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Navigating Towards Vision Zero: A Precision Approach to Mitigating Traffic Accidents in the Netherlands by 2050 using SAS Viya ®.

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ABSTRACT

The study embarks on an in-depth examination of the dynamics of traffic accidents in the Netherlands, critically assessing the progress towards the Vision Zero initiative against the backdrop of evolving urban landscapes and mobility demands. This analysis examines the accident data by focusing on various facets such as demographic vulnerabilities, road situations, weather conditions, and vehicle involvement which unveils pivotal trends and patterns essential for understanding the current road safety climate (Stipdonk & Reurings, 2012). Moreover, it scrutinizes the significant impact of intoxication on late-night accidents and high casualties during weekends highlighting the disparity in risk factors across different times. Also emphasizing the disproportionate representation of age groups in traffic casualties (Phillips & Brewer, 2011; Williams, 2003). Employing a comprehensive data-driven methodology, this paper not only maps the trajectory towards Vision Zero but also illuminates strategic areas for intervention, offering insights with global applicability for similar road safety endeavors (Peden et al., 2004).

INTRODUCTION

The Netherlands, renowned for its comprehensive traffic management and robust cycling infrastructure, stands at the forefront of global road safety initiatives. Amidst its bustling urban centers and extensive cycling paths, the Dutch government's dedication to the Vision Zero goal—aiming to eliminate all road fatalities and serious injuries by 2050—highlights a proactive commitment to safeguarding its citizens (Wegman, 2017). This ambition, grounded in the belief that every traffic death is preventable, necessitates a multifaceted approach, encompassing advanced infrastructure design, policy reform, and active public engagement (Tingvall & Haworth, 1999). However, despite progressive measures, the persisting prevalence of traffic accidents, especially among vulnerable groups such as cyclists and pedestrians, underscores the urgency for a nuanced exploration of contributing factors (Schepers et al., 2014).

PROBLEM STATEMENT

In the Netherlands, traffic accidents remain a significant challenge despite the country's commitment to the Vision Zero goal, aiming to eliminate all road fatalities and serious injuries by 2050 (Tingvall & Haworth, 1999). This study leverages advanced analytical tools provided by SAS ® Visual Analytics to dissect traffic accident data, focusing on vulnerable road users such as cyclists, pedestrians, and motorcyclists. The persistent occurrence of accidents, especially involving these groups, underscores the need for a nuanced understanding and targeted interventions (Wegman, Aarts, & Bax, 2008). The application of data mining techniques in traffic safety analysis represents a promising approach to uncover underlying

patterns and contributing factors to accidents (Srinivasan & Jovanis, 2013), providing a data-driven foundation for enhancing road safety measures.

DATA PREPARATION

The dataset is available on SAS Viya ® for Learners Platform as "ONGEVALLEN2016_EN" with 124,992 observations of traffic accidents in Netherland between January and December 2016 which was collated by the Department of Traffic system. The data consist of both numeric and character variables. In the data preparation phase for the analysis aligned with the Netherlands' Vision Zero initiative, a meticulous exploration of the dataset was undertaken using SAS Visual Analytics on the SAS Viya platform. This comprehensive approach was essential to ensure the data's integrity and relevance. Initially, the dataset was thoroughly examined to identify patterns and comprehend the significance of each variable, such as "Accident ending" (VKL_End), "Age of the youngest and oldest casualty" (Min_Age, Max_Age), and environmental factors like "Amount of precipitation" (RH) and "Average wind speed" (FH). Understanding these variables laid the groundwork for a detailed examination of the relationships between different data points, crucial in aligning the analysis with current traffic safety trends.

