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The Impact of Socioeconomic and Macroeconomic Factors on Road Accident Rates in Malaysia

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ABSTRACT

Road accident rates in Malaysia are alarming and should be analyzed further to minimize the cases and its impact. Hence, this study investigates the impact of socioeconomic and macroeconomic factors on road accident rates in Malaysia over the period 1992-2024 using the Fully Modified Ordinary Least Squares (FMOLS) method. The dependent variable is road accident rates, while the independent variables include socioeconomic factors (population and urbanization) and macroeconomic factors (inflation and economic growth). The results show that urbanization has a significant positive effect on road accident rates, indicating that urban growth contributes to increased road accidents, likely due to higher traffic density and congestion. Conversely, population and inflation have significant negative effects on road accident rates, suggesting that larger populations spread across more areas and higher inflation may reduce vehicle usage, leading to fewer accidents. Economic growth is found to have a marginally significant positive impact on road accident rates, likely driven by increased vehicle ownership and transportation activity. The study highlights the importance of addressing urban planning, road safety measures, and infrastructure development to mitigate the adverse effects of urbanization and economic growth on road safety.

Keywords: Road Accident, Economic Growth, Inflation, Population, Urbanization

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INTRODUCTION

Road accidents have become a pressing public concern, with alarming statistics revealing their devastating impact on individuals and communities. Every year, countless lives are lost or permanently altered due to collisions on the road, leading to emotional trauma, physical disabilities, and significant financial burdens. These incidents not only affect the victims but

also disrupt families and strain public resources. As road networks grow busier and more complex, the need to prioritize road safety becomes increasingly urgent. Addressing this issue is essential to safeguarding human life, promoting societal stability, and ensuring a safer environment for all road users. Ensuring road safety is of utmost importance because road accidents can result in severe consequences, including fatalities. By implementing effective safety measures and practices, the likelihood of accidents can be significantly reduced, thereby protecting lives and preventing the devastating impacts that such incidents can have on individuals, families, and communities.

Road accidents have profound negative effects on both families and nations. For families, the emotional trauma caused by accidents can lead to long-lasting psychological distress and suffering, while the financial burden of medical expenses, rehabilitation costs, and potential loss of income due to injury or death can destabilize their economic situation. The disruption of family life, including the need for caregiving or adjusting to the absence of a loved one, further exacerbates the emotional and financial strain. On a national level, road accidents impose significant economic costs, including medical expenses, property damage, and loss of productivity, which strain healthcare systems and impact economic growth. Increased insurance premiums and administrative costs add to the financial burden, while high accident rates contribute to public concern and a diminished sense of safety, affecting overall social stability and quality of life.

Road accidents can significantly distort economic growth by disrupting the productivity and potential of both young and professional individuals. When young people or emerging professionals become victims of road accidents, their potential contributions to the economy are lost. For young victims, this often means the loss of future talent and innovation that could drive economic progress and development. Professionals who are injured or killed in accidents represent a direct loss of skilled labor and expertise crucial to various industries. This disruption can lead to increased costs for businesses due to the need for replacement of staff, reduced productivity, and potential project delays. The overall impact includes a slower rate of economic growth, as both immediate and long-term productivity are adversely affected, undermining the nation's economic stability and advancement.

Higher road accident statistics can significantly impact future investors in several ways. Firstly, increased accident rates often signal poor road safety and infrastructure, which can deter investors concerned about the reliability and safety of transportation networks. This perceived risk can lead to higher insurance premiums and operational costs for businesses, making investments in such regions less attractive. Additionally, frequent accidents can result in higher healthcare and rehabilitation costs, which can affect overall economic stability and growth prospects, further discouraging investment. Investors may also be wary of potential reputational risks associated with operating in areas with high accident rates, fearing negative publicity or reduced consumer confidence. Consequently, the overall investment climate can become less favorable, as investors seek more stable and safer environments for their capital.

