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The Economic Impact of Road Traffic Accidents in the eThekwini Municipality

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Declaration

I Amadues Senzo Memela hereby declare that the research work titled, *"The Economic Impact of Road Traffic Accidents in the eThekwini Municipality"*, submitted for assessment and academic credit, is my original work. It is based on my own investigation and has not been submitted, either wholly or in part, to any other institution for any qualification.

All references to the work of other authors have been appropriately acknowledged in the text and listed in the reference section. This paper is in full compliance with ethical standards, and every effort was made to ensure the confidentiality and integrity of the data utilized in this study.

Name: Amadues Senzo Memela



Signed at Durban on 18 March 2025

Dedication

This work is evidence of the fortitude and encouragement of people who have followed this road with me, holding my hand and head up even amid trying circumstances for all of us.

To my friends, who have been the late-night confidants, the bearers of laughter, and the much-needed reminder to enjoy the journey, thank you for keeping my spirits and motivation high. Thank you to my friends who always reminded me of the purpose and broader perspective of this endeavour. You have been the catalyst that has illuminated even the most challenging days.

To my syndicate members, my partners-in-progress, who shared every discussion, discovery, and deadline, we did this together. Your insights and resilience inspired me to keep pushing forward, and this accomplishment is as much yours as it is mine.

To my family, particularly my late parents, especially my father who witnessed the inception of this journey but could not endure to see its conclusion, my foundation, I express my gratitude for your steadfast support, affection, and the sacrifices you made to enable my pursuit of this objective. Your faith in me has sustained me through every challenge, and I am eternally appreciative.

Lastly, I would like to express my sincere gratitude to Dr. Lumkile Mondi, my supervisor, for his unwavering support, forbearance, and wisdom, which have served as my beacon of light throughout this endeavour. I am grateful for the endless conversations, late-night calls, and your amusing sense of humour. I am grateful for your encouragement, reassurance, and demonstration of the genuine value of acquiring knowledge.

This work is a tribute to all of us and the significance of human value.

Abstract

This study investigates the economic impact of Road Traffic Accidents (RTAs) in the eThekwini Municipality, with a particular focus on the influence of key economic variables. The economic variables include the eThekwini GDP, inflation, road infrastructure investment, unemployment and traffic volume. The research assesses how these economic variables contribute to the likelihood of RTAs in the municipality and the impact RTAs have in society. The research employs econometric modelling techniques using EViews software, analysing data from 2009 to 2023. A multiple linear regression model was used to estimate the relationship between the independent variables (eThekwini GDP, inflation, road infrastructure, traffic volume, and unemployment) and the dependent variable (RTAs). Diagnostic tests such as the Breusch-Pagan-Godfrey test for heteroskedasticity, the Durbin-Watson test for autocorrelation, and Variance Inflation Factor analysis for multicollinearity were conducted to validate the model's accuracy and robustness.

The research findings indicate a significant negative relationship between eThekwini GDP and road traffic accidents, while road infrastructure investment shows a negative correlation with RTAs. This suggests that improvements in infrastructure are associated with a reduction in road traffic accidents, as better road conditions and increased safety measures can help mitigate the risk of accidents despite potential increases in traffic flow. Additionally, traffic volume is positively associated with the number of RTAs, highlighting the role of congestion in road safety. Inflation and unemployment, however, exhibit weaker correlations, indicating that while they play a role, their direct impact on RTAs may be more nuanced. The results emphasise the significance of making strategic investments in road infrastructure and traffic management as essential steps to reduce road traffic accident rates. In conclusion, the study's findings suggest that economic policies and planning should give top priority to improving infrastructure and managing traffic volume to promote road safety and preserve the city’s economic burden as results of road traffic accidents. The belief is that these insights provide useful information for policymakers and stakeholders in developing effective measures to tackle road traffic accidents in the eThekwini Municipality and improving the quality of life of eThekwini Municipality households.

Key words: eThekwini Municipality, economic factors, road traffic accidents, GDP, inflation, road infrastructure investment, unemployment and traffic volume

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List of abbreviations

RTA	Road Traffic Accidents
GDP	Gross Domestic Product
KZN	KwaZulu-Natal
Stats SA	Statistics South Africa
EDGE	Economic Development and Growth in eThekwini
VIF	Variance Inflation Factors

Chapter 1: Introduction

1.1 Background of The Study

Globally, road traffic accidents are a prominent factor contributing to the mortality rate of young individuals. They are the primary cause of death for individuals between the ages of 15 and 44. However, it is predicted that by 2030, they will rise to become the seventh most common cause of death. The increase in road fatalities in low and middle-income nations, especially in emerging economies experiencing rapid economic growth, is primarily caused by the growing number of deaths on roads due to urbanisation and increase of traffic volume (WHO, 2023).

Road traffic injuries impose a significant economic cost on both national economies and households. These accidents occurrences have a significant impact on the age group that is economically active and expected to make contributions to their families, society, and the workforce, especially in low and middle-income countries. The economic expenditure also have a substantial impact at the national level, placing a tremendous pressure on socio-economic, and infrastructure development. Evidence indicates that road traffic accidents and injuries in low and middle-income nations are projected to result in economic losses of up to 5% of GDP (WHO, 2023)

In 2023, the entire cost of road traffic accidents in South Africa’s was around R205.13 billion, which is equivalent to 2.74% of the country's GDP (RTMC, 2023). The growth in unemployment, inflation, number of vehicles would be expected to have greatly risen. The eThekwini Transport Authority (2022) states that the total cost of road traffic accident was R10.65 billion in the eThekwini Municipality. The municipality, businesses and households face significant costs in addressing road traffic accidents. In this study we the assess the economic impact of road traffic accidents on eThekwini Municipality to develop comprehensive strategies to alleviate its consequences.

1.2 Purpose Statement

The eThekwini Municipality is a Metropolitan municipality with its location situated on the eastern coast of South Africa in the KwaZulu-Natal Province and ranks as the third largest metropolitan municipality in the country, following Johannesburg and Cape Town. The metro comprises 4.2 million population, representing 34.7% of the total

population of the KZN Province, with eThekwini Municipality spanning an area of 2,556 km². eThekwini serves as the economic hub of KwaZulu-Natal, contributing 59.88% to the provincial GDP and 9.59% to the country's GDP (eThekwini Municipality, 2024).

The eThekwini Municipality, a significant economic hub in South Africa, has an escalating problem of road traffic accidents, which carry considerable economic and social consequences. Despite its pivotal role in the nation's economy, it significantly contributes to the national GDP through many industries. The continual increase in road traffic accidents has emerged as a significant impediment to economic progress, incurring considerable direct and indirect expenses for both the municipality and the nation. In a developing economy such as South Africa, such events disproportionately affect vulnerable communities, exacerbating socioeconomic inequality and reallocating resources from other critical development areas (eThekwini Transport Authority, 2022).

Several economic factors, including high unemployment rates, inflation, and fluctuating municipal GDP, are believed to contribute to the frequency and severity of RTAs in eThekwini. Additionally, the rapid urbanization and rising traffic volumes have placed further pressure on the existing road infrastructure, amplifying the likelihood of accidents. The persistent high number of RTAs in eThekwini presents a major challenge for local governance, impacting economic stability, health, and overall quality of life. Therefore, understanding the complex interplay between economic factors such as GDP growth, unemployment, inflation, traffic volume, and infrastructure investment is crucial for identifying effective policy measures to reduce accidents, minimize economic losses, and enhance public safety.

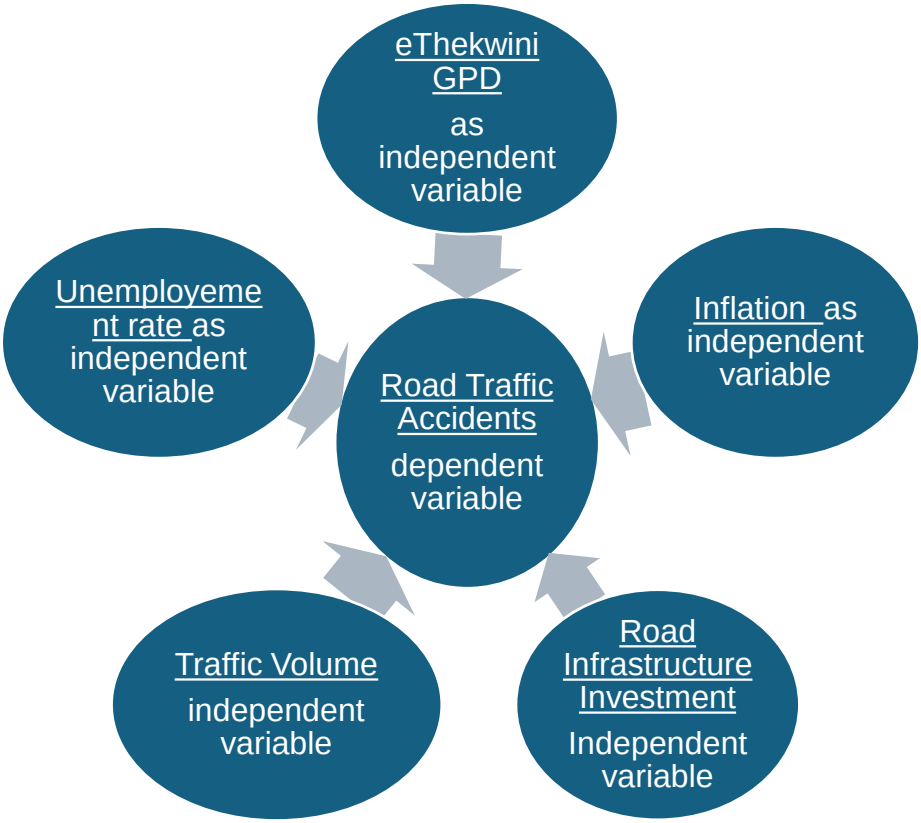


Figure 1 Conceptual framework (Author).

