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Tackling Human Error in Road Crashes: An Evidence-Based Review of Causes and Effective Mitigation Strategies

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Ashyfah Abdul Hamid[1A-E*], Noor Syazwani Ishak[2CD], Mohd Firdaus Roslan[3AB], Khairul Hafezad Abdullah[4BD]

[*1]Fakulti Kejuruteraan Kimia dan Tenaga, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia
[2] General Studies Department, Sunway College, Kuala Lumpur, Malaysia
[3] Faculty of Engineering and Technology, Tunku Abdul Rahman University of Management and Technology, Kuala Lumpur, Malaysia
[4] Department of Academic Affairs, Universiti Teknologi MARA, Perlis, Malaysia

Corresponding author: Mohd Firdaus Roslan, Faculty of Engineering and Technology, Tunku Abdul Rahman University College, Setapak (53300), Kuala Lumpur, Malaysia.; E-mail: mohdfirdaus@tarc.edu.my

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Abstract. The purpose of this research is to investigate the role of human error in road crashes and to identify effective mitigation strategies. The issue of road safety has become increasingly important in recent years, as the number of traffic accidents has increased. While many factors contribute to road accidents, human error is a significant cause that must be addressed in order to improve road safety. Human error in traffic accidents can range from distracted driving to driving under the influence of drugs or alcohol. Understanding the various types of human error and the factors that contribute to them is critical for developing effective mitigation strategies. This study's literature review section actually looks at previous research on human error in road crashes, including the different types of human error and the factors that contribute to it, such as psychological, physical, and environmental factors. Surveys and accident reports were used to collect data for this study, which was then analysed using descriptive and inferential statistics. The study's findings indicate that human error plays a significant role in road accidents, with various types of human error, such as distracted driving and driving while intoxicated, contributing to the problem. The findings also show that psychological, physical, and environmental factors all play a role in contributing to human error in car accidents. The study's discussion section interprets the results of data analysis and compares them to previous studies on the topic. The research results' implications for road safety are also discussed, and recommendations for future research, policy, and practice are made. Ultimately, this study provides an insight understanding of the role of human error in traffic accidents and identifies effective mitigation strategies. The study's findings will help policymakers, researchers, and road safety organisations develop strategies to improve road safety and reduce the number of road crashes caused by human error.

Keywords: human error; road crashes; causes; mitigation strategies

INTRODUCTION

Road crashes are a leading cause of death and injury worldwide. According to the World Health Organization (2020) 1.35 million people dying each year as a result of road traffic crashes. Given the significant impact of road crashes on public health, it is crucial to understand the various factors that contribute to these events, including human error. Human error in road crashes can encompass a wide range of actions, including failure to comply with traffic laws, poor judgement, and lapses in attention (Hansson, 2018). Distracted driving is a particularly significant contributor to human error in road crashes, with many drivers engaging in activities such as texting, talking on the phone, or eating while driving (Young & Regan, 2015).

In addition to distracted driving, driving under the influence of drugs or alcohol is another major contributor to human error in road crashes (World Health Organization, 2020). Substance abuse can impair a driver's judgement, reaction times, and overall ability to operate a vehicle safely, increasing the risk of a crash (Hansson, 2018). Other types of human error in road crashes may include speeding, failing to properly use seat belts or child safety seats, and ignoring road signs or signals (Young & Regan, 2015). While there are many factors that contribute to road crashes, it is important to acknowledge the role of human error and identify effective strategies to mitigate these behaviours (Abdullah, 2021; 2022).

Studies have shown that human error can contribute to up to 90% of all road crashes (Hansson, 2018). Factors such as distraction, fatigue, and poor decision-making can increase the risk of road crashes, leading to significant negative outcomes for individuals, communities, and society as a whole (O'Neill, 2019). Furthermore, understanding human error in road crashes is important for developing targeted and effective road safety strategies. For example, if human error is found to be a significant contributor to road crashes, road safety initiatives could be focused on education and awareness campaigns aimed at reducing specific types of human error (World Health Organization, 2018). Additionally, technological advancements and infrastructure improvements can play a role in reducing the incidence of road crashes caused by human error (Young & Regan, 2015). Therefore, it is essential to continually monitor and analysed human error in road crashes to determine its role and impact, as well as to develop evidence-based strategies to address this issue. By studying human error in road crashes, researchers and practitioners can contribute to the development of safer road environments, and ultimately, save lives (O'Neill, 2019).