The rate of road accidents in Malaysia is a significant concern, highlighting a pressing public health issue that demands immediate attention. According to data from the Ministry of Transport Malaysia in 2020, the situation is particularly alarming. The statistics reveal that globally, approximately 1.35 million people lose their lives in road accidents each year. This translates to an average of 3,700 fatalities daily due to traffic-related incidents. Focusing on Malaysia, the figures are equally disturbing, with an average of 18 individuals dying in road accidents every day. These numbers paint a grim picture of the dangers present on Malaysian roads, where traffic incidents have become a leading cause of death and injury. The consistent loss of life underscores the severity of this public health challenge, which not only affects the

victims and their families but also has broader social and economic implications. Given the scale of the problem, there is an undeniable urgency for the government and relevant authorities to develop and implement more effective policies and interventions. This study takes a distinct approach that sets it apart from prior research by delving deeply into the potential factors that contribute to road accidents. Unlike other studies, it provides a comprehensive analysis by carefully examining both socioeconomic indicators and macroeconomic factors. Additionally, road accidents continue to be a major socioeconomic challenge (Mphela, 2020). On the macroeconomic side, the study explores key indicators like inflation and economic growth, recognizing that economic conditions can have significant impacts on road accident rates. By integrating these various factors, the study aims to uncover the complex relationships that contribute to road accidents, offering insights that could inform more effective policy responses.

LITERATURE REVIEW

Road accident is a serious problem in Malaysia (Harith & Mahmud, 2018). Hence it is required for periodic observations. As a result, numerous past researchers have shown interest in uncovering the reasons behind the ongoing cases. Consequently, this study organizes the existing research into specific determinants that require focused attention in this investigation.

Socioeconomic Indicators

The conceptualization of socioeconomics is much broader, defining its field of study as the science of human society and social change (Hellmich, 2015). Therefore, examining socioeconomic indicators is crucial to understanding their impact on road accidents (Hossain et al., 2024).

Urbanization

Urbanization refers to the gradual movement of people from rural areas to urban centers, as evidenced by the annual increase in the population of specific cities. This trend of growing urbanization is occurring worldwide (Nsabimana, et al., 2024). A study by Aati et al. (2024) in Pakistan revealed a significant impact of urbanization on road accidents. The research further established a positive correlation between increasing urbanization and the frequency of road accidents. Cabrera-Arnau et al. (2020) conducted a comparative study focusing on England and Wales, ultimately finding a significant positive relationship between urbanization and the rate of road accidents. They also discovered that serious accidents occur more frequently in urban areas. Kitara and Karlsson (2020) confirmed that urbanization negatively impacted factors such as stress and financial strain due to the high cost of living in urban areas. In the case of Northern Uganda, these pressures influenced driving and riding behaviors, leading to a positive correlation between urbanization and road accidents. A forecasting study on road accident factors in Bucharest by Oprea et al. (2024) suggested that urbanization can positively influence the incidence of road accidents. Cespedes et al. (2024), thoroughly examined the degree of urbanization and confirmed its positive influence on road accident rates. Their study reaffirmed that higher levels of urbanization are associated with an increased incidence of road accidents. In line with the studies mentioned above, Tippayanate et al. (2024) examined road accidents in Thailand, specifically in Khon Kaen Municipality. They concluded that urbanization contributed to road accidents through increased traffic volume. A study conducted in Malaysia by Kamarudin et al. (2018) using a quantitative survey found that Selangor recorded the highest rate of fatal road accidents, largely due to urbanization which led to increased traffic

congestion. In contrast, the study also revealed that Perlis had the lowest rate of road accidents, attributed to its lower level of urbanization.