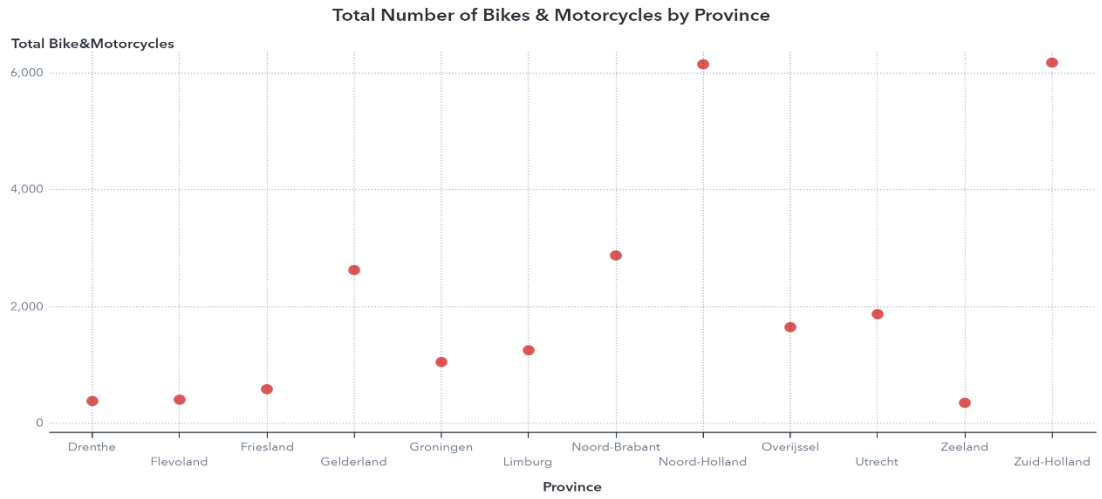
To augment the dataset's utility for our analysis, key data preparation steps were implemented. Missing data were identified and removed to ensure the findings' accuracy. Numerical values for critical variables, such as the age of the youngest casualty, were transformed into age group, which is categorical data, to enable a more nuanced analysis. Date information was refined to extract the month, weekday, and hour of each accident, thereby introducing a temporal dimension to the investigation. Geographical information was enhanced by generating province names from province latitude and longitude, facilitating a precise spatial analysis of accidents. Finally, the variable representing the province name was standardized across the dataset to ensure consistency.

These meticulous data preparation steps not only streamlined the analysis process but also significantly enhanced the ability to draw meaningful insights into traffic accident trends in the Netherlands. This methodical approach positions the analysis to effectively contribute to the Vision Zero goal, leveraging data-driven strategies to reduce traffic fatalities and injuries.

EXPLORATORY DATA ANALYSIS

After conducting data pre-processing and preparation using SAS ® Visual Analytics, our analysis delved into exploring the dataset to extract valuable insights. One significant step involved creating a new variable, "No. Of motorcycle and bikes," by combining the counts of motorcycles and bikes. This addition allowed us to focus on vulnerable groups within the dataset.

Upon examining the relationship between provinces and the newly calculated variable, intriguing trends emerged. Notably, provinces such as Noord Holland, Zuid Holland, and Noord Brabant exhibited a higher percentage of cyclists compared to others. This observation aligns with the Netherlands' reputation as the "Land of bikes" and its longstanding tradition of prioritizing cycling as a mode of transportation (Plazier, 2022). This finding holds relevance to our analysis towards achieving Vision Zero goals. Below is graphical summary of this:



To further contextualize our analysis, we integrated data on the number of accidents using a list table visualization (see Appendix 1). The provided data highlights the correlation between the number of accidents and the count of bikes and motorcycles in the top three populous provinces of the Netherlands. Notably, provinces such as Zuid Holland, Noord-Holland, and Noord Brabant, which are home to major urban centers like The Hague, Amsterdam, and Eindhoven respectively, exhibit both high accident rates and substantial numbers of bikes and motorcycles.

Zuid Holland, housing The Hague, the political capital of the Netherlands, records the highest number of accidents (25,037) alongside a significant count of bikes and motorcycles (6,175). Similarly, Noord-Holland, which includes Amsterdam, the economic and cultural capital, and Noord Brabant, with Eindhoven's technological prowess, also display notable accident rates and bike/motorcycle counts.

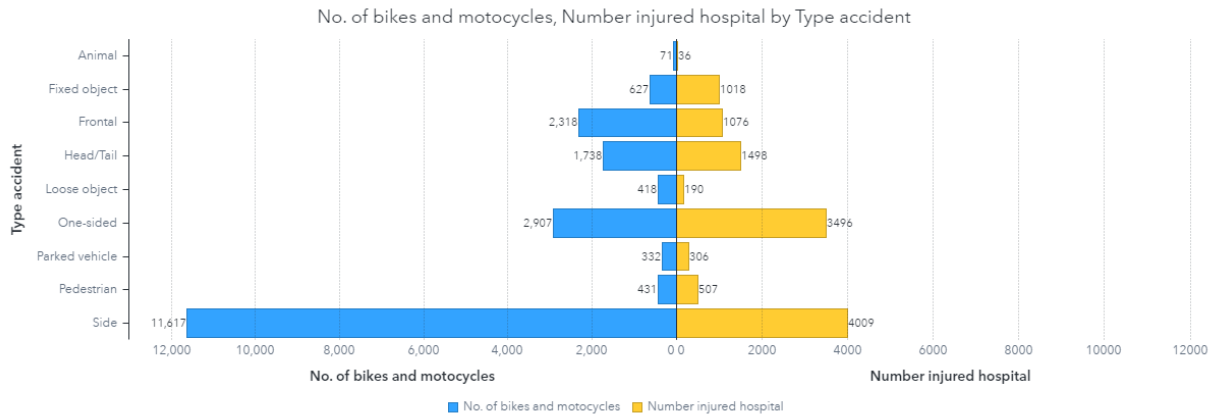
These urban centers serve as economic, political, and technological hubs, attracting large populations and fostering vibrant transportation networks. However, their urbanization, population density, and extensive cycling infrastructure contribute to elevated accident risks, especially in congested areas.

