decreased markedly over the study period. Results of Poisson regression reveals that variation in accident counts alone does not adequately explain year-to-year changes in fatalities. Overall, the study concludes that while road traffic accidents increased substantially during the post-COVID period, fatality rates per 1,000 accidents declined indicating changes in accident severity or emergency response effectiveness. This finding focuses the necessity of strengthened municipal road safety strategies and systematic data collection for evidence- based interventions.

Keywords: statistical analysis, road traffic accidents, fatalities, correlation

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Introduction

Road traffic accidents (RTAs) continue to contribute a significant role to global public health in the form of a high incidence of mortality, and disability (Mahato et al., 2025). Road traffic accident data analysis gives important and essential information required for monitoring public safety and making plan in local interventions. In context of world, road traffic crashes are a core public health issue. Approximately 1.35 million people die each year worldwide (World Health Organization, 2018) in road traffic accidents, and make traffic accidents a leading cause of death, especially among young adults. The majority of deaths occur in developing countries, where rapid motorization outpaces most of the investments in road safety management and enforcement systems (Godthelp & Ksentini, 2024).

The socioeconomic burden of road traffic accidents exceeds morbidity and mortality. In many cases, families of victims generally face large health expenditures, loss of the primary earners as well as long term psychological distress. In developing countries like Nepal, even a single fatal accident can push households far below the poverty line. Furthermore, traffic accidents strain public health systems resulting scarcity of essential service and resources. It also adds the indirect cost such as traffic congestion, insurance claims and the legal processing activities. hence, the local accident events are not merely an academic exercise, but a prerequisite for evidence-based resources allocation as well as policy formulation. Rajbiraj Municipality which is one of the emerging urban centers in Province 2, exemplifies the rapid increment of vehicles without safety infrastructures seen across Nepal. Consequently, this research adds localized evidence to support targeted interventions.

In the context of South Asia region, study shows that road traffic injuries and deaths are significantly higher than global averages (World Health Organization, 2023). Nepal, India, Bangladesh and several neighboring countries experiences a high share of road accidents. Based on reports, India alone faced over 150,000 road traffic deaths in 2021, which makes it one of the countries having highest numbers of reported fatalities within South-East Asia region. Furthermore, India also reported around 384,448 road traffic injuries during the same period. During the same period Nepal recorded nearly 94,665 injuries, placing Nepal and India among the highly affected by road accidents in the region. In Asia, Nepal has one of the higher road traffic fatality rates (Government of Nepal Ministry of Physical Infrastructure and Transportation, 2021). Records given by National police show increasing crash injuries and fatalities over time (Nepal Police, 2022). A total of 2,883 individuals died and 7,282 others were severely injured in around 24,526 road accidents across the country during the last fiscal year 2021/22.

Despite increasing evidence on road traffic injuries in Nepal, municipal-level analyses remain limited as compared to pre-and post-COVID accident patterns. In short, there is lack of detailed localized evidence on how accident frequency, fatalities, and injuries have changed over time in Rajbiraj municipality. Therefore, this study aims to examine annual road traffic accident trends in Rajbiraj Municipality from 2019 to 2024, focusing pre-and post- COVID periods using exploratory and descriptive statistical analysis.

Due to the lack of proper tools and infrastructures, national road safety statistics of Nepal underscore the actual magnitude of the problem. According to report, Nepal is at highest rank among the countries having higher road traffic crash fatality rates in Asia. Official estimates also indicate the increasing crash deaths as well as injuries over recent years. Disaggregated records demonstrate that pedestrians, cyclists, and motorcyclists are major portion of road fatalities in Nepal (Kuikel et al., 2022). In 2021, approximately, 8,000 fatalities were recorded to road crashes. During same period, a fatality rate above 28 per 100,000 population was recorded which was significantly higher than South Asia regional average which has approximately 16 per 100,000.

Nepal faces persistent burden of road traffic accident as illustrated by historical data. Traffic police records from 2001 to 2013 showed around 96,000 crashes, with over 100,000 injuries, resulting more than 14,500 deaths which raised the mortality rates over the period. Motorcyclists, Cyclists and pedestrians were the disproportionately affected, while males and young adults were in highly injured group. In Nepal, it is necessary to carryout effective actions on all five pillars of the decade action plan to reduce the road fatalities (Ojha, 2021). Road condition, drunk driving and weather conditions are major factors contributing in accidents in Nepal (Manandhar, 2022). People between 15 to 40 years of age are most affected in road-accident followed by those above 50 years (Thapa, 2013)

More recent analyses at national level also focuses that road traffic crashes and resulted injuries have been continuously increasing over the past decade. Overall national records indicate that around tens thousands of crashes related injuries annually, and a considerable number of fatalities. These national data give important context for evaluating local accident trends in municipalities such as Rajbiraj.