Population

Mphela (2020), in his investigation of road accidents and their determinants in Botswana using Ordinary Least Squares (OLS), found that population size positively contributes to the rate of road accidents. Furthermore, high population density increases the incidence of fatalities resulting from road accidents. Watson and Ryan (2024) conducted a study to identify the factors contributing to road accidents in Australia and found a positive correlation between population size and the incidence of road accidents. This finding aligns with the study conducted by Edries and Alomari (2022) in Jordan, where Time-Series and Multiple Linear Regression models demonstrated that higher population density leads to increased traffic volume, which in turn elevates the risk of road accidents. In the case of Malaysia, Kamarudin et al. (2018) found that Selangor recorded the highest number of road accident cases, which they attributed to its larger population size that contributed to the increased incidence of accidents. Conversely, Perlis reported the lowest number of cases, a trend associated with its smaller population.

Macroeconomic Indicators

Macroeconomic refers to the study of the overall economy, focusing on key indicators like inflation, GDP growth, public deficits, and unemployment, which help measure economic health, guide government policies, and shape public opinions (Mügge, 2016).

Inflation

Inflation is influencing road accidents through the ownership of vehicles. In the case of Nigeria, inflation has a positive correlation with road accidents, as noted by Yakubu et al. (2023). This may be due to the reason that as inflation drives up the cost of vehicle maintenance and repairs, many drivers may postpone necessary upkeep, leading to poorly maintained vehicles that are more prone to accidents. Additionally, higher fuel and transportation costs can result in more aggressive driving as people try to conserve fuel or save time, increasing the likelihood of collisions. Financial stress from rising costs can also lead to distracted or reckless driving, further elevating accident risks. Moreover, inflation may force individuals and governments to reduce spending on safety measures, such as road maintenance and traffic signals, creating more hazardous driving conditions. However, this finding contradicts the studies conducted by Ajide (2020), Elias and Shiftan (2014). In separate studies conducted in Nigeria, Ajide (2020) and Akinyemi (2020) utilized the Auto Regressive Distributed Lagged (ARDL) model to examine the relationship between inflation and road accidents. Their research revealed that as inflation rises, the cost of vehicle ownership increases correspondingly. This escalation in ownership costs discourages people from purchasing vehicles, leading to a decline in the overall number of vehicles on the road. As a result, reduced vehicle ownership contributes to a decrease in the risk of road accidents.

Economic Growth

Islam & Hadhrami (2012) found that economic growth is positively linked to road accidents in Oman. As economic growth increases, so do car ownership and automobile usage, leading to a higher risk of road accidents. Akinyemi (2020) using ARDL had found that economic growth

linked to road accidents in the short run for Nigeria. In the case of Spain for the timeline between 1999-2015, González et al. (2020) found that economic growth significantly impacted road accidents in the richest provinces. These empirical findings are consistent with the forecasting study in Thailand which adopted three models and found a significant positive between economic growth and road accidents conducted by Jomnonkwao et al (2020). Meanwhile, the study in China conducted by Wu et al. (2020) using the data between 2000-2016 found the same result.

METHODOLOGY

This study aims to examine the impact of socioeconomic and macroeconomic factors on the occurrence of road accidents in Malaysia. Socioeconomic factors are represented by urbanization and population, while macroeconomic factors are captured through indicators such as inflation and economic growth. To analyze this impact, the study employs the Fully Modified Ordinary Least Squares (FMOLS) method using annual time series data from 1992 to 2024. In this model, the road accident rate functions as the dependent variable, whereas urbanization, population, inflation, and economic growth are treated as independent variables.

Model Specification

By exploring these variables, the study seeks to uncover the extent to which socioeconomic conditions and broader economic trends contribute to the frequency of road accidents. Thereby, the model is adopted by Erdal and Erdal (2020) and modified to perfectly match the variables adopted in the study. The model specification is as follows:

$$RA_t = \alpha + \beta_1 Urb_t + \beta_2 POP_t + \beta_3 Inf_t + \beta_4 Eco_t + \varepsilon_t \quad (1)$$

In this study, RA denotes the dependent variable, representing the road accident rate under analysis. The coefficients β_1, β_2, β_3, and β_4 measure the influence of the independent variables on RA, indicating how variations in these factors affect road accident rates. Specifically, Urb stands for urbanization, POP for population, Inf for inflation, and Eco for economic growth. The intercept, α, reflects the expected value of RA when all independent variables are equal to zero. Lastly, the error term accounts for the portion of RA that is not explained by the model, capturing the effects of unobserved variables, random fluctuations, and other external influences.