1.3 Problem Statement

Despite several road safety measures, installation of traffic calming measures, educational campaigns and law enforcement, road traffic accidents still have a significant economic impact on eThekwini Municipality, situated in the KwaZulu-Natal province of South Africa (Monyatsi, 2019). Nevertheless, there is a shortage of thorough comprehension concerning the magnitude of this economic impact. Despite economic growth and continuous road infrastructure upgrades, the number of RTAs in the eThekwini Municipality has been increasing. RTAs constitute a significant public safety and economic risk, resulting in production and financial losses. These consequences affect individuals, businesses, government agencies, and the overall economy, making RTAs a crucial issue that need immediate attention. There is a lack of research on how economic factors such as GDP growth, inflation, and unemployment interact with traffic volume, infrastructure investment, and accident rates over time. Hence, it is imperative to conduct research to evaluate the economic impact of road traffic accidents in the eThekwini Municipality.

In the study, the researcher assesses the economic impact of road traffic accidents in the eThekwini Municipality region. It is done so by to examining the aspects such as, Traffic volume, road infrastructure investment, eThekwini GDP, inflation, and unemployment, that could contribute to the number of fatalities. Additionally, it complement and advance the study previously conducted and published by other scholars such as (Makhubela T, 2021) which covered Mpumalanga Province and (Olukoga, 2004) who covered eThekwini which is now outdated since the eThekwini Municipality has changed drastically since 2004, making this study crucial.

1.4 Research Objectives

- Understanding the economic impact that road traffic accidents have at eThekwini Municipality and its residents.
- Investigating the impact of economic variables including the GDP, inflation, road infrastructure investment, unemployment, and traffic volume on road traffic accidents.

1.5 Rationale of The Study

Road traffic injuries impose a significant economic cost on both national economies and households. There is a need to develop a more detailed and sophisticated understanding of the economic burden caused by road traffic accidents. Therefore, this study provided empirical insights into the relationship between economic growth, infrastructure investment, traffic volume, and road traffic accidents in eThekwini Municipality. The findings contribute to both academic research and policymaking by offering a data-driven understanding of how economic factors and infrastructure development influence road safety.

1. **Economic burden**: The study finds that RTAs impose a substantial economic burden on multiple stakeholders, including individuals, businesses, and government agencies resulting in local economy loss and the loss of productivity and human resources.
2. **Potential for economic growth**: The results indicates that economic growth, measured by GDP, correlates with increased vehicle ownership and mobility, contributing to higher accident rates. However, economic expansion also provides opportunities for increased investment in road safety programs. These findings underscore the importance of balancing economic development with

proactive road safety measures. Minimising the economic impact of road traffic accidents can result in heightened economic growth, higher quality of life, and increased competitiveness for the eThekwini Municipality.

3. **Contribute to existing research**: This study aims to enhance the current knowledge on road traffic accidents, economic impacts, and road safety by offering fresh ideas and perspectives specific to the setting of the eThekwini municipality.
4. **Policy Development**: The study finds that the increased infrastructure investment leads to a rise in RTAs due to higher traffic flow, long-term benefits emerge when infrastructure development is paired with strategic traffic management policies. This highlights the need for policymakers to design infrastructure improvements alongside safety regulations to achieve sustained reductions in accident rates. Policymakers can enhance road safety and minimise financial losses by identifying the most efficient measures to reduce accidents and its economic ramifications.
5. **International Alignment**: The study provides actionable insights into the complex relationship between economic growth, infrastructure investment, and road safety. This research contributes to global road safety discourse and offers evidence-based policy recommendations to reduce accident rates in eThekwini while supporting sustainable urban development. Curbing the economic impact of road traffic accidents is in line with both national and international objectives, including the United Nations Sustainable Development Goals.

The study's empirical findings provided a strong foundation for policy recommendations, emphasizing the need for an integrated approach to road infrastructure development, economic planning, and traffic safety. These insights can guide urban development strategies to ensure safer road environments while sustaining economic progress.

1.6 Delimitations of The Study

This research study will specifically focus on the eThekwini Municipality and will not extend to other municipalities or regions. The research intends to thoroughly evaluate the economic impact of road traffic accidents excluding indirect cost.

1.7 Assumptions

1. Reliable data, it is presumed that the authority accurately records road traffic accidents and that the data is dependable.
2. The analysis presupposes that the sample of road traffic accidents and economic factors data is indicative of the full metropolitan area.
3. The study assumes the reliability of economic factors data, such as eThekwini GDP, unemployment, inflation, traffic volume and road infrastructure investment.

Chapter 2: Literature Review

2.1 Introduction

In this chapter we present the theoretical foundation for evaluating the importance of the economic effect on the volume of road traffic accidents in the eThekwini Municipality. The significance of economic development and prosperity in reducing road traffic accidents is also emphasised. The study discusses the empirical evidence about the influence of economic variables on road traffic accidents.

This study utilises a range of ideas from social and economic science informed by the literature review, with a particular focus on political ecology theory, human capital theory, and the economics theory. The choice to employ these approaches is based on the recognition that theories play a crucial role in defining research challenges and selecting appropriate methodologies for conducting empirical studies.

2.1.1 Theoretical Framework

2.1.1.1 Political ecology theory.

Political ecology originated in the 1980s as a multidisciplinary topic that examined environmental issues by applying the principles and techniques of political economics. A fundamental principle of the discipline is that comprehending ecological transformation necessitates considering the political and economic frameworks and organisations in which it is deeply rooted (Neumann, 2009).

Government policy has a significant impact on the various factors that contribute to road traffic accidents, including the quality of the road network, the physical environment, the condition of vehicles, and the behaviours and attitudes of road users. The political ecology approach is applicable on a global level when considering the allocation of resources, health, risk, and poverty in the context of international trade relations (Bhavan, 2019).

2.1.1.2 Human capital theory

Human capital theory refers to the range of valuable abilities possessed by an individual that can be utilised to earn income in the job market and enhance a household's choices for consumption. Human capital investment is a dynamic notion

that allows individuals to choose to invest in their own skills and knowledge (Weiss, 2015). The efficiency of the entire production process may decrease, impacting the overall GDP. Productivity loss may be seen in the form of decreased production rates, heightened periods of inactivity, and diminished competitiveness in the international market. When road traffic accidents occur, there are enduring reductions in the workforce. Road accidents can cause long-term damage to a person's health and their capacity to work (Mahal, 2016).



Figure 2 Model of Human Capital Theory (Swanson & Holton, 2001)

2.1.1.3 Economic theory

As economies progress through various stages of development, their mortality rates often decrease with time, as countries improve their capacity to combat road traffic accidents and other factors that cause loss of life. Nevertheless, the situation with road traffic accidents is distinct. As low-income countries undergo development, the wages of their residents rise, allowing them to purchase vehicles for more efficient transportation (Sinha et al, 2021).

Enhancing road traffic safety is contingent upon economic development. The ratio of national investment in transportation infrastructure and network management platform is likely to increase as the economy develops, leading to effectiveness of various institutional improvements. Economic development enhances traffic infrastructure and transportation systems, while also increasing public consciousness regarding traffic safety. Thus, economic growth not solely decreases the incidence of traffic accidents, however it also advances the enhancement of safety on roads (Sun et al, 2019). The enduring ramifications of road accidents on human capital, such as diminished

capacity to generate revenue and escalated healthcare costs, might lead to a gradual decline in GDP growth (Calvo-Poyo et al,2020).