1.0 Difference between Urban and Rural areas

While analyzing, we observed urban areas had less lethal casualties compared to rural areas despite having higher accidents. Urban areas experience a higher frequency of traffic accidents due to dense traffic, complex road networks, and interactions between various road users. This leads to a higher number of fatal accidents compared to rural areas. Conversely, while rural areas have fewer accidents overall, they often result in more severe outcomes due to factors such as higher speeds and limited access to emergency services.

2.0 Number of bikes and motorcycle, Number of Injured by accident type

We transitioned our focus to identify the types of accidents that predominantly impacted cyclists. The graphical representation below illustrates our analysis:



The analysis commences with a focus on one-sided accidents, revealing a notable occurrence of such incidents involving bikes and motorcycles, which subsequently lead to a significant number of hospital injuries. This underscores the imperative to address the severity of one-sided collisions to mitigate their impact on road safety. Transitioning to pedestrian accidents, while comparatively fewer in number, they yield a substantial toll in terms of hospital injuries, accentuating the vulnerability of pedestrians in the context of road traffic incidents. These findings underscore the critical need to prioritize pedestrian safety as a fundamental aspect of comprehensive road safety initiatives aimed at safeguarding all vulnerable road users. Furthermore, insights from other accident types, including side and frontal collisions, emphasize the multifaceted nature of road safety challenges faced by cyclists and motorcyclists. Comprehensive measures encompassing infrastructure enhancements, public awareness campaigns, and policy interventions are warranted to mitigate risks and ensure the well-being of all road users, particularly those belonging to vulnerable groups.

3.0 Number of casualties, accidents by Hour accident

The peak occurrence of accidents and casualties at 17:00, followed closely by 18:00, can be attributed to several factors supported by existing research, to see the graphical illustration (see appendix 2). Firstly, the evening rush hour between 17:00 and 18:00 coincides with increased traffic volume as commuters leave work and travel home, leading to congestion and heightened risk of accidents (Kaplan, 2019). Additionally, fatigue and distractions after a full day of work may contribute to reduced attentiveness and increased likelihood of human errors, such as speeding or failing to yield, further elevating the risk of collisions (Tefft et al., 2019). Moreover, decreasing visibility during dusk hours can also play a role in accidents, as drivers may struggle to adapt to changing light conditions and accurately perceive their surroundings (Biehl et al., 2018). These findings underscore the importance of targeted interventions such as improved traffic management strategies, enhanced driver education, and increased enforcement during peak hours to mitigate the risk of accidents and promote road safety.

4.0 Number intoxicated (liquor/drugs), ratio deaths by Weekday accident

The observed spike in traffic fatalities on Saturdays, slightly surpassing Sundays, can be attributed to factors such as increased instances of driving under the influence (DUI) due to social activities and higher presence of young drivers, who are more prone to risky behaviors like speeding and not wearing seatbelts (Scott-Parker et al., 2014). This trend is exacerbated by environmental factors like reduced visibility during nighttime and the tendency for longer trips on weekends, increasing the likelihood of fatigue-related accidents (Stutts et al., 2005). A detailed graphical illustration of these trends and analysis is provided in Appendix 3.

RECOMMENDATION

To navigate towards the Vision Zero goal effectively, the Dutch government should prioritize the implementation of strategic measures focused on mitigating the identified risk factors. Recommendations include:

Enhancing Enforcement and Awareness Campaigns: Increasing DUI checkpoints and enforcement during peak risk times, especially on weekends, coupled with public awareness campaigns targeting young drivers, can significantly reduce DUI-related accidents (Scott-Parker et al., 2014).

