UNVEILING GLOBAL ROAD ACCIDENT PATTERNS: INSIGHTS, ANALYTICS, AND IMPLICATIONS FOR SAFER DRIVING PRACTICES

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ABSTRACT

Every day, we are confronted with alarming news of serious injuries and fatalities resulting from car accidents. In the past decade, these incidents have been on the rise, posing a significant concern for individuals and societies worldwide. The impact of these accidents is particularly devastating when innocent lives, including children, are affected by the long-lasting consequences. While driver behavior remains a major contributing factor to road accidents, there are also other indirect reasons such as infrastructure issues and weather conditions. Addressing this global problem is of utmost importance to safeguard lives and create a safer driving environment for everyone.

Sunkpho and Wipulanusat (2020) utilized Business Intelligence (BI) methods, specifically data visualization and analytics, to analyze accident data and provincial data obtained from the Talend Data Integration tool, loaded into a MySQL database, and visualized using Tableau. Their aim was to provide insights into highway accidents and advise the Thai government on adopting this system for formulating strategy options and contingency plans to improve the accident situation. Nour et al. (2020) employ advanced data analytics methods, specifically predictive modeling techniques, to predict injury severity levels and evaluate their performance using publicly available road accident data from the UK Department of Transport spanning 2005 to 2019. Golhar and Kshirsagar M (2021) propose and implement various strategies using the Map-Reduce framework, combining video surveillance and big data analytics, to address the issues of increasing on-road traffic, road congestion, rule violations, and road accidents, aiming to improve road traffic management and make urban population life more comfortable. Yuksel and Atmaca S. (2021) use accelerometer and gyroscope sensor data and applied various machine learning algorithms, including C4.5 Decision Tree, Random Forest, Artificial Neural Network, Support-Vector Machine, K-Nearest Neighbor, Naive Bayes, and K-Star algorithms, to model and evaluate risky driving behaviors, ultimately developing a highly accurate and cost-effective system capable of recording and identifying risky driving behaviors, with potential applications in usage-based insurance policies to incentivize safe driving practices. Mesquitela et al. (2022) use a data fusion process, incorporating information from various sources such as road accidents, weather conditions, local authority reports, traffic, and fire brigade, to analyze and identify geo-referenced accident hotspots in urban areas using ArcGIS Pro and Kernel Density and Hot Spot Analysis tools, aiming to evaluate the factors influencing accident severity and provide

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knowledge for local municipalities to improve their infrastructure and quality of life, with the results validated by an expert committee, and the approach being applicable to other cities with similar data availability.

Based on our Scopus search on "road accidents" and "analytics," no existing references were found directly aligned with our research idea. This highlights the originality of our paper, which aims to raise awareness about road accidents as a significant global issue and provide a comprehensive understanding of their key contributing factors through the analysis of road accident data from six representative countries across different continents including the UK, USA, Chile, Australia, Japan/UAE, and South Africa/Egypt. Our research sheds light on critical aspects of these incidents, explores trends, identifies influential factors, determines countries with low accident rates and casualties, and evaluates the potential impact of data analysis techniques on enhancing road safety. We will use datasets from the selected representative countries, focusing on road accidents that occurred between 2021 and 2022. By employing various analytical methods, we will explore the data from different angles, including descriptive analytics, diagnostic analytics, predictive analytics, prescriptive analytics, and cognitive analytics. Each method will contribute valuable insights to our analysis and understanding of the problem. We will employ Power BI for descriptive and diagnostic analytics, Python for predictive analytics using multilinear regression, Power BI for visualizing regression results, MaxDea Lite and Microsoft Excel for prescriptive analytics such as Data Envelopment Analysis (DEA) and Linear Programming, and also simulations to aid decision-making.

Through our analysis, we will address key questions related to road accidents and their impact. For instance, we will determine whether the number of road accidents decreased or increased from 2021 to 2022 and identify the major contributing factors. Furthermore, we will assess the countries with the lowest accident rates and casualties based on ratios per million inhabitants for both years. By leveraging visualization techniques in Power BI, we will present the findings in an accessible and informative manner, enabling stakeholders to grasp the insights easily. The visualization and analysis will provide a deeper understanding of the trends, underlying factors, and the potential of data analysis techniques, such as DEA and Linear Programming, in addressing road safety.

The importance of this research lies in its potential to generate significant impact. By shedding light on road accidents as a pressing global issue, the findings will raise awareness among individuals worldwide. Understanding the data from the six representative countries will enable comparisons, identification of best practices, and the formulation of informed strategies to reduce accidents and casualties. The results will benefit researchers, policymakers, and organizations involved in road safety initiatives. The insights gained will help shape evidence-based decisions, implement targeted interventions, and promote safer driving practices to prevent tragic outcomes caused by road accidents.

Key words: road accidents, analytics, road safety