Sri Lanka Journal of Forensic Medicine, Science & Law — June 2025;Vol.16(1): 22-29
DOI: https://doi.org/10.4038/sljfmsl.v16i1.7991

ORIGINAL ARTICLE

ROAD TRAFFIC ACCIDENTS IN SRI LANKA: A RETROSPECTIVE ANALYSIS AND ARTIFICIAL INTELLIGENCE-BASED SOLUTIONS FOR PREVENTION

Thilakarathna WGSR*, Thudugala MTKL, Hangilipola WACJ, Perera WNS, Paranitharan P
Department of Forensic Medicine, Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka

ABSTRACT

Introduction: This study aims to conduct a retrospective, descriptive analysis to identify the factors contributing to road traffic accidents (RTAs) and propose artificial intelligence (AI)-based solutions for their prevention.

Methods: The ninety-nine postmortem reports belonging to the investigators and documents connected to death investigations due to RTA were selected from fatalities reported to the Colombo North Teaching Hospital, Ragama, Sri Lanka, from 2001 to 2021. Data was gathered based on a pre-prepared questionnaire and analysed using IBM SPSS Statistics version 26. Strict confidentiality of individual information was maintained throughout the analysis and presentation of the results.

Results: Among the selected population, 83.8% were male, and the majority belonged to the 51-60 year age group (19.2%). Pedestrians were the most vulnerable group (41.5%), followed by motorcycle riders (17.2%). Main roads (72.7%) were the most frequent place for RTA. The most common time for RTA was between 06.01 pm and 12.00 am (38.4%). The majority of the RTAs had contributory human factors (85.8%), but most of them did not have any identifiable contributory environmental, road-related, or vehicle-related factors. Breaking road regulations was the most common contributory human factor (27.3%). It was followed by poor judgment (25.3%). Blood for alcohol was sent in 60.6% of the selected population, and 18.2% were found to be positive with available reports. (> 80mg/dl). Blood alcohol reports could not be traced in 14.1% of victims. Head injuries (41.4%) and multiple trauma (37.3%) were the most common causes of death among the fatalities due to RTA.

Conclusions: By analysing the data from history, toxicology reports, and other information provided by police, it can be inferred that the majority of RTAs had contributory human factors. It is postulated that supervised AI-based solutions could reduce the number of fatalities attributable to human errors.

Corresponding Author: Thilakarathna WGSR
sachinithilakarathna32@gmail.com
https://orcid.org/0009-0009-7395-9830

ARTICLE HISTORY
Received: 22.09.2024
Received in revised form: 11.02.2025
Accepted: 22.02.2025
Available online: 30.06.2025

Keywords: ***Artificial intelligence; contributory human factors; road traffic accidents***

INTRODUCTION

Road traffic accidents (RTAs) continue to play a pivotal role in causing numerous fatalities, injuries, and socioeconomic challenges. Every year, approximately 1.19 million people are cut short as a result of a road traffic crash[1]. In Sri Lanka, road traffic accidents reveal an upward momentum over the past decade.

According to the statistics for the year 2022 available with the Ministry of Transport, Highways, Ports, and Civil Aviation, the number of persons killed in road accidents involved 820 motorcyclists, followed by 720 pedestrians. Overall, 2515 deaths took place in the year 2022. The 908 motorcycles were involved in fatal accidents, being the largest contributor[2]. Road traffic accidents arise from a multitude of intertwined factors, including road users' behaviour, road infrastructure, vehicle conditions, and environmental elements. Understanding the factors that contribute to these road traffic accidents is crucial for developing effective preventive measures and ensuring safer road environments[3-7].

The significant advancements in the field of artificial intelligence (AI) have shown promising results in solving complex problems in several identified domains. By harnessing the power of AI, we can potentially enhance our ability to identify and mitigate the factors leading to road traffic accidents, ultimately paving the way towards a safer future. While traditional methods have provided valuable insights into accident causation, the integration of AI technologies holds immense potential for revolutionising accident prevention strategies. AI encompasses a range of techniques, including machine learning, computer vision, and natural language processing, which can be leveraged to process and analyse vast amounts of data efficiently. This enables the identification of patterns, trends, and risk factors associated with road traffic accidents that may not be readily discernible through conventional approaches[8].