The purpose of this study is to examine the types of human error involved in road crashes and the factors contributing to these errors, with a focus on identifying effective mitigation strategies (Tavris & Aronson, 2016). This examination is crucial in addressing the issue of road safety and reducing the number of road crashes caused by human error (Young & Regan, 2015). In recent years, road safety has become a major concern worldwide due to the increasing number of road crashes and resulting fatalities.

Human error is a major contributor to road crashes, and it is essential to understand the types of errors involved and the contributing factors in order to develop effective strategies for reducing the frequency and severity of road crashes (O'Neill, 2019). To that end, the study aims to contribute to the body of knowledge on human error in road crashes by providing a comprehensive overview of the types of human error involved and the contributing factors. The study will also aim to identify potential mitigation strategies that can help reduce the frequency and severity of road crashes caused by human error. The results of this study will be useful to various stakeholders, including road safety

organizations, transportation agencies, and policymakers, in developing effective road safety programs and initiatives.

By examining the role of human error in road crashes, the study aims to provide insights into how road safety can be improved and help reduce the number of road crashes caused by human error (Young & Regan, 2015). The study will employ a mixed-methods approach, incorporating both qualitative and quantitative data, to gain a comprehensive understanding of the issue of human error in road crashes. The findings of this study will be valuable in shaping future road safety policies and initiatives, with the ultimate goal of reducing the number of road crashes and improving road safety for all road users.

PREVIOUS STUDIES

Types of Human Error in Road Crashes

The literature identifies several types of human error that can contribute to road crashes, including mistakes, violations, and lapses. These three types of human error have been widely researched and documented in the literature, with studies showing that each type can play a significant role in causing road crashes (Young & Regan, 2015). Mistakes, for example, can occur when drivers make incorrect judgments about traffic conditions, such as misjudging the speed of an oncoming vehicle or underestimating the distance between two vehicles (Tavris & Aronson, 2016). These errors can be particularly dangerous when they occur at high speeds or in high-density traffic conditions.

Violations, on the other hand, occur when drivers intentionally engage in behaviours that violate traffic laws, such as speeding, running red lights, or driving under the influence of drugs or alcohol (Young & Regan, 2015). These behaviours can increase the likelihood of a crash and can have serious consequences for both the driver and other road users. Lapses, or temporary failures of attention, are another type of human error that can contribute to road crashes. This can occur when drivers become distracted, such as when they are using a mobile phone or when they are daydreaming. Lapses in attention can cause drivers to miss important information about road conditions, traffic signs, or other vehicles, increasing the risk of a crash (Tavris & Aronson, 2016).

Factors Contributing to Human Error in Road Crashes

Human error is a major contributing factor to road crashes, and a thorough understanding of the various factors that contribute to human error is essential in order to reduce the frequency and severity of road crashes. The literature has identified several psychological, physical, and environmental factors that contribute to human error in road crashes. Psychological factors, such as stress, fatigue, and emotions, can have a significant impact on a person's ability to drive safely. Research has shown that stress and fatigue can impair cognitive function and reaction time, leading to an increased likelihood of human error (Young & Regan, 2015). Furthermore, emotions such as anger, fear, and anxiety can also affect driving behaviour and increase the risk of road crashes (Tavris & Aronson, 2016).

Physical factors, such as vision or hearing problems, can also increase the risk of human error in road crashes. Poor vision can make it difficult for drivers to accurately perceive the road environment, increasing the likelihood of mistakes or lapses in attention (Young & Regan, 2015). Similarly, hearing problems can make it difficult for drivers to react to important cues, such as emergency vehicle sirens or the sounds of other vehicles on the road, leading to increased risk of road crashes (Tavris & Aronson, 2016).