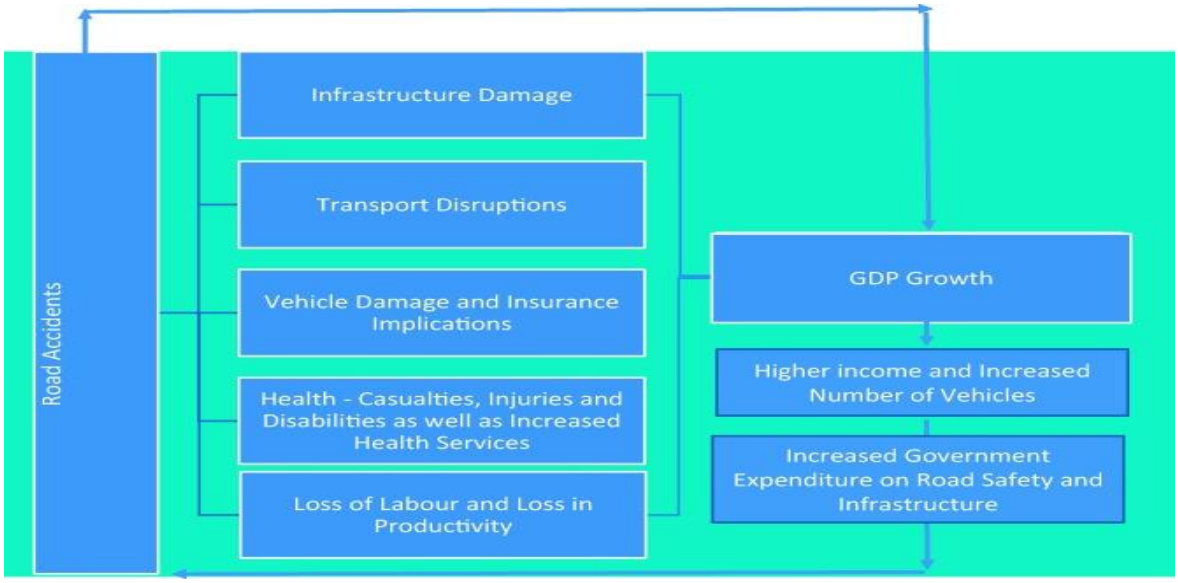


Figure 3 Economic Theory for Road Traffic Accidents (Tandrayen-Ragoobur, 2024)

The Figure 3 illustrates Economic Theory for Road Traffic Accidents which is the multifaceted impact of road traffic accidents on social and economic aspects, including feedback mechanisms that affect overall economic growth and governmental policy. The Figure 3 highlights the intricate, interrelated connections among road traffic accidents, socio-economic expenses, and economic development. By emphasising both direct effects and feedback mechanisms, it illustrates the significance of cohesive solutions that merge safety, infrastructure investment, and economic policy to mitigate the enduring consequences of road accidents on growth and productivity (Tandrayen-Ragoobur, 2024).

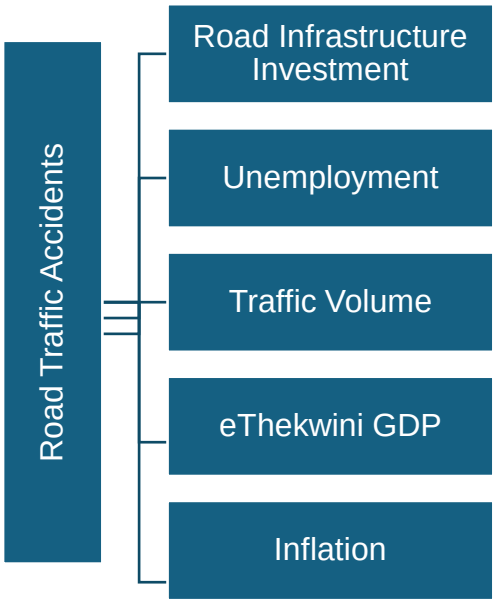


Figure 4 Conceptual framework (Author)

The Figure 4 above a conceptual framework delineates five pivotal factors influencing road traffic accidents, investment in road infrastructure, unemployment, traffic volume, eThekwini GDP, and inflation. The Figure 4 highlights the multifaceted nature of road traffic accidents, involving economic, infrastructural, and behavioural elements in interaction. For eThekwini Municipality, it emphasises the necessity of reconciling economic development with safety-focused investments, tackling both immediate and systemic factors contributing to accidents.

2.2 Empirical Literature Review

2.2.1 Impact of Road Traffic Accidents in Economic Development

A road traffic accident refers to any incident that occurs when at least one vehicle is in motion on a public or private road that is accessible to the public, resulting in at least one person being wounded or killed (WHO, 2015). Approximately 1.35 million individuals lose their lives each year due to road traffic accidents worldwide (WHO, 2023). Road traffic accidents are inflicting substantial economic consequences on victims, as well as on the entire nation, resulting in a loss of approximately 3% of the GDP (Arun Chand, 2021).

The economic impact of traffic accidents varies significantly and unpredictably among different countries. It can be argued that high-income nations bear the most significant macroeconomic burden of road accidents, whereas low-income and middle-income

economies experience the biggest health burdens. The uneven allocation can be attributed to variations in economic advancement, increased productivity, and a more educated labour force in affluent countries. This burden arises when the rate of motorization and traffic density surpasses the pace of infrastructural development and law enforcement (Chen et al, 2019).

The economic impact of road accidents in Africa is calculated to be $6.8 billion, equivalent to 3.3% of the region's GDP (WHO, 2023). This estimate can be considered a minimum estimate of the expenditures, especially considering that cautious estimations of the number of injuries and crashes have been utilised. This suggests that road traffic accidents impose a substantial and significant socio-economic burden on emerging countries (Ajibola, 2015).

2.2.2 Role of Economic Factors to Road Traffic Accident

Suphanchaimat et al, (2019) conducted a study analysing data from 2012 to 2016 to examine the relationship involving economic growth and road traffic accidents and deaths in Thailand. According to the study, the rate of RTAs rose from 449 to 524.9 occurrences per 100,000 individuals between 2012 and 2016. The study found substantial evidence between the regional economic growth RTAs after accounting for the influence of co-variables such as traffic volume and the economic impact of the employment and production.

Sun et al, (2019) study revealed that economic factors exert a substantial influence on the quantity of casualties resulting from road traffic accidents. When all other variables are held constant, there was an average drop of 0.19 in the number of road traffic injuries for every rise of 100 million the value of CNY in GDP. Each additional 100 million CNY invested in traffic infrastructure results in an average reduction of 13.93 road traffic casualties.

2.2.2.1 Gross Domestic Product (GDP)

Sun et al, (2019) alluded that enhancing road traffic safety is contingent upon economic development. The correlation between the growth of GDP and increased investment in transportation infrastructure results in a decline in the number of fatalities caused by traffic accidents. The economic growth may result in a higher allocation of national funds towards the construction of transport infrastructure and the

implementation of network management systems, leading to the successful implementation of numerous institutional advancements.

Wijnen, (2021) found that the economic impact of road accidents in Kazakhstan was calculated to be $6.8 billion, equivalent to 3.3% of the country's GDP. This estimate was considered a minimum value for the expenditures, especially because it is based on cautious estimations of the number of casualties and wrecks. This signifies that road accidents impose a substantial and significant socio-economic impact.

2.2.2.2 Inflation Rate

Francisco, José, & Oña, (2020) suggest that the inflation rate has a detrimental effect on the living standards of individuals in a certain country. Nations with minimal economic growth are typified by a high inflation rate, resulting in a significant cost of living. In these nations, vehicle owners have a propensity to infrequently maintain their motor cars, hence increases the probability of road traffic accidents. Moreover, residents in low-income nations experiencing significant inflation rates often possess antiquated vehicles that are unfit for road use. Vehicles that are not suitable for road use are more likely to be involved in traffic accidents because of mechanical malfunctions. Developed countries are distinguished by their low inflation rates, which allows its residents to easily afford the maintenance of their cars and the purchase of new vehicles. In affluent nations, it is uncommon for residents to retain their old vehicles. This accounts for the low incidence of road traffic accidents in developed countries (Bhavan, 2019). In a study done by (TaruwereYakubu & Muhammed, 2021) in Nigeria revealed that that road transport accidents exhibit an inverse relationship with the inflation rate, whereby elevated inflation rates correlate with a decrease in road transport crashes, and conversely.

2.2.2.3 Unemployment

The unemployment rate is an indicator of fluctuations in economic cycles (ITF , 2022). In economics, inflation, GDP, and unemployment are regarded as the three fundamental factors influencing economic development. The primary objective of an economy, regardless of its level of development, is to attain price stability, decrease unemployment, and maintain consistent economic growth for an extended duration by implementing and executing sound macroeconomic policies. The South African

unemployment figures indicate that young people are at a disadvantage in employment due to economic challenges (Khalid et al, 2021).

2.2.2.4 Road Infrastructure investment

There is a direct correlation between the amount of fund invested in the road network's infrastructure and the occurrence of road traffic crashes, according to the (WHO, 2015). The inadequate allocation of funds for road infrastructure in marginalised regions has resulted in deteriorated road furniture and roads filled with potholes, hence escalating the risk of road traffic accidents (Tandrayen-Ragoobur, 2024).

Investing in road infrastructure and conservation has a beneficial effect on society. In addition to preventing the deterioration of infrastructure and extending its lifespan, it also helps to decrease the number of road fatalities. This results in the additional value of a safer and more sustainable transportation system. Higher traffic volume rates, GDP growth, an ageing population, or increased average yearly rainfall are associated with decreased traffic fatalities (Calvo-Poyo, Navarro-Moreno, & Oña, 2020).

2.2.2.5 Traffic Volume

The rise in traffic volume has failed to decrease the number of mortalities in road traffic accidents, a phenomenon that is intricately linked to both vehicular traffic and drivers (Sun et al, 2019). From the standpoint of motor vehicles, the performance of these vehicles significantly influences road traffic safety (Modipa, 2022).
(Ostendorf, 2020) findings indicated that the frequency of accidents rises in a non-linear manner as traffic volume levels increase. Hence, that effectively controlling traffic flow to mitigate excessive congestion would yield the most significant results in reducing the frequency of accidents. Crucially, there is no discernible rise in the frequency of accidents as volume lowers, indicating that lowering traffic volume would not have a detrimental effect on public health.