Retrospective descriptive studies offer an invaluable approach to retrospectively examine past accidents, identify contributing factors, and establish correlations between variables. By leveraging data from postmortem reports, we can uncover critical information that sheds light on the dynamics of road traffic accidents. Although many studies are available to find factors that cause road traffic accidents, no comprehensive postmortem report data on identifying the factors contributing to road traffic accidents in Sri Lanka with an approach towards utilising artificial intelligence can be found. Analysing these postmortem reports and death investigations information is essential for gaining comprehensive insights into accident causation patterns, focusing on the safety measures that can be adapted in futuristic vehicles that travel on the road. This research aims to undertake a retrospective descriptive study to identify the factors contributing to road traffic accidents using postmortem report data and propose AI-based solutions for their prevention. Though the CCTV footage may provide a more detailed option to analyse traffic accidents, it may not be a practical technique in all situations.

OBJECTIVES

The main objectives of this study are to describe the demography of deaths following road traffic accidents, to gather contributory factors from death investigations, and to suggest plausible preventive measures using artificial intelligence.

METHODS

The 99 post-mortem reports belonging to the investigators and documents connected to death investigations due to RTAs were selected from fatalities reported to Colombo North Teaching Hospital (CNTH), Ragama, Sri Lanka, from 2001 to 2021. Data was gathered based on a pre-prepared questionnaire. Information regarding gender, age, place of the incident, type of collision, injuries, and environmental and road-related factors was included in the questionnaire. Police sketch data was also used to further evaluate the RTAs in selected cases, and all data were analysed using IBM SPSS Statistics version 26. Strict confidentiality of individual information was maintained throughout the analysis and presentation of the results.

RESULTS

The majority of road traffic accidents reported to CNTH and handled by the investigators involved men (83.8%), and 17.2% involved females. The majority of victims belonged to the age group of 51-60 years (19.2%), followed by 61-70 years (18.2%), 41-50 years (16.2%), and 21-30 years (16.2%).

Pedestrians were the most vulnerable group (41.5%) among the road users, and motorcycle riders (17.2%) were the second largest group facing road traffic accidents based on the available data (Table 1).

Table 1: Types of vulnerable road users

Vulnerable road user	Frequency (n)	Percentage (%)
Pedestrian	41	41.5
Motorcycle rider	17	17.2
Pillion Rider	4	4
Passenger of a vehicle	12	12.1
Three-wheel driver	3	3
Any other	22	22.2
Total	99	100

Major roads with heavy traffic (72.7%) were the most frequent places for RTAs, followed by junctions (16.2%), by-roads (6.1%), and bends (1%). Side impacts were the most common collision pattern (41.4%), followed by head-on collisions (28.3%) and rear-end collisions (18.2%). In the remaining 12.1% of the cases, details regarding the type of collision were not recorded.

The majority of accidents occurred between 6.01 pm and 12 am (38.4%) (Table 2). The accident rate was lowest between 12.01 am and 6 am (9.1%).

Table 2: Analysis of RTA based on collision time

Time of collision	Frequency (n)	Percentage (%)
6.01 am - 12 pm	26	26.3
12.01 pm – 6 pm	24	24.2
6.01 pm – 12 am	38	38.4
12.01 am- 6 am	9	9.1
Details not available	2	2.0
Total	99	100

The majority of the RTAs (85.8%) had contributory human factors, based on the inference from available history and other investigative documents submitted by the police. It was difficult to infer positively about any documented contributory environmental, road-related, or vehicle-related factors with the available data. Following careful analysis of the available data by the investigators, 27.4 %, 23.6%, and 7.5% of the cases were identified as due to breaking road regulations, poor judgement, and overspeeding, respectively (Table 3) Poor lighting (5.1%) and road bumps (1%) are some road and environmental factors that may have contributed to RTAs in selected situations.

Table 3: Analysis of RTA based on human factors contributing to RTA

Contributory human factors	Frequency (n)	Perecentage (%)
Intoxication	12	12.1
Overspeeding	7	7.1
Breaking road regulations	27	27.3
Poor Judgement	25	25.2
Vision/Hearing impairment	2	2
Any other disabilities	4	4
Any other	8	8.1
Details not available	8	8.1
None	6	6.1
Total	99	100

Head injuries (41.4%) and multiple trauma (37.4%) were the most common causes of death, followed by chest injuries (8.1%) and neck injuries (1%) from the available data. Other causes contributed to death in 12.1% of the cases. Blood for alcohol was sent in 60.6% of the selected population, and 18.2 % were found to be positive with available reports (>80 mg/dl). Blood alcohol reports could not be traced in 14.1% of victims.