Improving Urban Infrastructure: Developing safer, more segregated cycling paths and pedestrian zones in urban areas can reduce conflict points between vehicles and vulnerable road users, thereby lowering accident rates (Schepers et al., 2014).

Implementing Smart Traffic Management Solutions: Leveraging technology to manage traffic flow during peak hours and in accident-prone zones can alleviate congestion and minimize the risk of collisions (Kaplan, 2019).

Enhancing Rural Road Safety: Upgrading Road infrastructure in rural areas, including better lighting, signage, and emergency response capabilities, can mitigate the severity of accidents (Wegman, Aarts, & Bax, 2008).

Data-Driven Policy Making: Continuously analyzing traffic accident data to identify emerging trends and adjust policies accordingly ensures that interventions remain relevant and effective (Srinivasan & Jovanis, 2013).

LIMITATION & FURTHER STUDIES

There were several missing values in the data set which could provide useful information. The sample data was only from 2016, thus historical patterns or observations over several years will provide a better understanding of how to prevent future occurrences. The data set also lacks detailed contextual information regarding individual accidents, such as driver behavior or the presence of mitigating circumstances. Without this information, the analysis may only provide a partial knowledge of the underlying causes of accidents

More detailed research can be conducted to investigate the multifactorial causes of accidents identifying the interplay of many factors, including driver behavior, to gain a more detailed knowledge of accident causes. A system for continuous monitoring of accident data allowing for real-time analysis and fast revisions to road safety strategies could be established. regularly assessing the efficacy of initiatives and adjusting policies in response to changing trends.

CONCLUSION

The comprehensive analysis conducted using SAS Visual Analytics has illuminated critical insights into the dynamics of traffic accidents in the Netherlands, underscoring the multifaceted challenges on the path to achieving the Vision Zero goal by 2050. Our findings reveal that while urban centers exhibit a higher incidence of traffic accidents, particularly among cyclists and motorcyclists, the severity of accidents in rural areas is notably higher, often resulting in more severe outcomes (Wegman, Aarts, & Bax, 2008). The peak hours of 17:00 to 18:00 emerge as critical periods for accidents, highlighting the compounded effects of increased traffic volume, driver fatigue, and decreased visibility (Kaplan, 2019; Tefft et al., 2019). Moreover, weekends, especially Saturday, are identified as high-risk periods, largely due to DUI and the presence of young drivers engaged in risky behaviors (Scott-Parker et al., 2014; Stutts et al., 2005). These insights, captured and visualized through advanced data analytics, underscore the pressing need for targeted, data-driven interventions.

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Appendix

1

Province	No. of bikes and motocycles ▾	Number accidents
Zuid-Holland	6,175.00	25,037
Noord-Holland	6,146.00	20,862
Noord-Brabant	2,876.00	19,086
Gelderland	2,627.00	16,516
Utrecht	1,873.00	9,539
Overijssel	1,650.00	9,446
Limburg	1,255.00	8,802
Groningen	1,054.00	3,729
Friesland	589.00	3,884
Flevoland	410.00	2,479
Drenthe	388.00	2,847
Zeeland	356.00	2,765

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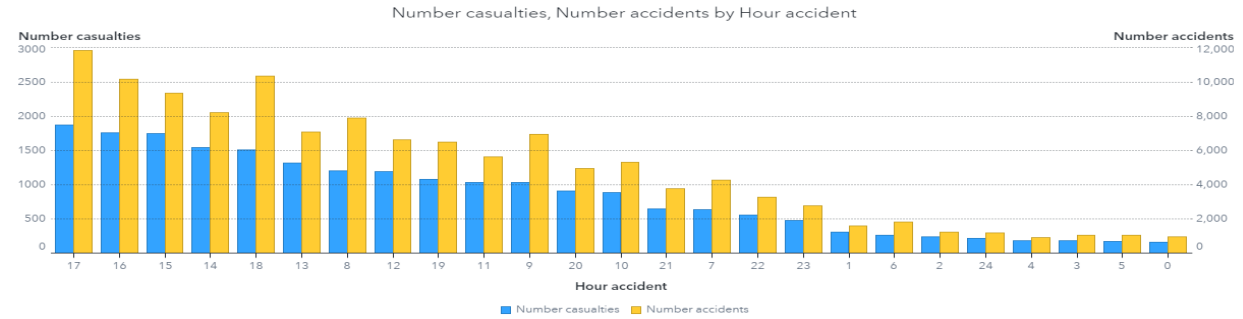

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