2.3 Analytical Framework

The economic impact of road traffic accidents is a significant burden on the victims, their families, various countries, and the global community, particularly poor and middle-income countries that suffer most of this burden. The cost savings resulting from these methods can be more effectively allocated towards the development of a nation and improved road infrastructure (Gorea, 2016) .

2.4 Conclusion

Enhancing the GDP and allocating resources towards road infrastructure may diminish the occurrence of road traffic accidents in eThekwini. This highlights the crucial role of economic progress in enhancing road traffic safety. The number of newly constructed roads, the rise in population, positive inflation and traffic volume are directly related to the number of casualties in traffic accidents. From an economic standpoint, it is crucial to prioritise the economic growth and enhance investments in transportation infrastructure.

2.5 Research Hypotheses

1. eThekwini GDP have direct impact to the Road Traffic Accidents eThekwini Municipality
2. Inflation have influence on the Road Traffic Accidents in eThekwini Municipality
3. The level of unemployment has influence to the number of Road Traffic Accidents in eThekwini Municipality.
4. Traffic volume have impact to the road traffic accidents.
5. The road infrastructure investment has impact to the road traffic accidents in the eThekwini Municipality

Chapter 3: Research Methodology

3.1 Research Design

Quantitative research employs mathematical, statistical, and computational approaches to obtain results. This structure allows us to create a sense of finality to the objectives under investigation by quantifying issues to comprehend their prevalence. This approach enabled us to generate result that could be projected onto the broader population (Gaille, 2019).

The researcher analysed the economic impact of road traffic accidents in eThekwini Municipality using the quantitative research approach to emphasise statistical results (Zawawi, 2007). The quantitative method offered the advantages of being efficient and cost-effective overall and allowed us to analyse the data using descriptive and inferential statistics. Furthermore, the research employed a regression technique to determine the relationship between economic indicators and RTAs in eThekwini. The data was imported to EViews software for correlation and validation.

3.2 Data Collection Method

Data for this study was collected from secondary sources, specifically focusing on reliable databases and reports issued by government departments and municipal bodies responsible for road safety, economic data, and infrastructure development within eThekwini Municipality. The fore information on the eThekwini GDP, unemployment rate and inflation rate were collected from Economic Development and Growth in eThekwini (EDGE) and Stats SA website road infrastructure investment from Municipal Annual reports Roads department and Treasury report, and lastly road traffic accidents from Road Safety Department of eThekwini Municipality for a period from 2009 to 2023.

3.2.1 Population

The study will focus on the entire eThekwini Municipality jurisdiction as means of gathering accidents data from the municipality.

3.2.1 Sample and Sampling Method

The sample for this study consists of annual data from the eThekwini Municipality covering the period from 2009 to 2023. The data includes key economic and traffic-related variables such as road traffic accidents, eThekwini's GDP, inflation rate,

unemployment rate, road infrastructure investment, and traffic volumes. These variables were chosen based on their potential influence on road traffic accidents and their relevance to the municipality's economic conditions.

This non-probability sampling technique was used because the study focuses on specific variables known to impact road traffic accidents, particularly within the context of eThekwini Municipality. The data was sourced from municipal reports, national databases, and other relevant economic and traffic-related statistical records. The use of purposive sampling ensures that the sample is relevant to the research objectives, allowing for a more detailed analysis of the economic impact of road traffic accidents within the study period.

3.3 Research Instrument

This research study used secondary data to investigate the fundamental research questions. In so doing the mathematical model called Econometric model was employed to examine the correlation between identified economic variable associated with road traffic accidents. This study imported data onto EViews software utilise linear regression analysis, a statistical approach used to investigate relationships between variables. EViews was chosen for its robust capabilities in managing and analysing time series data and its suitability for running statistical tests relevant to this study's objectives. Regression analysis employs the equation $\mathbf{Y=\beta0+\beta1X+\epsilon}$, where Y represents the dependent variable and X represents the independent variable, β0 is the intercept and β1 is the slope of the regression line and ϵ is the error term.

Dependent variable: The dependent variable was the road traffic accident, which serves as a measure of the economic consequences of road traffic accidents. **Independent Variables**: The factors encompassed are inflation, unemployment, traffic volume, road infrastructure investment, and eThekwini GDP. Subsequent It is necessary to gather data on the pertinent variables from 2009 to 2023 for the geographic region of eThekwini Municipality. The data encompassed historical records of accidents, counts of traffic volume, economic indicators, and other pertinent. Subsequently, statistical method program EViews was employed to estimate the model's parameters and evaluate the significance of the associations.

3.4 Procedure for Data Collection

The study identified essential economic variables such as eThekwini GDP, inflation rate, unemployment rate, road infrastructure investment, and traffic volume. These variables were selected based on their potential impact on road traffic accidents within the eThekwini Municipality. Data for these variables were primarily sourced from public databases, government publications, and municipal reports.

3.5 Data Analysis Strategies and Interpretation

The study used the Regression analysis where multi linear regression type will be chosen for the research paper. Regression analysis is a statistical technique used to ascertain the nature of the connection between one or more independent variables and a dependent variable. Gaining an understanding of how the independent factors influence the dependent variable is beneficial (Cote, 2021). In addition to MLR, simple linear regression is used to explore the relationships between pairs of variables the independent and dependent (GDP and RTAs, infrastructure investment and RTAs, Inflation and RTAs, unemployment and RTAS, traffic volume and RTAs). Furthermore, after the collection of data regression analysis was used through EViews software to perform a comprehensive evaluation of the data. This evaluation included verifying the completeness and cleanliness of the data prior to loading it into the interpretation and discussion of results.

3.6 Limitations

- Not all road traffic accidents that occur in the city of eThekwini are reported, and the reported accidents do not represent all accidents.
- The economic impact study does not thoroughly examine the costs related to health and grief.
- The study exclusively concentrates on the eThekwini Municipality and does not encompass any other locations.
- The sample size of 15 observations falls below the general threshold of 30 observations according to Central Limit Theorem, therefore the study results must be interpreted with extreme caution.

3.7 Quality Assurance

3.7.1 External Validity

The distinction amongst the general population and other target populations was made based on the two different forms of external validity. The validity of both generalisation and transportability conclusions relied on their ability to encompass various aspects, such as mechanisms, contexts, treatments, outcomes, units, and time (Michael G. Findley, 2021). The study sample specifically targeted the eThekwini Municipality. The sample that was used in the study is deemed appropriate for the research topic. The research findings exhibited external validity due to the substantial size of the sample, which represented a significant fraction of the large population.

3.7.2 Internal Validity

Internal validity assesses the extent to which the design, implementation, and analysis of a study enable reliable and accurate findings to address the research questions (Andrade, 2018). To ensure accuracy, a quantitative content analysis was utilised to gather secondary data on the economic impact of road traffic accidents on the eThekwini Municipality. Nevertheless, the reliable sources, such as Stats SA reports, Municipal accident data and the Municipal Annual Reports, played a crucial role in supplying accurate data that can be appropriately compared and verified.

3.7.3 Reliability

Reliability refers to the capacity of instruments to produce consistent outcomes when used at several instances (MASLAKÇI, 2020). This research utilised official economic and traffic data, which are typically standardised and meticulously gathered. Utilising authoritative sources, such as government reports and reputable statistics databases, enhances the reliability of the data and reduces errors stemming from inaccuracies or inconsistencies.

3.8 Ethical Considerations

The study uses aggregate data on economic variables and RTAs, sourced from public and official records. Since individual-level data is not employed, there are no direct risks to personal privacy. However, to respect confidentiality, all data handling follows standard privacy protocols, and any sensitive insights are reported in an aggregated and non-identifiable manner. The study ensured the preservation of secrecy regarding the findings.

Chapter 4: Data Presentation and Analysis

4.1 Introduction

This chapter elucidates the interaction between economic factors and road traffic accidents through meticulous data analysis, employing regression models and statistical tests. At first, the data about economic factors and road traffic accidents got entered the statistical software EViews for analysis using the regression approach via descriptive analysis through econometric formula and model fit and diagnostic.

The dataset used in this study spans from 2009 to 2023. The economic and road traffic-related variables extracted from the dataset are Road Traffic Accidents, eThekwini GDP, Inflation Rate, Roads Infrastructure Investment, Traffic Volumes, and Unemployment Rate. The examination of these variables facilitates comprehension of the relationship between economic conditions and road safety.

4.2 Data Analysis

The data collected included the eThekwini GDP, inflation rate, unemployment rate, traffic volume, budget allocation to roads infrastructure, and the number of annual road traffic accidents within the eThekwini Municipality jurisdiction. The data was collected and recorded using a software program called EViews for the purpose of analysis. The eThekwini GDP, unemployment, and inflation rate are measured in percentage terms. The Road Traffic Accidents are quantified as the total number of accidents occurring each year in eThekwini. Traffic volume is defined by the number of registered cars in eThekwini. Road infrastructure expenditure is assessed by the amount of funding allocated to road maintenance and refurbishing on an annual basis in eThekwini Municipality.