DISCUSSION

This study found that middle-aged (51 to 60 years) male adults were the most frequent victims of RTAs. According to similar research done in teaching hospitals in Kandy and Kurunegala, it has been revealed that the most common age group involved in RTAs was 26-35 years, and 97% of victims were males[9]. A study

done by Wazeema in 2018 also found that the majority of the victims of RTAs that occurred in Sri Lanka were male[10]. This is presumably due to the fact of shouldering family responsibilities and thus frequenting motorways as pedestrians, motorcycle riders, or occupants of other passenger vehicles. The slight shift in the age group is based on the data available to the investigators, and it may not necessarily reflect the trends at a national level. In addition, it must also be noticed that although young adults are more prone to non-fatal crashes, the aged may have a higher death rate[11].

According to the global road safety data from the World Health Organisation in 2018, more than half of the worldwide road fatalities involve pedestrians, cyclists, and motorcyclists[12]. A previous descriptive study done at NCTH also found that the high fatality rate among pedestrians (37.2%) was followed by bicycle or motorcycle riders or pillion riders (44%), [13]. A case study done in Kandy also revealed that pedestrians involved in road traffic accidents are at a very high percentage[14]. During the past decade, a significant elevation in the number of accidents involving motorcycles has been identified in Sri Lanka. According to the statistics for the year 2022 available with the Ministry of Transport, Highways, Ports and Civil Aviation, the number of persons killed in road accidents mostly involved motorcyclists and pedestrians[2]. The young age, desire to ride motorcycles, and the easy availability of motorcycles at an affordable rate may have contributed to the increasing numbers. A study conducted by Pathak *et al.* also concluded that motorcycles were the most common vehicle type involved in vehicular accidents in India during the 2009-2011 period[15].

Furthermore, this study observed that unfavourable behaviour, mostly breaking road regulations by pedestrians and drivers (27.3%), may be the primary contributory human factor. Driving at excessive speed had been a contributory cause in 7.5% of accidents, according to this study. A study conducted by Pathak *et al.* proved that vehicles that had a speed range of 40-60 km/h (37.9%) were responsible for higher percentages of accidents[15]. Further, 27.3 % of incidents were reported in this study due to violations of road rules and regulations while walking and driving on the roads. This is supported by research done in Nigeria. The Federal Road Safety Commission (FRSC) of Nigeria identified that human factors contributed to more than 80% of road traffic accidents[16].

Driving under the influence of alcohol is another risk factor that promotes road crashes.

Alcohol intoxication was identified in 18.2% of accidents in this study, where the alcohol level was >80 mg/dl, based on the toxicology reports. Another Sri Lankan study had observed that the consumption of alcohol is an important human factor contributing to RTA[6]. Poor judgement of road users (23.6%) could be another main reason behind RTAs in this study. The authors, by inferring the available data recorded during the death investigation process, opined that poor judgement may have had a role in the causation of the accident when opportunities were there to avoid a collision. The investigators were limited by a lack of visuals from CCTV footage, which may increase the accuracy of interpretation; however, careful analysis of data often identified poor judgement as a contributory human factor supported with sketch analysis.

In addition to that, the majority of road traffic accidents occurred on roads with heavy traffic during the evening hours due to the large number of vehicles and pedestrians occupying the main roads compared to junctions and by-roads during this period, as well as lower visibility of the surroundings. A descriptive cross-sectional study was conducted at teaching hospitals in Kandy and Kurunegala also found that the majority of RTAs had occurred after 6 pm and 76.9% of RTAs had occurred on carpeted main roads rather than on any other types of roads[9]. Side impacts were the main method for collision identified in this study, amounting to 41.4%, followed by head-on at 28.3% and rear-end at 18.2%. Faults in the braking system, defects in the engine, and a lack of modern safety features are the vital factors affecting road accidents. Also, environmental factors and road conditions are considered major contributory factors for RTAs[17]. Weather

conditions, including temperature, wind speed, and humidity, represent the principal external factors that have an impact on road traffic crashes. In this study, only a few incidents were identified due to environmental and road factors. This may be partly due to the lack of complete data available at the time of the death investigation.

Recognising the factors that contribute to road traffic accidents and taking preventive actions is essential to save the valuable lives of people in the world. The persisting problem of road crashes will not be solved merely by the strict implementation of road rules and severe punishments. Therefore, this study proposes potential remedies for reducing road traffic accidents using applications of artificial intelligence. With the introduction of artificial intelligence, it is rapidly transforming the vehicle industry and revolutionising road safety. Based on this study's data, as well as the most common vehicle used on Sri Lankan roads, this study proposes a motorbike that is developed using applications of artificial intelligence.