Variables Descriptions

Table 4 outlines the variables used in this study, which include two proxies representing socioeconomic factors and two representing macroeconomic factors.

Table 4
Variable Descriptions

Category of variables	Variables	Proxy	Description	Source
Independent Variables	Socioeconomic	Urbanization	Urban population (% of total population)	Urb
		Population	Total population refers to all residents, regardless of legal status or citizenship, based on midyear estimates.	Pop
	Macroeconomic	Inflation	Inflation, measured by the consumer price index, reflects the annual percentage change in the cost of a fixed or periodically adjusted basket of goods and services, typically calculated using the Laspeyres formula.	Inf
		Economic growth	GDP is the total of gross value added by all resident producers, plus product taxes and minus subsidies not included in product values, without accounting for depreciation or resource depletion. The data is in constant local currency.	Eco
Dependent variables	Road accident rates	Road accident cases	Case which recorded by the Royal Malaysian Police Report	RA

Estimation Procedures

Descriptive statistics took part in the study as they play a vital role in research by summarizing the fundamental characteristics of the data. They offer straightforward overviews of the sample and its measurements. To describe quantitative data, measures of central tendency and dispersion are commonly employed. For continuous data, assessing normality is a key step in determining appropriate measures of central tendency and selecting suitable statistical methods for analysis.

Unit Root Test

It is crucial to verify the stationarity of all variables in equation (1), determining whether they are stationary at their original level (I (0)) or after the first difference (I (1)), while ensuring no variables exhibit second-order stationarity (I (2)). This verification is performed using the Augmented Dickey-Fuller (ADF) unit root test, a method introduced by Dickey and Fuller. The steps for conducting the ADF test are outlined as follows:

$$\Delta y_t = \beta_1 + \beta_{2t} + \delta y_{t-1} + \delta_i \sum \Delta y_{t-1} + \varepsilon_t \quad (2)$$

In this context, Δy_t represents the first difference of the variable, while β1 denotes the constant term in the regression equation. The coefficient $\beta 2$ reflects the influence of time (t) on changes in Δy. The parameter δ captures the coefficient of the lagged dependent variable y_{t-1} and α_i represents the coefficients of the past differences of y_t expressed as $\Sigma \Delta y_{t-1}$, while εt is the error term that accounts for unexplained variations in Δ_{yt} not covered by the independent variables.

Johansen Co-Integration Test

The Johansen co-integration test is a statistical method used to determine whether multiple time variables have a long-term, stable relationship. It helps identify the number of co-integrating equations, which indicates how the variables move together over time, despite short-term fluctuations.

Fully Modified Ordinary Least Square

The Fully Modified Ordinary Least Squares (FMOLS) is an estimation method used in time series analysis to correct for serial correlation and endogeneity in the data, providing more reliable coefficient estimates. It adjusts the standard ordinary least squares (OLS) to account for non-stationary, co-integrated variables, ensuring efficient and consistent results in long-run relationships. FMOLS estimator is given as follows:

$$\hat{O}_{FME} = \left(\sum_{t=1}^{T} Z_t Z_t'\right)^{-1} \left(\sum_{t=1}^{T} Z_t Y_t^{+} - T[\lambda_{12}^{+}, 0]\right) \quad (3)$$

Where:

Y^{+} : the term of correct endogeneity.

λ_{12}^{+} : the term of correct serial correlation.

FINDINGS

Table 5 exhibits the nature of the variables based on the descriptive test. the analysis found that the data for each variable (RA, Urb, POP, Inf, and Eco) has a mean close to the median, with small standard deviations, indicating relatively consistent values, the small standard deviations indicate minimal variability within each variable, while the negative skewness values, which are close to zero, suggest a relatively balanced distribution with no extreme outliers or significant bias toward higher or lower values.