Table 1 Data for economic variables and road traffic accidents

Period	**Dependent Variable**	**Independent Variable**				
Year	RTA	eThekwini GDP %	Inflation %	Unemployment %	Traffic Volumes	Roads Infrastructure
2009	67643	-2.00	7.10	22.40	733305	R 3,405,541.01
2010	63266	2.90	4.30	20.40	742581	R 4,865,058.58
2011	62138	3.20	5.00	16.10	752506	R 5,528,475.66
2012	62318	2.80	5.60	16.00	785534	R 6,142,750.73
2013	63014	2.90	5.70	17.12	810484	R 7,678,438.42
2014	62388	1.77	6.13	16.52	829552	R 9,033,456.96
2015	65626	1.44	4.60	16.93	868013	R 10,037,174.40
2016	67678	1.06	6.40	20.20	880174	R 11,152,416.00
2017	67256	0.77	5.30	22.20	886573	R 12,673,200.00
2018	65956	1.06	4.70	19.90	871374	R 14,440,110.00
2019	65861	-0.13	4.12	21.83	887876	R 17,405,000.00
2020	48541	4.87	3.30	16.23	880807	R 24,433,000.00
2021	57472	4.31	4.50	24.10	894152	R 16,419,000.00
2022	61544	1.19	6.90	22.58	874859	R 17,160,630.00
2023	61197	0.45	6.09	21.18	885010	R 25,226,770.00
Average	**62793**	**1.77**	**5.316**	**19.58**	**838853**	**R 12,373,401.45**

Source: Statistics South Africa, Municipal reports, eThekwini Transport Authority Roads Safety

4.2.1 Regression Analysis

Table 2 Regression analysis

Dependent Variable: RTA				
Method: Least Squares				
Sample: 2009 2023				
Included observations: 15				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
eThekwini GDP	-1861.129568	410.7487	-4.531066452	0.001424
Roads Infrastructure	-0.000675439	0.000138	-4.909260649	0.000837
Traffic Volumes	0.047089761	0.015697	2.999842877	0.01496
Inflation	-340.6464489	635.0083	-0.536444059	0.604656
Unemployment	91.96761476	229.5956	0.400563445	0.698084
Constant ©	34958.79818	12851.54	2.720204051	0.0236

R-squared	0.888915456	Mean dependent var	62793.2
Adjusted R-squared	0.827201821	S.D. dependent var	4865.169
S.E. of regression	2022.402151	Akaike info criterion	18.35113
Sum squared resid	36810994.13	Schwarz criterion	18.63435
Log likelihood	-131.6335048	Hannan-Quinn criter.	18.34812
F-statistic	14.40387448	Durbin-Watson stat	1.559364
Prob(F-statistic)	0.000455264		

This regression research offers valuable insights into the determinants of road traffic accidents in the eThekwini Municipality between 2009 and 2023.

Key Findings:

- **Constant (C):** The intercept value of 34,958.80 indicates that all independent variables are equal to zero, the estimated number of road traffic accidents would be about 34,959. This result is considered statistically significant, as indicated by a p-value of 0.0236.
- **eThekwini GDP:** The coefficient of -1,861.13 suggests a robust negative correlation between eThekwini's GDP and road traffic accidents. More precisely, a 1% rise in GDP corresponds to a decrease of around 1,861

accidents. The statistical significance of this link is remarkably high, with a p-value of 0.0014.

- **Inflation:** The coefficient of -340.65 indicates a negative correlation between inflation and road traffic accidents, but this association is not statistically significant (p-value = 0.6047). Therefore, it shows that inflation may not have a substantial impact on the number of accidents.
- **Roads Infrastructure Budget:** The coefficient of -0.000675 indicates a strong and statistically significant negative correlation between the budget dedicated to road infrastructure and road traffic accidents (p-value = 0.0008). Therefore, it can be inferred that a higher allocation of financial resources towards road infrastructure leads to a decrease in the occurrence of accidents.
- **Traffic Volumes:** The coefficient of 0.047090 indicates a positive and statistically significant correlation between traffic volume and road traffic accidents (p-value = 0.0150). This demonstrates a positive correlation between traffic volume and the frequency of road traffic accidents.
- **Unemployment:** The coefficient of 91.97 indicates a positive but statistically insignificant correlation between unemployment and road traffic accidents (p-value = 0.6981), suggesting that unemployment does not have a major influence on accident rates in this situation.

The model analysis shows the R-squared value of 0.8889 indicates that approximately 88.89% of the variation in road traffic accidents can be explained by the independent variables in the model, suggesting a strong fit. Adjusted R-squared (0.8272), after adjusting for the number of predictors, 82.72% of the variation is explained, reinforcing the model's strong explanatory power. The standard error of regression (2022.402) provides a measure of how much the observed values differ from the predicted values. F-statistic (14.4039) and Prob(F-statistic) (0.000455), the significant F-statistic suggests that the overall model is statistically significant. The Durbin-Watson statistic (1.5594) suggests the presence of some autocorrelation in the residuals, although it is not significant.

The regression study demonstrates that the eThekwini GDP, road infrastructure investment, and traffic volumes have a substantial influence on the occurrence of road

traffic accidents in the eThekwini Municipality. The inverse correlation between eThekwini GDP and road budget implies that fostering economic growth and allocating resources to infrastructure can contribute to the mitigation of accidents. Nevertheless, the rise in traffic volumes is linked to an increase in accident rates. Additional variables, like as inflation and unemployment, do not exhibit substantial statistical impacts in this model.

4.2.2 Descriptive Analysis

Table 3 Descriptive statistics

Sample: 2009 - 2023						
	RTA	Traffic Volume	Roads Infrastructure	eThekwini GDP	Inflation	Unemployment
Mean	62793.2	838853.3	12373401	1.772667	5.316	19.57767
Median	63014	871374	11152416	1.44	5.3	20.2
Maximum	67678	894152	25226770	4.87	7.1	24.1
Minimum	48541	733305	3405541	-2	3.3	16
Std. Dev.	4865.169	58639.04	6772971	1.767563	1.086987	2.823466
Skewness	-1.700917	-0.7858	0.553778	-0.16009	-0.00692	-0.037605
Kurtosis	5.988871	1.998299	2.323469	2.841164	2.14464	1.507927
Jarque-Bera	12.81614	2.170834	1.052734	0.079843	0.457395	1.394962
Probability	0.001648	0.337761	0.590747	0.960865	0.795569	0.497838
Sum	941898	12582800	1.86E+08	26.59	79.74	293.665
Sum Sq. Dev.	3.31E+08	4.81E+10	6.42E+14	43.73989	16.54156	111.6074
Observations	15	15	15	15	15	15

The descriptive analysis statistics indicate that the variable Road Infrastructure Investment exhibits the highest level of variability, as evidenced by its highest standard deviation, compared to the other variables. Additionally, the RTA variable shows significant non-normality, as indicated by its negative skewness and high kurtosis. This may suggest that there have been major fluctuations in traffic conditions or changes

in accident reporting methods throughout the years as in the case of COVID-19 pandemic situation and confirmed in the study done in Johannesburg, South Africa (Moyo et al, 2022). The remaining variables exhibit greater stability, with eThekwini GDP and unemployment displaying normal distributions, suggesting constant economic conditions within eThekwini Municipality from 2009 to 2023.

1. **Road Traffic Accidents:** The data from the RTA shows a strong left skewness with a leptokurtic distribution, suggesting that most years have a higher frequency of accidents, while few years had much less accidents. This indicates that although the overall number of accidents remains high, there may have been certain years where interventions or circumstances significantly decreased the number of accidents.
2. **eThekwini GDP:** The GDP of eThekwini follows a normal distribution and exhibits near-symmetry, suggesting consistent and stable economic growth patterns throughout the analysed period. The economic conditions in eThekwini have remained stable, with no major disruptions or surges that would significantly impact the GDP and result in considerable fluctuations.
3. **Inflation:** The inflation data exhibits symmetry and follows a normal distribution, suggesting a continuous pattern of inflation. The stability of inflation indicates that the economic measures used during this era were successful in managing inflation and keeping it within a predictable range.
4. **Roads Infrastructure Expenditure:** The data shows a small tendency towards greater values on one side of the distribution curve, but overall, it closely resembles a normal distribution. Additionally, there are few years where the expenditure is significantly higher than the rest. The municipality's expenditure on road infrastructure has usually been consistent, with intermittent surges that could be associated with notable projects or increased budget allocations.
5. **Traffic Volumes:** Traffic volume data exhibits a modest negative skew, suggesting a usually stable volume with intermittent declines. The quantity of vehicles on the roads has remained stable, with only slight declines, which may be connected to some years of decreased economic activity including the Covid-19 pandemic period.
6. **Unemployment Rate:** The unemployment rate has a nearly symmetrical and regularly distributed pattern, suggesting persistent trends. The level of

unemployment in the municipal jurisdiction has remained relatively constant, indicating that there have not been any significant disruptions to the labour market or economic conditions during the research period.

The inverse relationship between eThekwini GDP and road traffic accidents indicates that as the economy strengthens, there is a tendency for the number of road traffic accidents to decline (Bhavan, 2019). This is attributed by enhanced infrastructure, heightened public consciousness, or improved traffic control systems (Sun et al, 2019).