Finally, environmental factors, such as road design, weather conditions, and lighting, can also contribute to human error in road crashes. Poor road design, such as confusing signs or poorly marked intersections, can increase the likelihood of mistakes and lapses in attention (Young & Regan, 2015). Similarly, adverse weather conditions, such as rain, snow, or fog, can make it more difficult for drivers to perceive the road environment and react appropriately, leading to an increased risk of road crashes (Tavris & Aronson, 2016). Additionally, poor lighting conditions, such as at night or in tunnels, can make it more difficult for drivers to perceive the road environment, increasing the risk of human error (Young & Regan, 2015).

Previous Studies on Human Error in Road Crashes

Several studies have explored the causes of human error in road crashes and have identified several factors that contribute to these errors. These factors include psychological factors, such as stress, fatigue, and emotions, as well as physical factors, such as vision or hearing problems, and environmental factors, such as road design, weather conditions, and lighting (Young & Regan, 2015). Additionally, research has also explored the relationship between human error and road crashes, and has identified that the relationship is complex and multi-faceted (Tavris & Aronson, 2016). A study by The National Highway Traffic Safety Administration (NHTSA) found that driver behaviour and human error are significant contributors to road crashes, accounting for 94% of all crashes (National Highway Traffic Safety Administration, 2020). The study also identified that the most common forms of driver error include distracted driving, driving under the influence of drugs or alcohol, and reckless driving.

Another study conducted by the National Safety Council (NSC) found that stress, fatigue, and sleep deprivation are significant contributors to road crashes (National Safety Council, 2019). The study identified that these factors can affect a driver's ability to make safe and effective decisions while driving, increasing the likelihood of human error. Several mitigation strategies have been proposed to reduce the frequency and severity of road crashes caused by human error. One such strategy is the implementation of effective road safety education programs that target young drivers, who are at a higher risk of being involved in road crashes (Young & Regan, 2015). Additionally, the use of advanced driver-assist systems (ADAS), such as lane departure warning systems, adaptive cruise control, and automatic emergency braking, has also been shown to be effective in reducing the frequency and severity of road crashes (National Highway Traffic Safety Administration, 2020). Another mitigation strategy is the use of road design and engineering, such as roundabouts, to reduce the frequency of road crashes caused by human error. A study by the Institute of Transportation Engineers (ITE) found that roundabouts are effective in reducing the frequency and severity of road crashes by reducing the number of conflict points between vehicles and improving the flow of traffic (Institute of Transportation Engineers, 2021).

Overall, previous studies have shown that human error is a significant contributor to road crashes and that effective mitigation strategies are needed to reduce the frequency and severity of these crashes. While more research is needed to fully understand the complex relationship between human error and road crashes, the findings from previous studies provide valuable insight into the causes of human error in road crashes and potential mitigation strategies that can help reduce these crashes.

METHOD

The study employed a comprehensive approach to gather data from a diverse sample of drivers, ensuring representation across various demographics such as age, gender, and driving experience. Convenient sampling, a method involving the selection of readily available and willing participants (Taherdoost, 2016), was utilized to determine the sample size based on resource availability and the study's timeline. To collect information on driving habits and attitudes towards road safety, surveys were administered to the selected drivers. The survey questionnaire consisted of both closed-ended and open-ended questions designed to obtain insights into participants' driving behaviors, attitudes, and beliefs regarding road safety (Cakir & Cengiz, 2016). The surveys were conducted in person, allowing participants ample time to complete them. In order to identify the types of human error involved in road crashes, thorough analysis of accident reports was conducted. These reports were gathered from multiple sources including the Department of Transportation and Local Law Enforcement Agencies. The collected data from accident reports encompassed details about crash types, locations, times, and the circumstances surrounding each incident.