Driver Assistance Systems (DAS) have become a sought-after technology with the advances in artificial intelligence[18]. Autonomous driving systems are one of the major applications in DAS (Fig. 1). The incorporation of AI algorithms makes a vehicle more autonomous, resulting in self-navigation and perceiving and adapting to dynamic environments, resulting in a safer journey. In order to work without manpower, an autonomous system has been included with cameras to monitor the vehicle's position within the lane and detect the rider's mental condition while driving. It may be presumed that an emotionally unstable person, showing signs suggestive of fatigue, may be more prone to collisions, and thus, the driving can be switched to a DAS. Researchers found that a person's emotions and feelings can be interpreted with more than 60% accuracy by analysing their eye expressions[19]. Based on that information, it is proposed that the autonomous motorbike system include an eye-expression-sensitive camera on its helmet. Also, this system can be included with various sensors to automatically measure the speed of the vehicle and light intensity of the surroundings and provide real-time feedback to assist riders in making safe decisions while driving. The sensors above a certain speed limit or very poor road surface may activate an alarm system to alert the driver, and similarly, when the environmental lighting is not sufficient, the intensity of the headlight and other supportive lighting systems can be activated. Research done in the recent past reiterates that the sweat alcohol levels correlate with blood alcohol level[20]. Biosensors can be attached to detect the alcohol level, blood pressure, and heart rate of the motorcyclist. Based on biosensor data, an autonomous system can recognise the physiological condition of the rider and alert the driver regarding their fitness to drive and may suggest automated driving to minimise collisions, basically, to follow road regulations more precisely and to minimise errors in judgement.

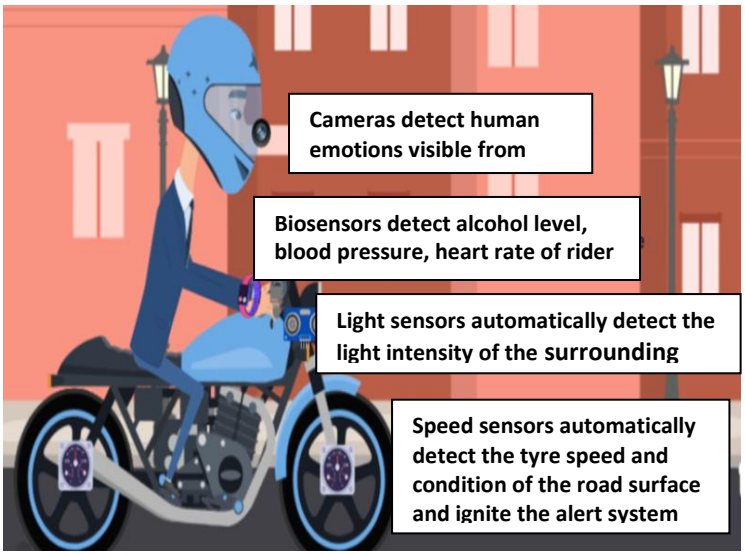

Figure 1: Proposed Autonomous Driving System

One of the most significant advances in road safety has been collision detection and prevention technology (Fig. 2). Vehicles now use AI to detect potential collisions and implement preventive steps to avoid them. The motorbikes of the future can be facilitated with AI-powered collision avoidance systems with radar sensors to avoid objects in the path, including humans, by using an 80 GHz wideband Frequency

Modulated Continuous Wave (FMCW) radar sensor on a maximum measurement range of 5.69 yds with a movable radar target[21]. These systems can intervene autonomously by adjusting the motorcycle's speed, steering, or braking to avoid or mitigate crashes.

Figure 2: Proposed collision detection system

The increasing urban population has become a major challenge in managing traffic flow, resulting in road traffic accidents worldwide. To address these problems, cities are looking for smart traffic management systems that use AI algorithms to analyse real-time data from several sources, such as GPS devices on vehicles (Fig. 3). Royo *et al.* (2019) stated that GPS uses the signal from a network of satellites[22].