Investing in road infrastructure is vital, as evidenced by its strong association with RTA. Increased investment in infrastructure can result in improved road conditions, thus leading to a decrease in accidents (Sun et al, 2019) (Tandrayen-Ragoobur, 2024). Nevertheless, the relationship between traffic volume and RTA is not as strong, indicating that the volume of cars alone may not be the main cause of accidents. Instead, it is likely that the way these vehicles interact with road conditions and traffic control systems has a more significant role (Ashraf et al, 2019).

4.2.3 Covariance and Correlation Analysis

Table 4 Covariance and Correlation analysis

Covariance Analysis: Ordinary						
Sample: 2009 2023						
Included observations: 15						
Covariance						
Correlation						
t-Statistic						
Probability	RTA	eThekwini GDP	Inflation	Roads Infrastructure	Traffic Volume	Unemployment
RTA	22091878.83					
	1					
eThekwini GDP	-6048.850533	2.915992889				
	-0.753638882	1				
	-4.134079336	-----				
	0.001175699	-----				
Inflation	2362.4748	-1.044629333	1.102770667			
	0.478639191	-0.582540848	1			
	1.965529808	-2.584125503	-----			
	0.071085083	0.022678578	-----			
Roads Infrastructure investment	-16563456465	1469431.773	-1968443.209	4.28E+13		
	-0.538563617	0.131509935	-0.286472312	1		
	-2.304597255	0.478320093	-1.078074298	-----		
	0.038330405	0.640366192	0.300598897	-----		
Traffic Volume	-49211435.47	4297.910444	-12617.71467	2.97E+11	3.21E+09	
	-0.184818073	0.044428215	-0.212096172	0.802447	1	
	-0.678052011	0.160346536	-0.782527056	4.848581	-----	
	0.509628109	0.875072887	0.447925171	0.000318	-----	
Unemployment	3421.2358	-2.039150444	0.636547333	4486877	46491.54	7.440496222
	0.266849093	-0.437779164	0.22222205	0.251389	0.300862	1
	0.998339552	-1.755606592	0.821780735	0.936468	1.137476	-----
	0.336335543	0.102673968	0.426017126	0.366104	0.27587	-----

The Correlation matrix analysis of the data from 2009 to 2023 for the eThekwini Municipality, depicts that,

Road Traffic Accidents and eThekwini GDP Covariance: -6048.851 and Correlation: -0.7536 (p = 0.0012). There is a strong and statistically significant negative link between the Road Traffic Accidents and the GDP of Durban. This implies an inverse relationship between the eThekwini GDP and the occurrence of road traffic accidents. One potential rationale is that economic expansion results in enhanced infrastructure, optimised traffic control, and more public safety consciousness, all of which may contribute to a decline in accidents.

***Road Traffic Accidents and Inflation Covariance*:** 2362.475 and Correlation: 0.4786 (p = 0.0711). There is a moderate positive relationship between RTA and inflation, although it is not statistically significant at the 5% level. This implies that greater inflation rates may be linked to a rise in accidents, potentially caused by less investment in infrastructure or maintenance during times of economic hardship.

Road Traffic Accidents and Roads Infrastructure investment Covariance: -1.66E+10 and Correlation: -0.5386 (p = 0.0383). The interpretation of the data shows that there is a moderate and statistically significant negative association between RTA and road infrastructure investment. This suggests that when there is a higher allocation of funds towards road infrastructure, there is a corresponding decrease in the occurrence of accidents. This underscores the significance of investing in road safety measures and upkeep.

Road Traffic Accidents and Traffic Volumes Covariance: -49211435 and Correlation: -0.1848 (p = 0.5096). The little negative relationship between RTA and traffic volumes does not have enough statistical evidence to be considered significant. This implies that the quantity of vehicles on the road might not have a significant impact on the occurrence of road traffic accidents during the analysed period.

Road Traffic Accidents and Unemployment, Covariance: 3421.236 and Correlation: 0.2668 (p = 0.3363). The relationship between RTA and unemployment is weak and lacks statistical significance. This suggests that fluctuations in the unemployment rate have a restricted direct influence on the frequency of road traffic accidents.

The analysis reveals that the variables with the highest level of significance in relation to road traffic accidents in the eThekwini Municipality are GDP and infrastructure expenditure which is like study done by (Calvo-Poyo, Navarro-Moreno, & Oña, 2020). More precisely, an increase in GDP and an increase in investment towards road infrastructure are linked to a decrease in the number of road traffic accidents (Bhavan, 2019). Additional indicators such as inflation, traffic volume, and unemployment exhibit weaker and less reliable correlations with road traffic accidents.

4.2.4 Diagnostic Check

4.2.4.1 Variance Inflation Factor Analysis

Table 5 Multicollinearity check

Variance Inflation Factors			
Sample: 2009 2023			
Included observations: 15			
	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF
eThekwini GDP	168714.4787782408	3.748540604001772	1.804243034392309
Roads Infrastructure	1.892952068844423e-08	13.60084015760706	2.972289497168376
Traffic Volume	0.0002464086514043427	638.7934564095481	2.900165023236663
Inflation	403235.5856495414	43.42201541556233	1.630798410218228
Unemployment	52714.15122478466	75.53621642154925	1.438418767575493
C	165161957.6455309	605.7120925011742	N/A

Variance Inflation Factors Analysis (VIF) is performed to evaluate the extent of multicollinearity among the independent variables in the regression model (Belsley, Kuh, & Welsch, 1980). Multicollinearity arises when there is a strong correlation between independent variables, which can lead to difficulties in accurately calculating the coefficients.

- **Centered VIF:** This is the standard VIF, calculated after centering the variables. It is the more commonly used measure and is interpreted as follows: **VIF < 5:** Low to moderate multicollinearity. **VIF between 5 and 10:** Moderate to high

multicollinearity that might be problematic. **VIF > 10:** High multicollinearity, which could severely affect the estimates.

Interpretation of the VIF Table:

1. **eThekwini GDP (VIF = 1.804):** The VIF for GDP is below 5, indicating low multicollinearity.
2. **Inflation (VIF = 1.631):** The VIF for inflation is also below 5, indicating low multicollinearity.
3. **Roads Budget (VIF = 2.972):** The VIF for the roads budget is below 5, indicating low multicollinearity.
4. **Traffic Volumes (VIF = 2.900):** The VIF for traffic volumes is below 5, indicating low multicollinearity.
5. **Unemployment (VIF = 1.438):** The VIF for unemployment is below 5, indicating low multicollinearity.

All the variables in this regression model have VIF values that are significantly below the crucial threshold of 5. This indicates that there is no significant sign of multicollinearity in this analysis. Hence, the calculated coefficients for the independent variables are deemed dependable and consistent, exhibiting limited susceptibility to multicollinearity.

4.2.4.2 Residual Analysis

Table 6 Heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
Null hypothesis: Homoskedasticity				
F-statistic	2.841368	Prob. F (5,9)	0.0824	
Obs*R-squared	9.18275	Prob. Chi-Square (5)	0.102	
Scaled explained SS	1.98459	Prob. Chi-Square (5)	0.8513	
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 2009 2023				
Included observations: 15				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	46030332	13738021	3.35058	0.0085
eThekwini GDP	-405713.4	439081.7	-0.924004	0.3796
Inflation	127813	678810.6	0.18829	0.8548
Roads Infrastructure	0.512474	0.147075	3.48444	0.0069
Traffic Volumes	-57.71276	16.7802	-3.439337	0.0074
Unemployment	-74831.97	245432.9	-0.304898	0.7674
R-squared	0.612183	Mean dependent var	2454066	
Adjusted R-squared	0.39673	S.D. dependent var	2783432	
S.E. of regression	2161905	Akaike info criterion	32.30005	
Sum squared resid	4.21E+13	Schwarz criterion	32.58327	
Log likelihood	-236.2504	Hannan-Quinn criter.	32.29704	
F-statistic	2.841368	Durbin-Watson stat	1.990702	
Prob(F-statistic)	0.082449			

The Breusch-Pagan-Godfrey test is employed to detect heteroskedasticity in the residuals of a regression model. The null hypothesis posits homoscedasticity, which implies that the residuals variance remains constant.

Interpretation of the results:

1. F-statistic: 2.841368, Prob. F (5,9): 0.0824, The p-value (0.0824) is marginally higher than the conventional significance criterion of 0.05 but lower than 0.10. This indicates there might be slight presence of heteroskedasticity, though it is not very statistically significant.
2. Obs*R-squared: 9.182750, Prob. Chi-Square (5): 0.1020, The p-value (0.1020) above the significance level of 0.05, indicating that we cannot reject the null hypothesis of homoskedasticity at the 5% level of significance. There is no significant evidence of heteroskedasticity in the residuals.
3. The Scaled Explained Sum of Squares (SS) has a p-value of 0.8513, indicating a high probability that there is no heteroskedasticity present based on this statistic.

The results of the Breusch-Pagan-Godfrey test indicate that there is not much evidence of heteroskedasticity in the regression model. The p-values are in proximity to the 0.10 threshold, suggesting that although there may be heteroskedasticity, it is not incredibly significant.