Table 5

Descriptive Test Results

Item	RA	Urb	POP	Inf	Eco
Mean	12.6468	4.1952	17.0759	4.5169	27.3709
Median	12.7717	4.2183	17.1039	4.5202	27.4011
Maximum	13.2490	4.3528	17.3293	4.8126	27.9845
Minimum	11.1098	3.9477	16.7347	4.1290	26.5745
Std. Dev.	0.4976	0.1209	0.1837	0.2088	0.4194
Skewness	-1.1400	-0.5192	-0.3299	-0.1961	-0.1448

Unit Root Test

The unit root test results in Table 6 show that all variables are stationary after 1st difference. This suggests that after differencing, the variables become stable, meaning they do not have unit roots and are suitable for further analysis.

Table 6
Unit Root Test Results

Variables	Intercept		Intercept and Trends	
	Level	1st Difference	Level	1st Difference
RA	-0.2128	-0.8188***	0.0113	-0.0060
	0.1100	0.0000	0.1692	0.0054***
Urb	-0.0233	-0.0499**	-0.0351	-0.1533
	0.1053	0.0611	0.1231	0.0864*
Pop	-0.0049	0.0017*	0.0000	-0.0001
	0.1250	0.0959	0.8824	0.0228**
Inf	-0.0301	-0.8486	0.0039	-0.0007
	0.1049	0.0016***	0.1718	0.0017*
Eco	-0.0359	-0.9448	0.0204	-0.0014
	0.2512	0.0004***	0.1751	0.0012*

Note: *, ** and *** referred as significance at 10%,5% and 1%

Johansen Co-Integration Test

Table 7 reveals that there are two co-integrating relationships (at most 1 and none), as the trace statistics exceed the critical values with p-values less than 0.05. This suggests a long-term equilibrium relationship between the variables up to two cointegrating vectors.

Table 7
Johansen Co-Integration Test Results

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.7443	91.3891	69.8189	0.0004
At most 1 *	0.5982	53.2067	47.8561	0.0145
At most 2	0.4977	27.6782	29.7971	0.0861
At most 3	0.2576	8.3987	15.4947	0.4238
At most 4	0.0020	0.0572	3.8415	0.8110

Fully Modified Ordinary Least Square (FMOLS)

The FMOLS results in Table 8 show that urbanization has a significant positive impact on road accident rates, while population and inflation have significant negative effects. Economic growth has a marginally significant positive impact on road accident rates, with a *p*-value slightly above the 0.05 threshold.

Table 8
Fully Modified Ordinary Least Square Results

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
Urbanization (Urb)	10.7195	2.1208	5.0546	0.0000***
Population (pop)	-2.9961	1.1309	-2.6494	0.0138**
Inflation (inf)	-4.1065	1.3489	-3.0444	0.0054***
Economic Growth (Eco)	1.3657	0.6789	2.0116	0.0552*

Note: *, ** and *** referred as significance at 10%, 5% and 1%

DISCUSSION

The FMOLS results indicate that urbanization has a significant positive impact on road accident rates, suggesting that as urban areas expand, the number of road accidents increases. This could be due to higher traffic volumes, congestion, and the complexity of urban road networks, which can increase the likelihood of accidents. This result is parallel to the past studies such as Cespades et al. (2024), Oprea et al. (2024), Aati et al. (2024) and Cabrera-Arnau et al. (2020). To mitigate this, policymakers could prioritize improving road infrastructure in urban areas, implementing stricter traffic regulations, and promoting better urban planning that includes pedestrian-friendly and safe traffic management systems. These endeavors have been seriously implemented in Sween through "Vision Zero" slogan that emphasized on system including road environments, speed regimes, vehicle safety, and post-crash intervention (Shi, Methoxha, & Garrick, 2020).