This study contributes to existing body of research by examining municipal-level road traffic accident trends in Rajbiraj Municipality (2019–2024), using officially reported annual data despite aggregation and small sample size limitations. The COVID-19 pandemic disrupted global mobility, leading paradoxical trends in several countries with lesser vehicles on road but higher speeds with increased severity of crashes due to empty highways. In contrast, Nepal experienced a post-lockdown surge in private vehicle ownership, mainly in motorcycles as people avoided the sharing of

transportation. This led to increase the number of vehicles exceeding the accident frequencies and fatality rates. In India, post COVID accident data revealed sudden rise in two-wheeler pedestrian fatalities increasing the driving behavior risk and destroyed the road surfaces after monsoons in low maintenance periods (Mohan et al. 2022). In Bangladesh also, a spike in road crashes was noted following the relaxation of movement constraints, with many accidents involving overcrowded public vehicles. These regional trends indicate that post-COVID accident dynamics are context-specific and affected by local mobility behaviors. Rajbiraj's experience-sharp increment in accident with declining fatality rates- different from some global trends which underscore the need for localized investigations. This perspective will help policymakers to avoid adopting inappropriate strategies from dissimilar contexts.

Methods and Materials

This analysis uses officially reported annual road traffic accident data for the years 2019–2024 ($n = 6$) from Rajbiraj Municipality. The counts of vehicle accidents, human fatalities, human injuries, animal deaths, and animal injuries are the variables included in this study. The whole data are categorized as the pre-COVID period and 2021–2024 as the post-COVID period for the descriptive comparisons.

As the data contains the small number of annual observations in aggregated form, the analytical strategy focuses descriptive and exploratory statistical methods. Study do not emphasize confirmatory inference. Descriptive statistics includes totals, means, ranges, and year-to-year changes, to summarize accident and casualty levels while percentage change analysis is used to quantify differences between pre-COVID and post-COVID periods. Rate analysis, is used to calculate variation in accident volume across year with fatalities per 1,000 accidents. The visual inspections of annual trends and rank-based assessments to identify directional changes over time are measured by "Trend description".

Pearson and Spearman correlations are applied descriptively to examine associations among the study variables accidents, injuries, and fatalities. Furthermore, Exploratory Poisson regression, is used to check whether annual accident counts are associated with fatality counts. Interpretations of inferential statistics are done carefully. No any casual conclusion is drawn while the results are performed as descriptive indicators of observed patterns. Give only six annual data, traditional time series analysis like ARIMA, and interrupted time series are not feasible. Therefore, the analytical strategy give transparency about statistical limitations. Due to small sample size descriptive statistics are supplemented with affect sizes instead of relying on p-value only. Bootstrap confidence intervals could be considered for robustness though it is not included in the study. Negative binomial models or generalized estimating

equations could be future studies with higher temporal resolution. These methodological choices align with best practices to analyze routine administrative data in small resources setting (AbouZahr et al., 2007), where statistics-based information must be balanced against practical utility.

Nepal Road Safety profile 2025, Global status report on road safety 2023 by the World Health Organizations, and Nepal Disaster Report 2024 (Sedhai, 2025) are the sources that provide robust data on road traffic accidents in Nepal and South Asia.

Results and Discussion

Annual Accident Statistics

Table 1 demonstrate the annual data of vehicle accidents, human injuries, and animal casualties recorded in Rajbiraj Municipality. Number of accidents increased substantially after 2020, attaining a maximum in 2022, and then by declining in 2023 and 2024.