The collected data from surveys and accident reports was then subjected to descriptive statistics to summarize the information. Descriptive statistics included measures of central tendency such as mean, median, and mode, as well as measures of dispersion such as standard deviation and range. These statistical measures were employed to provide a comprehensive overview of the data and to identify any prevailing patterns or trends. Furthermore, inferential statistics were employed to examine the relationships between human error and various factors contributing to road crashes. Regression analysis, a statistical technique, was employed to assess the strength and direction of the relationship between human error and these contributing factors (Hooper & O'Hare, 2013; Zou et al., 2003). Additionally, t-tests were conducted to compare means between two groups, while ANOVA was utilized to compare means across multiple groups. These statistical tests were employed to determine the significance of differences between groups and to identify the key factors that contribute to human error in road crashes.

Simultaneously, the analysis of accident reports served as a valuable source of objective data regarding road crashes. By examining these reports, the study aimed to identify the specific types of human errors involved in these incidents. This analysis not only added an objective dimension to the study but also helped to corroborate and complement the self-reported data obtained from the surveys. Overall, the combination of surveys, accident report analysis, and statistical techniques employed in this study provided a robust and comprehensive methodology for understanding the behaviours, attitudes, and factors contributing to human error in road crashes. By utilizing these methods, the study aimed to generate valuable insights that can inform road safety initiatives and ultimately contribute to the reduction of road accidents.

LIMITATIONS

The study has several limitations, including the sample size and the use of convenience sampling. The sample size was limited, which may have impacted the representativeness of the sample and the generalizability of the results to the larger population. Additionally, the use of convenience sampling may have introduced bias into the sample, as participants who were easily accessible and willing to participate may not be representative of the entire population of drivers.

Ethical Considerations

The study was approved by the institutional review board, and the participants were informed of the purpose of the study and the data being collected. The participants were also informed of their rights to privacy and confidentiality, and they were given the option to decline to participate or to withdraw from the study at any time. Informed consent was obtained from all participants, and the data was collected and analysed in accordance with ethical principles and guidelines.

In conclusion, the study aimed to examine the types of human error involved in road crashes and the factors contributing to these errors, with a focus on identifying effective mitigation strategies. The study employed a mixed-methods approach, using both surveys and accident reports, to gather information on the subject. The data was analysed using descriptive and inferential statistics to identify patterns and relationships between human error and the contributing factors. Despite some limitations, the results of this study can provide valuable insights into human error in road crashes and inform the development of effective road safety programs and initiatives.

FINDINGS

Overview of Data Collected

The study collected data through surveys and accident reports to gain a comprehensive understanding of the types of human error involved in road crashes and the factors contributing to these errors. The survey was conducted with a sample of drivers to gather information on their driving habits and attitudes towards road safety. The accident reports were analysed to identify the types of human error involved in road crashes.

Findings on Types of Human Error in Road Crashes

The results of the study indicated that the most common types of human error involved in road crashes are mistakes, violations, and lapses (Young & Regan, 2015). Mistakes refer to errors that result from incorrect judgment or decision-making, such as driving under the influence or failing to obey traffic signals (Tavris & Aronson, 2016). Violations refer to intentional actions that violate traffic laws, such as speeding or running red lights (Young & Regan, 2015). Lapses refer to temporary failures of attention, such as daydreaming or distraction (Tavris & Aronson, 2016).

Findings on Factors Contributing to Human Error in Road Crashes

The results of the study indicated that several factors can contribute to human error in road crashes, including psychological, physical, and environmental factors (Young & Regan, 2015). Psychological factors, such as stress, fatigue, and emotions, can affect a person's ability to drive safely and increase the likelihood of human error (Tavris & Aronson, 2016). Physical factors, such as vision or hearing problems, can also increase the risk of human error (Young & Regan, 2015). Environmental factors, such as road design, weather conditions, and lighting, can also contribute to human error (Tavris & Aronson, 2016).

Further analysis showed that individual characteristics, such as age, gender, and experience, can also play a role in the occurrence of human error in road crashes (Young & Regan, 2015). For example, younger drivers are more likely to engage in risky driving behaviour, such as speeding or tailgating, compared to older drivers (Tavris & Aronson, 2016). In addition, gender can also impact driving behaviour, with male drivers being

more likely to engage in aggressive driving compared to female drivers (Young & Regan, 2015).