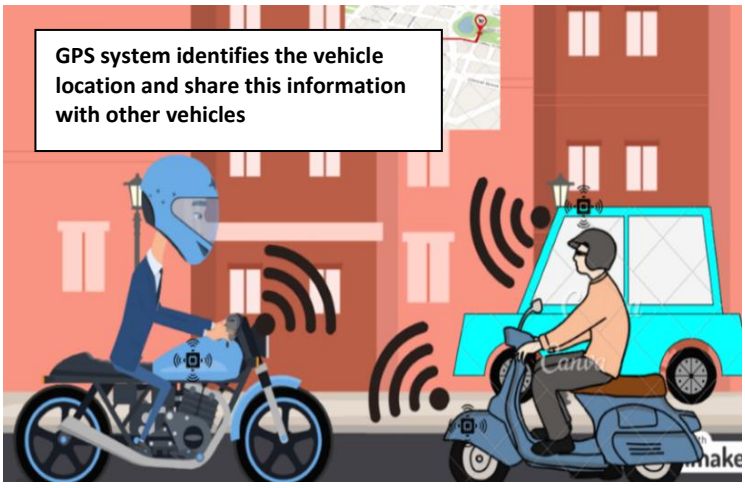

Figure 3: Proposed Traffic management system

AI algorithms can identify traffic patterns, predict changes in conditions, and provide recommendations for optimal traffic settings. This helps reduce traffic congestion and improves the smooth movement of vehicles. It detects locations in real-time, designed to detect accidents rapidly, which can reduce emergency response times, remove reporting errors, and save more lives.

CONCLUSIONS

Road traffic accidents have become a major barrier in the development process of Sri Lanka, which highly impacts all spheres of life. The road traffic accidents and deaths were a result of multiple factors, including human factors, poor environmental conditions, mechanical defects in vehicles, and demographic characteristics of the accidents. However, results of this study based on available data show that the majority of the contributory factors were human-related, and by that we can suggest supervised AI-based technologies that could detect human factors that may contribute to breaking road regulations and poor judgement in advance, and convert the riding experience under the guidance of AI. Further, poor environmental and road conditions can be addressed with additional mechanisms to be operated within the bike by the AI. This will prevent most fatalities and provide the complementary support needed to enhance road safety for a better future.

RECOMMENDATIONS

Existing studies on AI technologies and their potential applications in advancing traffic accident prevention in Sri Lanka are inadequate. Therefore, comprehensive case studies or pilot projects in specific regions or cities in Sri Lanka are needed to demonstrate the effectiveness of AI in reducing road traffic accidents.

ACKNOWLEDGEMENTS
None.

CONFLICTS OF INTEREST
The authors declared no conflicts of interest.

ETHICAL ISSUES
None. The authors have retrospectively used the postmortem data from their records, institutional guidelines and without divulging the identity of the subjects.

SOURCES OF SUPPORT
None

AUTHOR CONTRIBUTIONS
WGSRT: The acquisition and analysis of data for work, interpretation of data for the work; drafting the work or revising it critically for important intellectual content; final approval of the version to be published; agreeing to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **MTKLT:** The acquisition and analysis of data for work, interpretation of data for the work; drafting the work or revising it critically for important intellectual content; final approval of the version to be published; agreeing to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **WACJH:** The acquisition and analysis of data for work, interpretation of data for the work; drafting the work or revising it critically for important intellectual content; final approval of the version to be published; agreeing to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **WNSP:** Conception or designing of the work, the acquisition of data for work, interpretation of data for the work; drafting the work or revising it critically for important intellectual content; final approval of the version to be published; agreeing to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **PP:** Conception or designing of the work, the acquisition of data for work, interpretation of data for the work; drafting the work or revising it critically for important intellectual content; final approval of the version to be published; agreeing to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. World Health Organization. *Global status report on road safety 2023*. Available from: https://www.who.int/teams/social-determinants-of-health/safety-and-mobility/global-status-report-on-road-safety-2023.

2. National Council for Road Safety. *Road Accidents*. Available from: https://www.transport.gov.lk/web/index.php?option=com_content&view=article&id=29&Itemid=149&lang=en#type-of-vehicles-involved-in-accidents [Accessed 22nd October 2024].

3. Amarasingha N. Risk factors of crashes involving motorcycles in Sri Lanka. *Journal of South Asian Logistics and Transport*. 2021 Sep 24;1(2):1-18. https://doi.org/10.4038/jsalt.v1i2.31.

4. Ahmed SK, Mohammed MG, Abdulqadir SO, *et al*. Road traffic accidental injuries and deaths: A neglected global health issue. *Health Science Reports*. 2023;6(5):e1240. https://doi.org/10.1002/hsr2.1240.

5. Chand A, Jayesh S, Bhasi AB. Road traffic accidents: An overview of data sources, analysis techniques and contributing factors. *Materials Today: Proceedings*. 2021;47(15):5135–5141. https://doi.org/10.1016/j.matpr.2021.05.415.