Table 1

Annual Accidents statistics

Year	Vehicle Accidents	Dead People	Injured People	Animal death	Animal Injured	Period
2019	250	69	140	0	0	Pre-COVID
2020	469	70	253	4	1	Pre-COVID
2021	1864	97	1158	10	6	Post-COVID
2022	2156	89	1450	3	3	Post-COVID
2023	1633	75	1197	3	1	Post-COVID
2024	1523	82	1051	3	2	Post-COVID

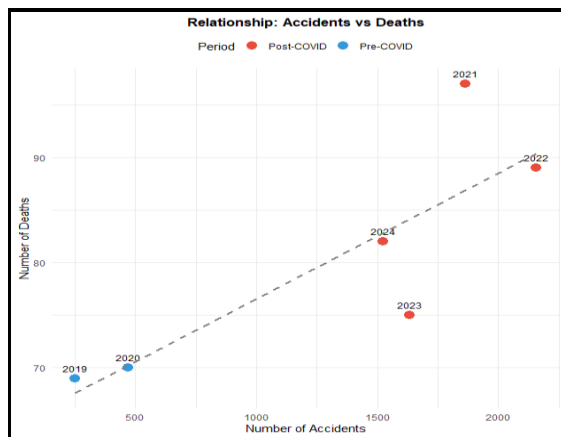
Note. Data from annual accident records, Traffic Office, Rajbiraj Municipality (2019–2024).

Pre-COVID and Post-COVID Accident Levels

During the pre-COVID period (2019–2020), the mean number of vehicle accidents was 359.5 per year whereas, during post-COVID period (2021–2024), the mean number of vehicle accident recorded was 1,794.0 accidents per year, resulting an increment by approximately 399%. This result shows significant differences in number of accidents during two periods. Relationship plots between accidents versus death are displayed in figure 1 for post and pre-COVID.

Figure 1

Number of accidents versus number of deaths for post and pre-COVID period.



Note. Data from annual accident records, Traffic Office, Rajbiraj Municipality (2019–2024).

Fatalities and Fatality Rates

Table 2 demonstrate the number of accidents over period 2019 to 2024 including fatalities per 1000 accidents.

Table 2

Fatalities and Fatality Rates

Year	Accidents	Fatalities per 1,000 Accidents
2019	250	276.0
2020	469	149.3
2021	1864	52.0
2022	2156	41.3
2023	1633	45.9
2024	1523	53.8

Figure 2 displays the fatalities per 1,00 accidents during the period 2019 to 2024.

Figure 2

Fatality rate (per 100 accidents)

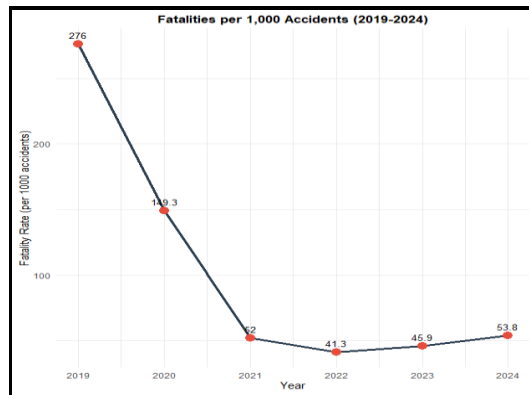


Table 2 clearly demonstrate that the fatality rates per 1,000 accidents declined substantially after 2020 and the accident counts substantially increased in later years but the number of fatalities per accident was decreased compared to the pre-Covid period.

Correlation Patterns between Variables

Exploratory correlation analysis (Table 3) demonstrates that there is a strong positive correlation between vehicle accidents and injured people ($r = 0.992$), suggesting that injury counts increase almost proportionally with accident frequency. Similarly, there is a moderate positive correlation between vehicle accidents and fatalities ($r = 0.832$), but there is moderate relationship between injuries and fatalities ($r = 0.763$). These correlations reveal how the variables move together during the but cannot be interpreted as predictive relationships.

Table 3

Pearson Correlation Matrix

Variable	Accidents	Deaths	Injured
Accidents	1.000	0.832	0.992
Deaths	0.832	1.000	0.763
Injured	0.992	0.763	1.000

Exploratory Poisson Regression

The results of an exploratory Poisson regression model were estimated. The annual fatalities were taken as the response variable while vehicle accidents were taken as the explanatory variable.

The estimated incidence rate ratio (IRR) for vehicle accidents was: $IRR = 1.00015$; 95% Confidence Interval: (1.00002, 1.00028) and the p-value = 0.021

This result shows that each additional accident increases the expected fatalities by 0.015% increase in fatalities and the results are statistically significant, the effect size is extremely small, indicating that variation in accident counts is not meaningfully explain changes in fatalities per year.