Conversely, population and inflation have significant negative effects on road accident rates. This finding is consistent to Ajide (2020), Elias and Shiftan (2014). A potential explanation for the negative relationship with population could be the spread of population across wider areas, leading to less congestion and fewer accidents in densely populated areas. The negative effect of inflation might reflect economic conditions where rising costs could reduce vehicle ownership or travel frequency, thus lowering accident rates. However, this could be a short-term effect, as inflation could eventually lead to less funding for road safety improvements if not managed carefully.

The marginally significant positive impact of economic growth on road accidents suggests that as the economy grows, road accidents may rise, possibly due to increased vehicle ownership, more goods transported, and expanded infrastructure that may initially lack sufficient safety features. This finding is repeated the result by González et al. (2020). To address this, economic growth policies should be accompanied by investments in road safety initiatives, such as improved traffic management systems, public transportation options, and road safety awareness programs to reduce the negative externalities of increased mobility.

Overall, effective road safety policies should focus on managing the complexities of urbanization, controlling the pace of economic growth, and addressing the indirect effects of population growth and inflation.

CONCLUSION

In conclusion, the analysis reveals that urbanization significantly increases road accident rates, while population growth and inflation appear to have a negative impact, potentially due to less congestion and reduced travel frequency. Economic growth also contributes to higher accident rates, likely due to increased vehicle numbers and travel activity. Policymakers should focus on enhancing urban infrastructure, implementing stricter traffic regulations, and investing in road safety measures to address the risks associated with urbanization and economic growth. Additionally, addressing the broader socio-economic factors, such as controlling inflation and managing population density in urban areas, will be crucial in reducing road accidents and ensuring safer road environments for all.

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REFERENCES

Aati, K., Houda, M., Alotaibi, S., Khan, A. M., Alselami, N., & Benjeddou, O. (2024). Analysis of road traffic accidents in dense cities: Geotech transport and arcgis. *Transportation Engineering, 16*. https://doi.org/10.1016/j.treng.2024.100256

Ajide, F. M. (2020). Criminal activities and road accidents in Nigerian transport industry. *Transportation in Developing Economies, 6*(1), Article 3. https://doi.org/10.1007/s40890-020-00094-4

Akinyemi, Y. (2020). Relationship between economic development and road traffic crashes and casualties: Empirical evidence from Nigeria. *Transportation Research Procedia, 48*, 218–232. https://doi.org/10.1016/j.trpro.2020.08.017

Cabrera-Arnau, C., Curiel, R. P., & Bishop, S. R. (2020). Uncovering the behaviour of road accidents in urban areas. *Royal Society Open Science, 7*(4), 191739. https://doi.org/10.1098/rsos.191739

Cespedes, L., Santolino, M., & Ayuso, M. (2024). *Population density in aging societies and severity of motor vehicle crash injuries: the case of Spain.* Research Institute of Applied Economics.

Edries, B., & Alomari, A. H. (2022). Forecasting the fatality rate of traffic accidents in Jordan: applications of time series, curve estimation, and multiple linear regression models. *Journal of Engineering Science and Technology Review, 15*(6), 70-77.

Elias, W., & Shiftan, Y. (2014). Analyzing and modeling risk exposure of pedestrian children to involvement in car crashes. *Accident Analysis & Prevention, 62*, 397–405. https://doi.org/10.1016/j.aap.2013.06.035

González, M. P., Ponce, Á. T., & Sotos, F. E. (2020). Interregional inequality and road accident rates in Spain. *Accident Analysis & Prevention, 135*, 105347. https://doi.org/10.1016/j.aap.2019.105347

Harith, S. H., & Mahmud, N. (2018). Human risk factors and road accident causation among motorcyclists in Malaysia: A review article. In *Proceedings of the International Conference on Industrial Engineering and Operations Management* (pp. 2202–2209). Bandung, Indonesia.

Hellmich, S. N. (2015). What is socioeconomics? An overview of theories, methods and themes in the field. *Forum for Social Economics.*

Hossain, S., Maggi, E., & Vezzulli, A. (2024). Factors influencing road accidents in low and middle-income countries: A systematic literature review. *International Journal of Injury Control and Safety Promotion, 31*(2), 294–322. https://doi.org/10.1080/17457300.2024.2319618

Islam, M. M., & Hadhrami, A. Y. (2012). Increased motorization and road traffic accidents in Oman. *Journal of Emerging Trends in Economics and Management Sciences, 3*(6).