6. Kodithuwakku DS, Peiris TSG. Factors contributing to the road traffic accidents in Sri Lanka. *SLIIT Journal of Humanities and Sciences*, 2021;2(1):109–122. https://doi.org/10.4038/sjhs.v2i1.44.

7. Ashraf I, Hur S, Shafiq M, Park Y. Catastrophic factors involved in road accidents: underlying causes and descriptive analysis. *PLoS One*. 2019;14(10):e0223473. https://doi.org/10.1371/journal.pone.0223473.

8. Siswanto J , Syaban ASN, Hariyani H. Artificial intelligence in road traffic accident prediction. *Jambura Journal of Informatics. 2023;*5(2):77-90. https://doi.org/10.37905/jji.v5i2.22037.

9. Madhumali NWM, Bandaranayaka HMT, Hashari GC, *et al*. Identification of risk factors for road traffic accidents using injured drivers: A cross sectional study conducted in Sri-Lanka. *International Journal of Community Medicine and Public Health.* 2021 Sep;8(9):4232-4239. https://doi.org/10.18203/2394-6040.ijcmph20213524.

10. Wazeema TMF. A matter of life and death: Road traffic accidents in Sri Lanka: *International Journal of Innovative Research and Knowledge.* 2018.

11. Bhalla K, Navaratne KV, Shahraz S, Bartels D, Abraham J, Dharmaratne S. Estimating the incidence of road traffic fatalities and injuries in Sri Lanka using multiple data sources. *International Journal of Injury Control and Safety Promotion*. 2010;17(4):239–246. https://doi.org/10.1080/17457300.2010.490919.

12. World Health Organization. Global status report on road safety 2018. Available from: https://www.who.int/publications/i/item/9789241565684.

13. Perera WNS, Harshana WAS, Bandara AGRK, Paranitharan P. A descriptive study on pattern of regional injuries in fatal road traffic accidents (RTA) in North Colombo Teaching Hospital, Sri Lanka. *Proceedings of the 12th Indo-Pacific Association of Law Medicine & Science (INPALMS) Congress*. 2016.

14. Edirisinghe J. Pedestrian involved road traffic accidents – case study in Kandy town, Sri Lanka. Journal of Injury and Violence Research. 2019 Aug;11(4). https://doi.org/10.5249/jivr.v11i2.1305.

15. Pathak SM, Jindal AK, Verma AK, Mahen A. An epidemiological study of road traffic accident cases admitted in a tertiary care hospital. *Medical journal Armed Forces India*. 2014;70(1):32-35. https://doi.org/10.1016/j.mjafi.2013.04.012.

16. Lawrence A. Assessement of human factors as determinants of road traffic accidents among commercial vehicle drivers in Gbonyin local government area of Ekiti State, Nigeria. *IOSR Journal of Research & Method in Education (IOSR-JRME)*. 2015;5(1):69–74.

17. Singh SK. Road traffic accidents in India: Issues and challenges. *Transportation Research Procedia*. 2017;25:4708-4719. https://doi.org/10.1016/j.trpro.2017.05.484.

18. Jiménez F, Naranjo JE, Anaya JJ, García F, Ponz A, Armingol JM. Advanced driver assistance system for road environments to improve safety and efficiency. *Transportation Research Procedia*. 2016;14:2245–2254. https://doi.org/10.1016/j.trpro.2016.05.240.

19. Lee DH, Anderson AK. Reading what the mind thinks from how the eye sees. *Psychological Science*. 2017;28(4):494–503. https://doi.org/10.1177/0956797616687364.

20. Selvam AP, Muthukumar S, Kamakoti V, Prasad S. A wearable biochemical sensor for monitoring alcohol consumption lifestyle through ethyl glucuronide (EtG) detection in human sweat. *Scientific Reports*. 2016;6:23111. https://doi.org/10.1038/srep23111.

21. Piotrowsky L, Jaeschke T, Kueppers S, Siska J, Pohl N. Enabling high accuracy distance measurements with FMCW radar sensors. *IEEE Transactions on Microwave Theory and Techniques*. 2019;67(12):5360–5371. https://doi.org/10.1109/TMTT.2019.2930504.

22. Santiago R, Ballesta-Garcia M. An overview of Lidar imaging systems for autonomous vehicles. *Applied Sciences*. 2019;9(19):4093. https://doi.org/10.3390/app9194093.