Trend Assessment

A descriptive measurement of annual trends indicates a non-monotonic behavior in accident counts, resulting rapid increment from 2019 to 2022 and then declining. Adversely, fatality rates have a downward pattern over time. Furthermore, the rank-based trend inference suggests a negative correlation between year and fatality rate but this association is not statistical significance and is interpreted descriptively.

The results of the document clear changes in the level and composition of road traffic accidents in Rajbiraj Municipality between 2019 and 2024. There are higher reported accident counts and lower fatality rates per accident during post covid. These patterns are found stable observed in the annual data. The observed decrease in fatality rates despite a surge in accident counts may indicates several underlying factors that warrant further study. One possible description is a shift in accident severity, where a larger proportion of post-COVID crashes could contain minor collisions or non-fatal injuries rather than high-impact, lethal events. This could be associated to changes in traffic composition, such as an increase in two-wheeler usage or a higher volume of intra-city trips, which often result in less severe results compared to high-speed highway accidents (Manandhar, 2022). Furthermore, improvements in post-crash response and emergency medical services in the municipality over the study period may have revealed to lower fatalities per accident, though this hypothesis requires validation through incident-level data. Nationally, the Asian Transport Observatory (2025) focuses that road safety data in Nepal specially masks critical variables such as vehicle type, road user category, and time of crash, all of which are essential for understanding severity patterns. The World Health Organization (2023) similarly focuses that disaggregated data is crucial for designing forecasted interventions. Thus, while the decline in fatality rates in Rajbiraj is encouraging, it should be interpreted carefully without detailed information on crash circumstances and response mechanisms.

Since the analysis is based on aggregated annual records, study does not capture differences in accident severity, types of road user, or timing. Therefore, the findings should be understood as a summary of observed outcomes not as an explanation of underlying causes. despite data limitations, the observed trends of the study reveal actionable implications for the Rajbiraj municipality. Sharp post COVID increment in reported accidents necessitates a corresponding expansion of emergency medical services. Establishment of designated trauma bay at Rajbiraj Hospital as well as training

traffic police in fundamental life support could further reduce fatality rate. The moderate correlation between accidents and fatalities ($r= 0.832$) indicates that not all accident types are equally lethal. Furthermore, the declining fatality rate should not breed complacency, annual deaths remain around 80-90 persons, indicating a major public health burden. municipality should prioritize low-cost, high-impact measures while advocating for funding for black-spot improvements.

Conclusion

The national and regional road safety data consistently demonstrate high rates of road traffic injuries and fatalities in Nepal and South Asia. This study reveals a descriptive status of road traffic accident trends in Rajbiraj Municipality during 2019 to 2024 based on officially reported annual data. The analysis mentions a substantial increments in the number of reported vehicle accidents after 2020, with the mean number of annual accidents rising from 359.5 in the pre-COVID period (2019–2020) to 1,794.0 in the post-COVID period (2021–2024). Although, there is the higher volume of accidents in the later years, fatalities per 1,000 accidents markedly declined, suggesting that although more accidents were reported, the number of fatalities decreased over time relative to accident frequency.

Furthermore, exploratory correlation analysis as well as Poisson regression demonstrate that year-to-year variation in number of accidents alone does not fully explain observed differences in fatality totals. This suggests that other factors including crash severity, vehicle types involved, and emergency response outcomes also influence fatality counts. However, due to the small number of observations as well as the use of aggregated annual data, results revealed should be interpreted as descriptive instead of inferential.

The national and regional road safety data, show persistently high rates of road traffic injuries and fatalities in Nepal and South Asia. Also, the observed patterns in Rajbiraj focuses both the level of the road safety challenge and the value of organized data collection and monitoring. There is need of continued efforts to improve road accident reporting, pooled with increased level of detailed and frequent data collection, will be required for designing forecasted interventions and evaluating their effectiveness over time.

For better timeseries analysis, monthly or weekly accident data can give more robust estimates. furthermore, the qualitative interviews with traffic police, ambulance drivers as well as hospital staff to understand the reporting biases. Municipality authority should designate a Road safety Focal Person responsible for collating accident data from Nepal Police, hospitals and insurance claims. launching of a public awareness

campaign targeting motorcyclists focusing on helmet use and speed control. Furthermore, the establishment of road safety funds supported by traffic violation fines,

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