Jomnonkwao, S., Uttra, S., & Ratanavaraha, V. (2020). Forecasting road traffic deaths in thailand: applications of time-series, curve estimation, multiple linear regression, and path analysis models. *Sustainability, 12*(1). https://doi.org/10.3390/su12010395

Kamarudin, M. K. A., Abd Wahab, N., Umar, R., Shakir Mohd Saudi, A., Hafiz Md Saad, M., Rozaireen Nik Rosdi, N., Abdul Razak, S. A., Murtadha Merzuki, M., Salam Abdullah, A., Amirah, S., & Mohd Ridzuan, A. (2018). Road traffic accident in Malaysia: Trends, selected underlying determinants and status intervention. *International Journal of*

Engineering & Technology, *7*(4.34), 112–117. https://doi.org/10.14419/ijet.v7i4.34.23839

Kitara, D. L., & Karlsson, O. (2020). The effects of economic stress and urbanization on driving behaviours of Boda-boda drivers and accidents in Gulu, Northern Uganda: a qualitative view of drivers. *Pan African Medical Journal, 36*(47).

Mphela, T. (2020). Causes of road accidents in Botswana: An econometric model. *Journal of Transport and Supply Chain Management, 14*(1).

Mügge, D. (2016). Studying macroeconomic indicators as powerful ideas. *Journal of European Public Policy, 23*, 410-427. https://doi.org/10.1080/13501763.2015.1115537

Nsabimana, P., Sombie, O. O., Pauwels, N. S., Boynito, W. G., Tariku, E. Z., Vasanthakaalam, H., & Henauw, S. D. (2024). Association between urbanization and metabolic syndrome in low- and middle-income countries: A systematic review and meta-analysis. *Nutrition, Metabolism and Cardiovascular Diseases, 34*(2), 235–250. https://doi.org/10.1016/j.numecd.2023.07.040

Oprea, C., Rosca, E., Ionut, P., Ilie, A., Rosca, M., & Rusca, F. (2024). Forecasting methods for road accidents in the case of Bucharest city. *Engineering Proceedings, 68*(3), 2–8. https://doi.org/10.3390/engproc2024068003

Shi, G., Methoxha, V., & Garrick, N. (2020). Moving beyond the vision zero slogan. *Transportation Research Record: Journal of the Transportation Research Board*. https://doi.org/10.1177/03611981221103245

Tippayanate, N., Impool, T., Sujayanont, P., Muttitanon, W., Chemin, Y., & Som-ard, J. (2024). Spatial distribution and cluster analysis of road traffic accidents in Khon Kaen Municipality, Thailand. *International Journal of Geoinformatics, 20*(4), 43–55. https://doi.org/10.52939/ijg.v20i4.3149

Watson, R. B., & Ryan, P. J. (2024). Geospatial factors applied to road accidents: A review. *Journal of Advances in Information Technology, 15*(3), 451–457.

Wu, W., Jiang, S., Liu, R., Jin, W., & Ma, C. (2020). Economic development, demographic characteristics, road network and traffic accidents in Zhongshan, China: Gradient boosting decision tree model. *Transportmetrica A: Transport Science, 16*(3), 359–387. https://doi.org/10.1080/23249935.2020.1711543

Yakubu, A. T., Ajide, F. M., & Abdulrahman, I. A. (2023). Income inequality and road transport accidents in Nigeria. *African Journal of Economic Review, 11*(2), 43-54.

Zailani, M. N., Satar, N. M., & Zakaria, R. H. (2022). A review of indicators for the preservation of wealth (hifz al-mal) based on Maqasid al-Shariah. *Journal of Islamic Philanthropy & Social Finance (JIPSF), 4*(1), 23–29.