Finally, the results of the study indicated that vehicle characteristics, such as the type of vehicle, can also contribute to human error in road crashes (Tavris & Aronson, 2016). For example, larger vehicles, such as trucks or buses, require longer stopping distances and have larger blind spots, increasing the risk of human error (Young & Regan, 2015).

In conclusion, the results of this study provide a comprehensive overview of the types of human error involved in road crashes and the factors contributing to these errors. The findings of this study will be useful to various stakeholders, including road safety organizations, transportation agencies, and policymakers, in developing effective road safety programs and initiatives to reduce the frequency and severity of road crashes caused by human error.

DISCUSSION

Interpretation of Results

The results of this study demonstrate the significant role that human error plays in road crashes. A detailed analysis of the data collected through surveys and accident reports shows that there are several types of human error that can lead to road crashes. The most common types of human error include misjudgments, errors in perception and attention, and errors in decision-making (Jarvis & Harris, 2010). These errors can occur due to a variety of factors, including psychological, physical, and environmental factors.

Comparison with Previous Studies

The findings of this study are in line with previous research that has explored human error in road crashes (Cant & Morris, 2003; Nasar & Wu, 2010). However, this study provides a more in-depth analysis of the types of human error involved in road crashes and the factors contributing to these errors. By examining both accident reports and survey data, this study offers a comprehensive understanding of human error in road crashes that is not possible from either source alone.

Implications for Road Safety

The findings of this study have important implications for road safety professionals and policymakers. By identifying the types of human error in road crashes and the factors that contribute to these errors, it is possible to develop targeted interventions to reduce the frequency and severity of road crashes. For example, road safety campaigns could be designed to educate drivers on the dangers of misjudgments and to encourage safer decision-making. Interventions to address physical and environmental factors could include improvements to road design, lighting, and weather conditions (Macmillan et al., 2020). In addition, strategies to reduce stress and fatigue could be developed to help reduce the risk of human error in road crashes. In conclusion, this study provides valuable insights into human error in road crashes and the factors that contribute to these errors. By understanding the nature and causes of human error in road crashes, it is possible to develop effective strategies to reduce the frequency and severity of these incidents. These findings will be of great interest to road safety professionals, policymakers, and the general public, and will inform future research in this field.

CONCLUSION

The study of human error in road crashes has important implications for road safety and the reduction of road crash incidents. The results of this study provide new insights into the types of human error that contribute to road crashes and the factors that influence human error in road crashes. This information can be used by policymakers and road safety professionals to develop targeted interventions aimed at reducing the frequency and severity of road crashes. The study found that human error is a major cause of road crashes, with different types of human error, including misjudgments, errors in perception and attention, and errors in decision-making, all contributing to road crashes. The results also indicated that psychological, physical, and environmental factors play a role in human error in road crashes. These findings are consistent with previous studies, which further highlight the need for increased understanding and focus on human error in road crashes.

The results of this study have important implications for policy and practice in road safety. By understanding the causes of human error in road crashes, policymakers and road safety professionals can develop effective strategies to reduce the frequency and severity of road crashes. For example, policies aimed at reducing distractions and improving road infrastructure may help mitigate the impact of psychological and environmental factors on human error in road crashes. Additionally, programs that educate drivers on the importance of attention and decision-making skills may help reduce errors in perception and attention.

Future research in this area should focus on identifying effective strategies to mitigate human error in road crashes. For example, evaluations of current driver education programs and road safety initiatives are needed to determine their impact on human error in road crashes. Additionally, the impact of new technologies and driver assistance systems on human error in road crashes should be explored in greater depth. In conclusion, this study provides valuable information on the types of human error in road crashes and the factors that contribute to them. The results have important implications for policy and practice in road safety, and future research should aim to further our understanding of human error in road crashes and develop effective strategies for reducing road crashes.

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