4.2.4.3 Autocorrelation Analysis

Table 7 Autocorrelation

Sample: 2009 2023						
Included observations: 15						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
*|	*|	1	-0.126	-0.126	0.288	0.591
|	|	2	-0.001	-0.017	0.288	0.866
|*	|*	3	0.084	0.083	0.440	0.932
*|	*|	4	-0.112	-0.093	0.730	0.948
|	|	5	0.026	0.002	0.748	0.980
*|	*|	6	-0.098	-0.105	1.021	0.985
* |	*|	7	-0.108	-0.121	1.394	0.986
**|	***|	8	-0.307	-0.370	4.837	0.775
|	|	9	0.064	-0.027	5.013	0.833
*|	**|	10	-0.151	-0.206	6.173	0.801
|*	|*	11	0.167	0.172	7.958	0.717
|	*|	12	-0.053	-0.150	8.195	0.770

Autocorrelation analysis evaluates the extent to which the mistakes in a time series regression model are associated with one other at various time intervals. Within this framework, it is beneficial to ascertain whether the residuals from the regression model exhibit any trends, indicating the possibility of excluding significant variables or incorrectly specifying the model.

The autocorrelations (AC) and partial autocorrelations (PAC) at different lags exhibit an overall pattern of being low, with most values being near zero. This indicates that there is a lack of significant autocorrelation in the residuals at these specific time intervals. The maximum observed autocorrelation is at a lag of 8, with a value of -0.307. Nevertheless, this result does not suggest a noteworthy autocorrelation. The

Q-Statistic values for each lag are minimal, and the accompanying p-values are all significantly higher than the standard significance level of 0.05. The lack of notable autocorrelation in the residuals indicates that the model is accurately described in reference to the time series data. The absence of substantial autocorrelation indicates that the residuals are independent over time, which is favourable for ensuring the accuracy of the regression results.

The autocorrelation analysis reveals that the residuals derived from the regression model do not display any noteworthy autocorrelation. This validates the dependability of the model in elucidating the correlation between the economic variables and road traffic accidents in eThekwini Municipality from 2009 to 2023.

4.3 Results Discussion

The purpose of this study was to investigate the correlation between several economic and infrastructural factors and the occurrence of road traffic accidents in the eThekwini Municipality from 2009 to 2023. A linear regression model was used to analyse the effect of eThekwini's GDP, road infrastructure expenditure, traffic volumes, inflation, and unemployment on the annual number of road traffic accidents.

4.3.1 Evaluation of hypotheses

1.0 eThekwini GDP have direct impact to the Road Traffic Accidents eThekwini Municipality.

The study revealed a substantial negative correlation between eThekwini's GDP and the number of Road Traffic Accidents. The coefficient of this correlation was -1861.129568, indicating a strong negative link. Additionally, the p-value associated with this finding was 0.0014, suggesting a statistically significant result. More precisely, there was a correlation between a rise in eThekwini GDP and a decrease in road traffic accidents. This discovery implies that when the economic conditions improve, there is a tendency for road safety to increase, potentially because of enhanced road maintenance, safer vehicles, and more conscientious driving behaviour supported by economic stability (Jadaan et al, 2018).

A higher GDP indicate better economic conditions, which results in better road safety due to increased funding for road maintenance, greater investments in traffic

management systems, and heightened public awareness of road safety (Yusuff M. A., 2015). In addition, there may be a correlation between economic growth and improvements in vehicle technology, adoption of safer driving behaviours, and stricter enforcement of traffic rules. The inverse correlation between eThekwini GDP and RTAs implies that economic expansion has a favourable impact on road safety. This underscores the potential advantages of economic progress in mitigating traffic-related accidents, on the condition that expansion is accompanied by strategic expenditures in infrastructure and safety precautions (Tandrayen-Ragoobur, 2024).

2.0 Inflation have influence on the Road Traffic Accidents in eThekwini Municipality.

Inflation, which quantifies the pace at which the overall costs of goods and services increase, hence reducing the ability to buy, was projected to potentially impact RTAs through many means. Significant rising inflation may result in financial strain for humans, thereby impacting their habits on the road. For example, economic constraints could result in decreased allocation of funds towards car upkeep or insurance, heightening the likelihood of accidents as highlighted by (Makhubela, 2021) in study done in Mpumalanga province. Rising inflation can lead to higher expenses for fuel and vehicle maintenance, thus prompting changes in driving habits, such as reducing the frequency of trips or decreasing overall vehicle usage. If road usage decreases, there is a possibility of a reduction in the number of accidents (Sohaee & Bohluli, 2024).

Although there were possible links between the two, the study concluded that inflation did not have a noteworthy influence on road traffic accidents. The inflation coefficient was -340.6464, however, the p-value of 0.6047 indicated that this coefficient was not statistically significant. This suggests that changes in inflation rates does not have a meaningful correlation with changes in the number of road traffic accidents. Within the scope of this investigation, it is indicated that inflation may not have exerted a significant enough impact to directly affect road safety outcomes which aligns to (TaruwereYakubu & Muhammed, 2021) study.

3.0 The level of unemployment has influence to the number of Road Traffic Accidents in eThekwini Municipality.

Unemployment is the proportion of the labour force that is not employed yet actively looking for a job. It was hypothesised that unemployment could impact RTAs in the subsequent manners that increase financial stress results in vehicle neglect increasing the road traffic accidents possibility. Additionally increased unemployment could result in a decrease in the number of vehicles on the road, as fewer individuals would be commuting to work or other places of interest. This, in turn, may lead to a reduction in the occurrence of accidents. Financial strain can potentially result in more hazardous driving behaviour as individuals hurry to fulfil multiple job commitments or engage in other sources of income (Khalid et al, 2021).

However, the study's results indicate that unemployment did not exert a substantial influence on road traffic accidents. The coefficient for unemployment was positively correlated (91.97), but statistically insignificant (0.6981), suggesting that there is no meaningful association between unemployment rates and the number of RTAs (TaruwereYakubu & Muhammed, 2021). This phenomenon may be attributed to the consistent unemployment rates seen over the study period and the influence of other prevailing factors that have a greater impact on road accidents.

4.0 Traffic volume have impact to the road traffic accidents.

An evident correlation was found between the amount of traffic volume and the occurrence of road traffic accidents. The rise in the number of registered vehicles directly correlates with an increase in the occurrence of traffic accidents. The results emphasise the significance of implementing traffic management and control strategies to reduce the effects of increasing vehicle volumes on road safety (Sun et al, 2019).

The chance of road traffic accidents is strongly influenced by traffic volume, which is measured by the number of registered vehicles. As the number of vehicles increases, the likelihood of road traffic accidents also increases. The analysis revealed a statistically significant (0.0150) positive association between the volume of traffic and the frequency of road traffic accidents. The coefficient for traffic volume was positive, suggesting a direct relationship between the number of vehicles on the road and the probability of accidents. This aligns with the anticipation that greater traffic density augments the likelihood of collisions (Ashraf et al, 2019).

This discovery reinforces the need of controlling the amount of traffic as a method to decrease road traffic accidents, (Makhubela, 2021) alluded to this in a study done in Mpumalanga Province that found the strong positive relationship between traffic volumes and road traffic accidents.

5.0 The road infrastructure investment has impact to the road traffic accidents in the eThekwini Municipality.

Road infrastructure investment pertains to the financial resources designated for the upkeep and enhancement of the road system. This component is pivotal as the calibre of road infrastructure has a direct impact on driving conditions and safety. Investment in road infrastructure was discovered to have a substantial adverse impact on traffic accidents. The correlation between increased investment in road infrastructure and a decrease in road traffic accidents underscores the significance of ongoing investment in road maintenance and enhancements. This implies that improved roadways and associated infrastructure have a direct impact on decreasing the occurrence of traffic accidents (Bhavan, 2019).

The analysis discovered a statistically significant inverse correlation between expenditure on road infrastructure and the occurrence of road traffic accidents. The negative coefficient suggests that higher investment in road infrastructure is linked to a decrease in the occurrence of road traffic accidents, and this relationship is statistically significant with a p-value of 0.0008. The correlation between road infrastructure investment and traffic safety is evident, heightened investment results in safer roads and a reduction in road traffic accidents (Pembuain, Priyanto, & Suparma, 2018)

The research emphasises the crucial importance of well-maintained and sufficiently funded road infrastructure in improving traffic safety. Investments in road improvements, such as resurfacing, lane expansion, and the installation of safety measures like traffic lights and signage, can diminish the probability of road traffic accidents (Calvo-Poyo, Navarro-Moreno, & Oña, 2020).

4.4 Summary of Data Presentation and Analysis

EViews played a crucial role in effectively performing and confirming the econometric analysis in this study, guaranteeing the accuracy and strong evidence-based support

for the drawn results. The study utilised multiple linear regression to evaluate the influence of factors such as eThekwini GDP, inflation, traffic volume, and road infrastructure investment on road traffic accidents. EViews offers powerful tools for conducting these regressions, facilitating the estimation of coefficients, verification of statistical significance, and interpretation of the findings. EViews facilitated the execution of crucial diagnostic tests, such as assessing heteroskedasticity and autocorrelation. The conducted tests ensured the reliability and validity of the regression results, aiding in the identification and resolution of any faults in the model.

The direct relationship between traffic volume and the occurrence of road traffic accidents emphasises the necessity of implementing efficient traffic management measures to reduce the likelihood of accidents as the number of vehicles on the road rises. Conversely, the inverse relationships observed between the GDP of eThekwini and the investment on road infrastructure, and the occurrence of road traffic accidents indicate that enhancing economic growth and making targeted investments in road infrastructure can have a substantial impact on enhancing road safety.

Although inflation and unemployment are important economic indicators that can indirectly impact many social outcomes, the present research did not discover any substantial correlation between these factors and the occurrence of road traffic accidents in the eThekwini Municipality. These data indicate that, in this situation, economic policies and investments in infrastructure have a greater impact on road safety outcomes.

Chapter 5: Conclusions and Recommendations

5.1 Introduction

This chapter aims to consolidate the results of the previous chapter to offer practical suggestions for policymakers, urban planners, and stakeholders who are engaged in the improvement of road traffic safety and infrastructure development. Furthermore, it provides a concise overview of the main findings derived from the study, analysing the significance of the outcomes and their possible influence on future investigations and real-world implementations. The recommendations concentrate on implementing economic and infrastructural measures to reduce road traffic accidents, while the

study's findings emphasise the contributions to comprehending the intricate relationship between economic factors and road safety.

5.2 Conclusion based on Research Objectives

- *Investigating the role of economic factors, GDP, inflation, road infrastructure investment, unemployment, and traffic volume the likelihood of contributing to road traffic accidents.*

The study found a negative correlation between eThekwini's GDP and the number of road traffic accidents. This suggests that as the local economy expands, the occurrence of RTAs tends to decline. This discovery suggests that economic growth could enhance road safety, because of improved infrastructure and increased resources allocated to traffic management.

While there was a positive association between inflation and RTAs, its influence was comparatively less significant than that of other factors. This implies that although rising prices could influence consumer behaviour and road usage patterns, they do not have a significant impact on road safety in the municipality for this study.

The study revealed a significant inverse correlation between investment in road infrastructure and road traffic accidents, highlighting the crucial role of sufficient and well-maintained roadways in decreasing the number of road traffic accidents. This discovery emphasises the crucial importance of government expenditure in guaranteeing safer traffic conditions.

The research showed a direct relationship between the amount of traffic and the occurrence of RTAs, suggesting that higher traffic volumes lead to a higher probability of accidents. This aligns with the notion that an increased number of vehicles on the road increases the likelihood of accidents and events connected to traffic. The research revealed a lower, but nevertheless significant, link between unemployment and RTAs. Elevated levels of unemployment might result in heightened instances of erratic driving behaviour and stress-induced occurrences, hence amplifying the likelihood of accidents.

- *Understanding the economic impact that road traffic accidents have at eThekwini Municipality and its residents.*

In addition to the immediate financial impact, road traffic accidents also incur indirect expenses, including reduced productivity, loss of income resulting from road traffic

accidents, the long-term expenses associated with caring for individuals impacted by severe accidents and misdirection of financial resources to non-infrastructure investments. These expenses have a cumulative effect on the economy in the city, diminishing the total economic production and intensifying the financial burden on residents.

In conclusion, the study highlights the significance of economic factors in road safety legislation. Investment in road infrastructure is essential for mitigating road traffic accidents, whilst economic variables such as unemployment and GDP offer insights on overarching trends that may influence traffic conditions and accident frequencies. These findings may inform future policy actions designed to enhance road safety and mitigate the economic impact of road traffic accidents on the eThekwini Municipality.

5.3 Recommendations

In line with the results of this study, the following recommendations are proposed to mitigate the economic impact of road traffic accidents in the eThekwini Municipality

1. Enhance road infrastructure investment, considering the substantial negative correlation between spending on road infrastructure and road traffic accidents, it is advisable for policymakers to prioritise strengthening investments in road maintenance and enhancements to infrastructure. This includes the development of safer roadways, enhanced maintenance, and the adoption of sophisticated traffic control technologies.
2. Public awareness and education campaigns, implementing public awareness efforts that educate motorists about the risks linked to economic downturns, such as the significance of vehicle maintenance and safe driving practices, could also aid in decreasing the occurrence of road traffic accidents.
3. Review economic policies, given that eThekwini's GDP has had an adverse effect on road traffic accidents, it would be advantageous to review economic policies to continue and enhance GDP development while upholding road safety standards. To guarantee a secure and effective road network, it is imperative to maintain a harmonious equilibrium between economic expansion and investments in infrastructure.

4. Address Inflation and unemployment, while this study did not find a substantial influence of inflation and unemployment on road traffic accidents, it is important to acknowledge their potential implications for the future. Policymakers should strive to achieve inflation control and decrease the rate of unemployment to promote overall economic balance, which in turn has an indirect positive impact on road safety.

5. Monitor traffic volume trends, the correlation between the volume of traffic and the occurrence of road traffic accidents indicates the necessity for efficient traffic management measures. Implementing strategies to regulate traffic flow, such as implementing congestion pricing, optimising traffic signals, introducing intelligent transport system, and promoting alternate methods of transportation to alleviate congestion.

6. Integrate Traffic Management with Infrastructure Development, although improvements in road infrastructure may initially result in a rise in road traffic accidents due to increased traffic volumes, the long-term advantages are contingent upon efficient traffic management. Policymakers must guarantee that infrastructure upgrades are supplemented with strategic traffic management measures, including optimised signal timing, speed restriction, and enhancements for pedestrian safety, to reduce short-term accident risks.

5.4 Contribution of the Study

This study provides significant insights into the economic impact of road traffic accidents in the eThekwini Municipality, specifically in terms of crucial economic indicators like as GDP, inflation, road infrastructure investment, unemployment, and traffic volume. These contributions hold great importance, both within the realm of academic research and for the purpose of practical policymaking.

This research offers a more comprehensive knowledge of how macroeconomic factors, such as GDP, inflation, unemployment, road infrastructure investment, and traffic volume, affect road safety by conducting a quantitative analysis of their impact on the occurrence of road traffic accidents. The connection between these factors is essential in formulating policies that effectively target the fundamental economic causes of traffic accidents, rather than merely treating its surface manifestations.

One significant contribution of this study is the creation of evidence-based policy recommendations specifically designed for the eThekwini Municipality. The empirical findings establish basis for proposing specific actions, such as allocating more resources to road infrastructure, enhancing traffic management, and implementing economic policies that consider the impact of inflation and unemployment on road safety.

This study further enhances the academic field by presenting a framework for future investigations into the intersection of economics and road traffic safety. The methodology and conclusions can serve as a point of reference for comparable studies in different municipalities and regions, hence facilitating comparative study and broader generalisations.

The research highlights the need of investing in road infrastructure to decrease the probability of road traffic accidents. The study presents empirical evidence that demonstrates a negative relationship between infrastructure expenditure and accident rates. This supports the idea that well-maintained and sufficiently funded road infrastructure is crucial for enhancing road safety. This discovery adds to the current discussion on the distribution of public resources and the ranking of infrastructure projects.

5.5 Possible future areas of research

Technological Interventions and Smart City Initiatives: Future studies could investigate the effects of smart technologies on road safety as more cities implement these advancements. Research might investigate the efficacy of traffic management systems, automated enforcement mechanisms, and real-time data analytics in mitigating road traffic accidents, specifically in metropolitan environments such as eThekwini.

The influence of socioeconomic disparities on road safety: Although this study primarily examined macroeconomic indicators such as GDP, unemployment, and inflation, future investigations could investigate the impact of socioeconomic inequalities within the municipality on the probability of road traffic accidents. An exploration of the impact of income inequality, educational accessibility, and disparities in public transport on road safety could yield more precise recommendations tailored to certain demographic segments.

Comparative Studies Across Different Municipalities: To provide a more comprehensive perspective, future studies should examine the economic impacts of road traffic accidents in different municipalities or provinces and make comparisons. Comparative studies can determine the most effective methods and offer valuable insights into how various economic situations and regulatory frameworks impact road safety results.

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Annexures

Annexure A: Ethical Clearance Certificate

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School

Wits Business School Ethics Committee

04/07/2024

Ethics clearance number: **WWBS/BA2626310/604**

RE: Mr Amadues Memela

To whom it may concern

Mr Amadues Memela (2626310) is currently registered as a MBA (Research Article) student at the Wits Business School, University of the Witwatersrand, Johannesburg.

This letter is to confirm that, at the time of writing, Amadues Memela does not need ethical clearance for the study entitled:

The Economic Impact of Road Traffic Accidents in the eThekwini Municipality

This decision has been reached based upon a description of the project supplied by Amadues Memela to the Wits Business School Ethics Committee, constituted as a subcommittee of the University Human Research Ethics Committee (Non-Medical), which has been evaluated by the subcommittee chair. This decision has then been ratified by the University Human Research Ethics Committee (Non-Medical).

If, however, Amadues Memela changes the methods of data collection and analysis for this project, this decision may no longer be valid. If such changes take place, this should be communicated to the Wits Business School Ethics Committee.

Please feel free to contact me or the supervisor should you require any further information.

Yours sincerely,

Ethics Clearance
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Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

Signature

28-10-2024
Date: